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Leveraged Exchange Trated Funds's Emerging Markets: A Practical Application of Statistical Arbitrage Based on Cointegration

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Abstract

Pair Trading is a Neutral Market Strategy descendant of Statistical Arbitrage. Its objective is to identify pairs of assets whose historical prices or variations have high correlation between them. To attain this, pairs trading takes advantage of overvalued assets sales and purchases undervalued assets. To identify the goal pair, we performed back-testing using historical log returns (from December 31, 2008 through April 16, 2013). With the goal pair identified we run the daily strategy using historical adjusted at closed price data and historical log returns (from December 31, 2010 through September 11, 2015). Herein, we consider two inverse Exchange Trade Funds versus benchmark EEM (iShares MSCI Emerging Markets ETF) index. The objective of this work is to demonstrate that automated trading strategy built under the co-integration approach in moving windows of 60 and 180 days is able to beat a buy and hold strategy on the EEM benchmark.

Key words: pair trading; statistical arbitrage; exchange traded funds (ETF); cointegration; mean reverse

JEL classification: C61; C63; G11; G12

1. Introduction

The Exchange Traded Funds (ETFs) are one of the most innovative investment instruments that have expanded the range of options available in the market and meet the needs of increasingly sophisticated investors. One of the main objectives of the use of traditional passive ETFs management is to minimize the tracking error, which results in transactional and operational efficiencies. This is a clear competitive advantage over investment funds, since through them it is possible replicate the behavior and performance of a reference index or benchmark; offering investors access to the markets of different countries, regions or sectors, as well as fixed income and commodities, in addition to leveraged and inverse ETFs that take advantage of certain market opportunities, at low cost and with relative ease. There is consensuse among researchers and practitioners that passive management instruments do not allow to take advantage of changes in the market trend, showing a path dependence of underlying price index, and generally falling in transactional inefficiencies that make their cumulative returns Long-term deviate considerably as a result of the rebalancing associated with their daily activities. This is increased in an environment of high volatility and decreased in stable markets, making them less competitive than passive portfolio construction strategies.

Active management of these instruments gives competitiveness, such as market strategies rely on timing, short selling, long / short, neutral market or track time or volume weighted price, in order to identify patterns, market trends and benefits, and to take advantage of them. However, if the institution let to a manager in charge of drawing

up a strategy of active trading, this action always involves decisions based on common sense, experience and technical preparation of the trader, which may entail an implicit operational risk.

The operation of the active portfolio of an ETF tends to considerably raise the transaction costs of the instrument, leading to a transactional inefficiency, which one of the main advantages of ETFs is broken regarding investment funds. On this basis, the application of mathematical models and financial analysis tooling technology have enabled the development of algorithms that automate decision making, replacing subjectivity in judgment of the trader and minimizing the probability of error. Such algorithms are intended not only to maximize portfolio performance and minimizing the variance of the same, also minimizing operational risk, reducing impact on the market, the best execution of orders in time and in different markets, significant reduction in transaction costs and minimizing market inefficiencies.

Among the automated trading strategies, both academics and practitioners have shown great interest in the use of pair trading and its variants as an investment strategy in financial assets, because its construction is neutral market, which increases the probability of profit, on the other hand they are relatively simple to program, besides that supports its design using different estimation techniques, such as minimum distance, time series, stochastic control, copulas approach and cointegration (Krauss 2015).

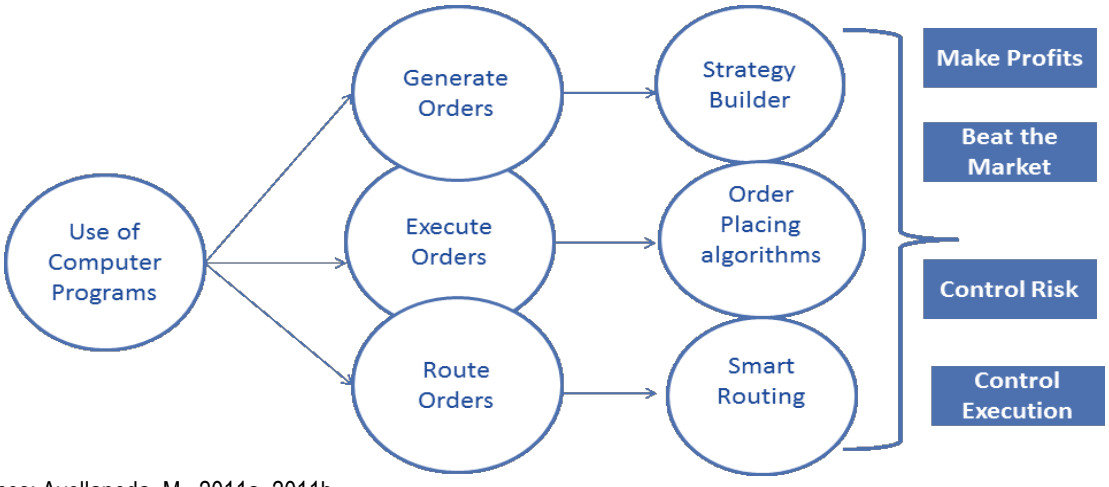
This paper therefore seeks to demonstrate that automated pair trading strategy built under the cointegration approach over moving windows of 60 and 180 days allows active management of ETFs on EEV (BRIC MSCI Emerging Markets Ultrashort ETF) and FXP indices (FTSE China 50 Ultrashort ETF) has better results over benchmark EEM (iShares MSCI Emerging Markets ETF). These results can be the basis for the creation of new investment vehicles in the Mexican stock market, which will provide an investment option for portfolio diversification and exposure to emerging markets.

2. Basic concepts

Algorithmic trading

As it mentioned before, technological changes have impacted precipitously rules and mechanics of operation in the financial markets, one of the most significant and relevant examples of these technological changes is undoubtedly the Algorithmic Trading (AT). Today many financial market participants use the AT as a fundamental tool for their operation. According to Hendershott, the AT can be defined as “the use of computer algorithms to automatically make certain trading decisions, submit orders and manage those orders after submission” (Hendershott, Jonesand Menkveld 2011). Additionally, the use of AT reduces trade prices, improves liquidity and enhances the informativeness of quotes (Hendershott, Jonesand Menkveld 2011). Then in Figure 1 it is shown systematically how operate the AT.

Figure 1. Algorithmic trading stages. Own elaboration



Sources: Avellaneda, M., 2011a, 2011b.

As showed in Figure 1, the Algorithmic Trading have three big steps, the first one means de intensive use of computer programs and computational resources in order to build back tested strategies that allowed identify market opportunities, make profits and beat a market benchmark. When you have identified a Buy/Sell opportunity you need to call a second algorithm that helps to put in place all orders in the Market automatically through Direct Market Access, API or Sponsored Access. Finally, if the Strategy Builder is trading through several assets, brokers and markets, a smart routing algorithm will help to control the execution and the order placing in order to avoid pricing effects for big shorts or big long orders.

Statistical arbitrage

According to Lo (2010), Pole (2007) and Thorp (2008), Statistical Arbitrage or "Stat Arb" encompasses those strategies of mean reversion and other statistical tools with quantitative and computational approach, that involving the trading of numerous securities in short periods of time (measured in days, hours, or seconds) and require a certain level of technological and computational infrastructure to carry them out. In order to identify Long/Short positions in market, with help of multi task experts. Some key features of Stat Arb operation are the following: Trade Book Neutral Market: No correlated with Market; Systematic Trading Signal: Identify Temporal Mispricing of an asset; Long/Short: Going long or short in Statistical related Securities; Parametric Approach: Use econometric tools to identify related securities and reduce exposure to systematic shocks; Beat the Market; Hedge Risk.

Pair Trading

Pair trading can be defined as a “pair” of positions which are offset to each other, for which it is necessary, identify at least two actives with a history of very similar prices. In fact, it requires prices move together. From which the formation of a synthetic asset object of Trading (Spread) is given. Another condition required is that the spread between two correlated assets must show mean reversion and the trajectory of prices should co-integrate. Thus, the generic strategy is to go short on the overvalued asset and get along in the undervalued asset simultaneously. A portfolio of "pairs" should not be correlated with the market, Alexander and Dimitriu (2002), Alexander, Giblin and Weddington (2002), Avellaneda and Lee (2008), Gatev, Goetzmann and Rouwenhorst (2006), Pole (2007) and Vidyamurthy (2004).

Exchange Trade Funds

Some authors like Henh (2005) consider that one of the most important financial innovations of the last decade, after the creation of futures contracts and option, is undoubtedly the emergence of Exchange Traded Funds (ETFs), better known in the Mexican market as Referenced Certificates Shares (TRACs). Because his popularity and trading volume has grown considerably; today constitute an investment vehicle that is indispensable component in shaping investment portfolios. Thus, in recent years, ETFs have expanded the range of options for all types of investors, allowing exposure of their portfolios to indexes based on different sectors, in different markets with varying degrees of capitalization, currencies, commodities, derivatives, regions and even on debt markets. Gastineau (2001, 2002) argues that the ETF basic idea originates with the development of so-called "program trading" between 1970 and 1980, which had flexibility and ability to negotiate investment portfolios in a single transaction with a scheme similar to that used in implementing the common shares. These first traded portfolios were made up of the exact sample of 500 stocks that make up the S&P 500 and tried to replicate their performance. These types of instruments were called Index Participation Shares (IPS), and initially began to be negotiated with relative popularity on the American Stock Exchange (AMEX) and the Philadelphia Stock Exchange in 1989. But his success could not avoid the attention of CME and the Commodity Futures Trading Commission (CFTC), which considered that this instrument expose to investors at the same risks as futures contracts therefore should be subject to the same regulation and its operations should be arbitrated and compensated by the Option Clearing Corporation. However, shortly after a federal court in Chicago ruled that the IPS constituted an illegal type of future contracts in stock markets, ordering withdraw its contribution and to investors liquidate their positions.

In the early 90s, a similar to the IPS instrument that was part of the family of so-called "index funds" was created. This instrument was traded on the capital market of Toronto and designated as Toronto Index Participation (TIP), whose objective was to replicate the performance of the Toronto 35 Index. This investment vehicle, unlike its predecessor IPS and its competitors, investment funds, had the characteristic of being traded intraday and whose asset management fees used to be too low, on the other hand shared skills with IPS, it can negotiate a complete investment portfolio in a single operation, it was what caught the attention of qualified investors.

In 1993, based on the structure of the TIPs, the AMEX created the S&P 500 Depositary Receipt (SPDR) or commonly known as "Spider"; that considered the first ETF traded on an exchange, (Deville *et al.* 2008, Elton *et al.* 2002, Gastineau 2001). This ETF was handled by PDR Service Corporation, Amex State Street Bank and Trust, which formed a trust to manage the assets that compose this portfolio. Its structure and negotiation mechanism served as a model for the creation of new ETFs.

By 1999, ETFs were sued by an instrument highly qualified and institutional investors, which encouraged the launch of the Nasdaq 100 Index Tracking Stock, popularized as the "Cube" or "Qubes" alluding to its characteristic ticker "QQQQ". With the emergence of this new product that replicates indexes in the technology sector, the ETF market suffered a big boost from 1995 to 2001 showed an annual growth of 130%, and today has become one of the assets most traded in capital markets of US and Europe.

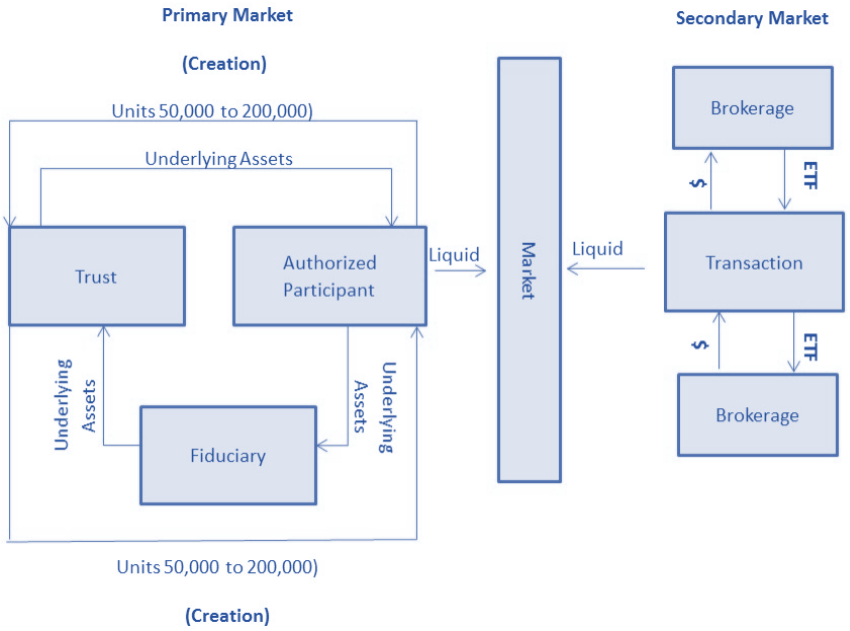
Thereafter, ETFs have continued their steady growth, not only in trading volume but also in terms of the amount of assets under management and variety, as currently coexist 4 generations of ETFs, with specific operating characteristics, making it an excellent investment alternative to traditional funds that do not have the ability to be traded intraday and whose fees are considerably higher.

State Street Global Advisors (2013) have published a data sheet where they recognize that the original idea of ETFs was developed by Nathan Most, who aimed to design an investment whose operation was based on the operation of bonded warehouses. The Warehouse would review the assets, store and guard them issuing their own certificates of deposit that could be exchanged for Bonds Pledge and were subject to trading on the stock market, as they are guaranteed by the assets deposited in the warehouse.

This idea was interpreted by managers of ETFs and applied to entities and negotiation mechanisms corresponding to its creation. Based on this, there are two figures under which ETFs are organized in the US and these are the Investment Company with Obligations (Unit Investment Trust "UITs") which are mutual funds almost always indexed emitting investment units with a specific settlement date, they are not allowed to make active changes in the composition of its portfolio and are usually shorter than traditional mutual funds life; Common Investment Company or Open (Open-End Funds) that are more flexible investment scheme since it has no restrictions on the issuance of shares or certificates, which provide the holder the right on an aliquot of Net Assets that make up the Fund, pledging to buy back the shares if the holder wishes to sell, may adjust the composition of the underlying fund and may not indexed, being the structure under which it operates most mutual funds.

The ETF's mechanics is showed in the Figure 2. Figure 2 illustrates the implementation of the original idea of Nathan, the process of creating an ETF which shows that an ETF arises from the objectives of the Financial Advisor (Fund Manager) and managers of the Trust (the Trust), determine which benchmark choose to be replicated, in this way come to market index providers who develop and provide licenses to new and existing indices; in exchange for a payment previously agreed gain access to the index methodology, etc. rebalancing as well as the right to replicate and use the name.

Figure 2. ETF's Mechanics. Own elaboration



Source: Ramaswamy (2011).

Exchange Trade Funds in Mexico

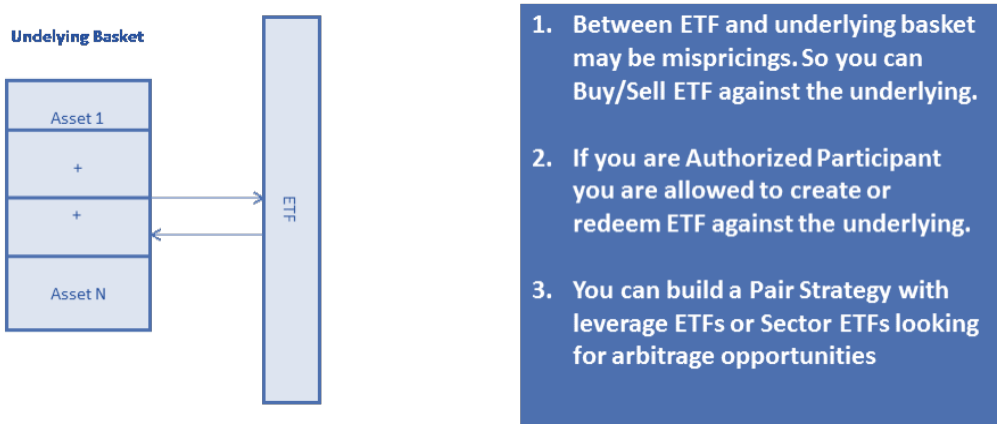
In Mexico ETFs are constituted by Trusts in which the portfolio that comprises the ETF, where a Trustee accompanied by a financial advisor who is responsible for daily operations and rebalancing of the underlying portfolio of the ETF is deposited, is responsible for managing the assets that make up the assets of the Trust and in turn seek to replicate the composition of a stock index, currency, commodities, sectors, etc. The Trust is authorized to issue certificates that give their holders an aliquot in Net Asset Value (NAV) that make up the assets of the Trust, and in turn allows increasing the same, operating similarly to mutual funds US.

3. Construction of the trading strategies

Exchange Trade Fund strategies

Figure 3 shows some typical strategies used with ETFs

Figure 3. Typical strategies ETFs



Source: Avellaneda and Zhang (2010). Avellaneda (2011).

Leverage and inverse Exchange Trade Fund's

The leveraged and inverse leveraged ETFs are designed to provide an additive multiple of the daily performance of the underlying index that serves as Benchmark. According to Little (2010) and Shum (2012) the impact of compounding on cumulative returns is a fact, and we can demonstrate that over a 2-day holding period, the net return on the underlying index is:

$$R_{t+1}^{U} = (1 + R_t^{U})(1 + R_{t+1}^{U}) - 1 = R_t^{U} + R_{t+1}^{U} + R_t^{U} R_{t+1}^{U} . \quad (1)$$

And if we calculate the net return on a 2x Bull-ETF, we obtain the expression

$$R_{t+1}^{Bu} = (1 + 2R_t^{U})(1 + 2R_{t+1}^{U}) - 1$$

$$= 2R_t^{U} + 2R_{t+1}^{U} + 4R_t^{U} R_{t+1}^{U} .$$

From (1), we can arrive to:

$$R_{t+1}^{U} = -R_t^{U} R_{t+1}^{U}, \quad (2)$$

using (2)

$$R_{t+1}^{Bu} = 2R_{t+1}^{U} + 2R_t^{U} R_{t+1}^{U} . \quad (3)$$

For the case of a 2x Bear Leveraged-ETF, we can calculate the net return over a 2 day holding period using the expression:

$$R_{t+1}^{Be} = (1 - 2R_t^{U})(1 - 2R_{t+1}^{U}) - 1$$

$$= -2R_t^{U} - 2R_{t+1}^{U} + 4R_t^{U} R_{t+1}^{U} .$$

Again, using (2), we can obtain:

$$R_{t+1}^{Be} = -2R_{t+1}^{U} + 6R_t^{U} R_{t+1}^{U} . \quad (4)$$

We can see that the effect is not symmetric, now assuming we have perfect replication, the deviation due to corresponding is $6R_t^{U} R_{t+1}^{U}$ for the 2x Bear Leveraged-ETF is not symmetric, in fact is three times bigger than the deviation of its 2x Bull-ETF counterpart, it means, "if the underlying index is trending up, a 2x bull ETF will generate a higher return than otherwise, and a 2x bear ETF will generate a Smaller loss than otherwise. We will call this the *trending* effect. If returns are negatively Autocorrelated (*i.e.,* a positive return on day t followed by a negative return on day t+1, or vice versa), the deviations will be negative. Therefore, even if the underlying index breaks even, both the 2x Bull and 2x Bear ETFs will post a negative return, with the latter being three times larger. We will call this the *flat-return* effect" (Shum 2012).

Pair selection

Pair selection follows these steps:

- the pair selection is based on the methodology proposed by Avellaneda and Lee (2008) and Thomaidis, Kondakis and Dounias (2006);
- the observation period chosen comprises from December 31, 2008 to April 16, 2013;
- it is assumed that a relationship exists between price vectors which satisfies the following equation:

$$P_t = \alpha + \beta Q_t + X_t$$

- that in differential form satisfies a stochastic dynamic process:

$$dP_t = \alpha dt + \beta dQ_t + dX_t$$

- the fluctuating prices of pair, defined as a spread can be easily estimated through a parametric model that follows an Ornstein-Uhlenbeck process:

$$dX_t = \kappa(X_{t-1} - \mu)dt + \sigma dW_t, \kappa > 0$$

$$E\left\langle dX_t \middle| X(s), s \le t \right\rangle = \kappa(X_{t-1} - \mu)dt$$

- Pair selection: to identify pairs we construct statistical estimation of the Ornstein-Uhlenbeck process for 9 Emerging Markets Inverse ETFs. For each ETF in the universe, we use adjust at close prices and calculate simple correlation parameter with 100 days sample, the parameters' estimation for Ornstein-Uhlenbeck process were done using a 60-day trailing estimation window. We are interested in ETFs with mean-reversion times less than ½ period (κ > 252/30 = 8.4), with medium and high correlation between prices and in ETFs that have fast mean reversion based on the parameters below:

$$\kappa > (252/30) \qquad \tau = 1/\kappa \qquad \tau \le T_1,\ T_1 = (60/252)$$

Table 1. List of possible assets to form the pair trading. Using 100 days' sample for correlations and 60 days sample for Ornstein –Uhlenbeck Process. With log returns from December 31, 2008 to April 16, 2013

PAIR	a_100	b_100	a_60	b_60	✔	SSR	?(60-2)	?	?Xt	?t	‼	✱	⛰
EWZ_ILF	0.000052270	0.979115242	0.000023957	0.089221292	0.013172132	0.002029418	0.000034990	0.005915232	0.000205241	7.578065351	0.000025358	264.4819363	0.003780977
EEM_EWZ	-0.000358820	0.646034493	-0.000217208	-0.199416620	0.090422622	0.005509900	0.000094998	0.009746706	-0.000216594	5.193977550	0.000181095	176.460141000	0.005667002
EEV_FXP	-0.000608367	0.564562647	0.001713790	-0.245191210	0.153308370	0.005676179	0.000097865	0.009892682	-0.000177775	4.102491024	0.000137633	153.844764300	0.006500059
FXP_BKF	0.000095600	-2.268549000	0.000492435	-0.172150200	0.024091200	0.007989437	0.000137749	0.011736648	-0.003683760	7.391317345	0.000420112	192.551301000	0.005193421
FXP_EEM	0.000386160	-2.426611180	0.001233891	-0.220514420	0.095915180	0.010727030	0.000184840	0.013595576	-0.000377489	6.429234743	0.001010960	165.453878800	0.006043980
RSX_BKF	-0.002795710	1.066319016	-0.000204212	-0.104572390	0.070451841	0.002655995	0.000045793	0.006767054	-0.000208074	7.128925099	0.000184879	247.106905300	0.004046831
EEV_EEM	-0.000270888	-1.995468000	-0.000055454	-0.561091620	0.068263845	0.000077394	0.000001334	0.001155151	-0.000009286	0.121886363	0.000035521	63.243486590	0.015811905
RSX_EEM	-0.000412722	1.136339274	-0.000588800	0.011779165	0.104006069	0.003876279	0.000068324	0.008175109	0.002853698	51.932707580	0.000595818	486.079147500	0.002057278
EEV_RSX	-0.000270888	-1.995468000	0.000340871	0.014461712	0.068263845	0.007735985	0.000133379	0.011548985	0.004645042	63.196253370	0.000345873	463.624634200	0.002156917
EEM_ILF	-0.000109103	0.770462861	-0.000249962	-0.128907120	0.027494030	0.001308601	0.000022562	0.004749956	-0.000082214	4.065913950	0.000221420	224.210221700	0.004460100
PIN_FXP	0.000109230	-0.748093480	0.003470091	-0.069165220	0.027525839	0.026592733	0.000458495	0.021412506	-0.003203702	33.094557550	0.003245607	292.348287000	0.003420578

Pair detection: Co-integration approach

- The next step is to test the co-integration with constant of Engle and Granger (1987), it was performed, to achieve verify that there is co-integration between selected pairs, based on it is possible to assume that mean reversion exists between these two actives.
- For Cointegration Process we based on Alexander and Dimitriu (2002), Alexander, Giblin and Weddington (2002), Engle and Granger (1987) and Thomaidis, Kondakis and Dounias (2006). The Pair Sample is from December 31, 2010 to September 11, 2015. The main idea of Pair trading is to Pick Fundamentally Related Stocks and detect stable relative price relationships.
- There is a linear relation between the log- returns of two ETFs classified in the same industry, sector or type:

$$P_t = \alpha + \beta Q_t + X_t$$

$$dP_t = \alpha dt + \beta dQ_t + dX_t$$

- The residuals are modeled as a mean–reverting process. Ornstein-Uhlenbeck (AR-1) process:

$$dX_t = \kappa(X_{t-1} - \mu)dt + \sigma dW_t, \kappa > 0$$

$$E\left\langle dX_t \middle| X(s), s \le t \right\rangle = \kappa(X_{t-1} - \mu)dt$$

- Applying techniques from cointegration analysis from Engle and Granger (1987). Two assets P and Q, follow a common stochastic trend and are integrated order d, there is a linear combination between both that give us a Synthetic Spread X which is integrated order d-b, where b>0. There, the two series are cointegrated in the long run ci(d,b).

Table 2. Engel-Granger analysis test for co-integration

Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
REEV	-42.42092	0.000000	-1740.214	0.00000
RFXP	-40.84373	0.000000	-1674.156	0.00000

To confirm Cointegration was applied Johansen Cointegration Test. Trace test indicates 2 co-integrating equations at the 0.05 level and Max-eigenvalue test indicates 2 cointegrating equations at the 0.05 level.

Table 3. Johansen analysis test for co-integration

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob**
None*	0.19256028	678.713922	15.49471288	0.00010
At most 1*	0.173131418	319.383969	3.841465501	0.00000
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob**
None*	0.19256028	359.329952	14.26460015	0.00010
At most 1*	0.173131418	319.383969	3.841465501	0.00000

Strategy description

Due the good Cointegration results we decide to build a group with two inverse *ETFs* (-2x), *ProShares UltraShort FTSE China 50* (FXP) that follow the inverse performance of China's FTSE 50 and the *ProShares UltraShort MSCI Emerging Markets* (EEV) that follow the inverse performance of *MSCI Emerging Markets Index*. In this paper we

use the General Pairs Trading Model originally posed by Avellaneda and Lee (2008). In the General Pairs Trading Model, P_t and Q_t are the Market Price of a pair of assets with similar characteristics and trajectory, then one might expect that the assets' performance follows one another given a systematic component defined by the *Beta* Ratio or *Hedge Ratio* as follows:

$$\ln\left(\frac{P_t}{P_{t-1}}\right) = \alpha + \beta \ln\left(\frac{Q_t}{Q_{t-1}}\right) + X_t, \tag{5}$$

where: α indicates the excess return that the strategy can get over the market performance, β is the coverage ratio or *Hedge Ratio* and X_t is the residue or idiosyncratic component of the equation. In its differential version can be written as:

$$\frac{dP_t}{P_t} = \alpha dt + \beta \frac{dQ_t}{Q_t} + dX_t \tag{6}$$

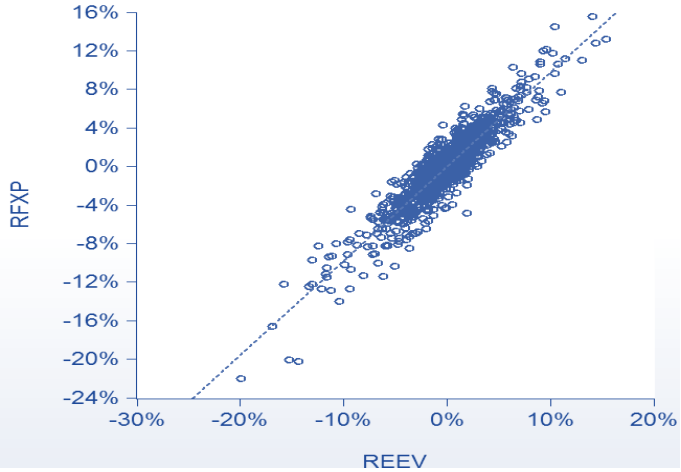
We identify a positive correlation between log returns of EEV and FXP, the R^2 is 75.48%, and use Augmented Dickey-Fuller Test to find a Stationary Process. For corroborate if it is a stationary process, specifically an Ornstein-Uhlenbeck process type, the Dickey-Fuller test is used.

Table 4. Dickey-Fuller analysis test for stationary process

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-40.83164	0.0000
Test critical values:	1% level	-3.434029	
	5% level	-2.863052	
	10% level	-2.567622	

There is a positive correlation between the logarithmic returns of FXP and significant at 95% confidence, an R^2 of 79.85%, which indicates EEV in the first instance that there, is a whole movement between the selected pair.

Figure 4. Positive correlation between the logarithmic returns of the FXP and the logarithmic returns of the EEV.



To test Trading Strategy and estimate parameters we use an experimental setting:

- Sample Period: December 31, 2010 to September 1, 2015;
- Trading Parameters: Window Lenght {60, 180} days and Trading Period {60, 180} days;
- We define two moving confidence bounds as ($Z_t^{L,a}$, $Z_t^{H,a}$) ($Z_t^{L,\alpha}$, $Z_t^{H,\alpha}$) that could be of the form $Z_t = \mu \pm n\sigma$;

- We decide that the Hedge Ratio must have a floor and a ceil to round it;
- The Trading Rule is obtained after 10,000 simulations:

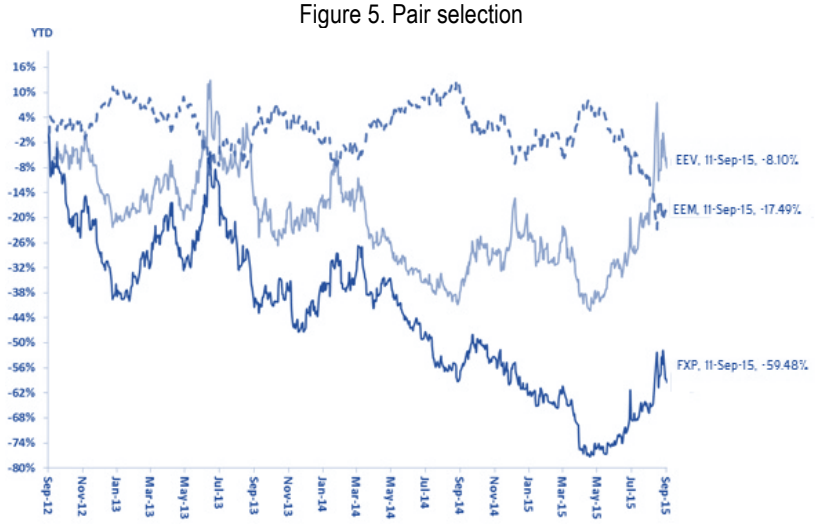
$$\text{Buy if}: X_t < Z^{L,\alpha}{}_t = 1*\left(floor\left[hedgeRatio\right]\right) + (\phi < \left(hedgeRatio - floor\left[hedgeRatio\right]\right)$$

$$\text{Sell if}: X_t > Z^{H,\alpha}{}_t = -1*\left(floor\left[hedgeRatio\right]\right) + (\phi < \left(floor\left[hedgeRatio\right] - hedgeRatio\right))$$

$$\text{Buy if}: X_t < Z^{L,\alpha}{}_t = 1*\left(ceil\left[hedgeRatio\right]\right) + (\phi < \left(ceil\left[hedgeRatio\right] - hedgeRatio\right))$$

$$\text{Sell if}: X_t > Z^{H,\alpha}{}_t = -1*\left(ceil\left[hedgeRatio\right]\right) + (\phi < \left(ceil\left[hedgeRatio\right] - hedgeRatio\right))$$

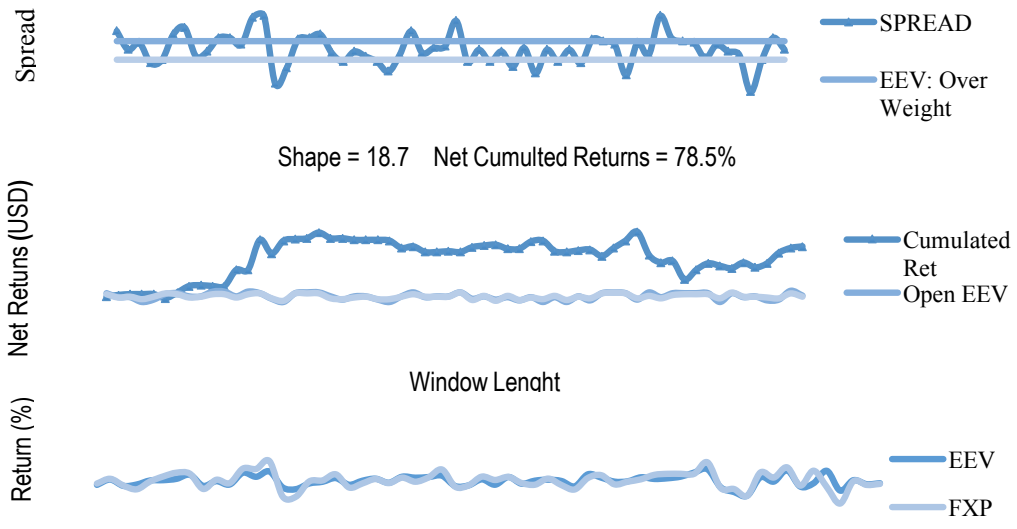
Figure 5. Pair selection



Source: Own Elaboration based on Yahoo Finance and MSCI Data.

Estimated 60 days of log-returns

Figures 6 a, b and c. Estimated log-returns of 60 days.



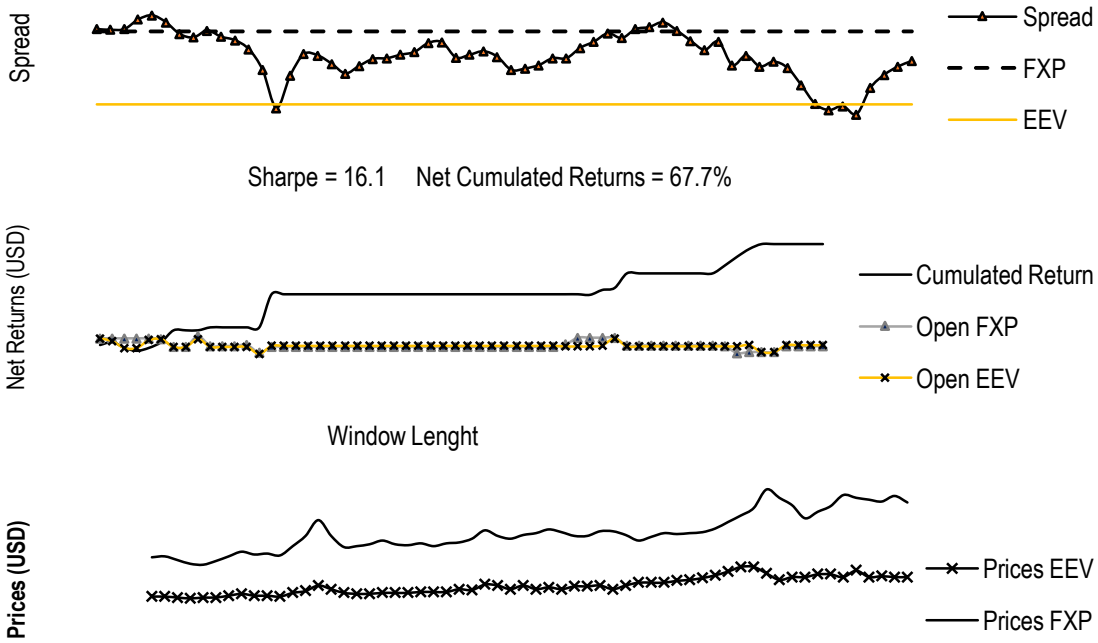
It is that in the 60-day window portfolio consists of pairs:

$$Z_t = \ln P_t - 1.3588 \ln Q_t - X_t$$

This means: Initially I buy my Spread, I find myself short on FXP (sale) which is the most overvalued ETF, and very long in EEV (overbought) for 1.3588 shares as undervalued, approximately every 0.79 days there is a rebalancing positions between day 30 and 40 as many signals on sale FXP (long positions) seen since at this point it is undervalued, while I am short in the EEV as overvalued, and by day 60 my position became neutral by market conditions and the background only got Cash inside because in this situation decided to unwind the positions to be reinvested in a more stable option. The strategy proposed in 60 days with logarithmic yields obtained a cumulative performance of 78.5% net, removing transaction costs for trade 0.05% (total $ 0.39 USD), and a Sharpe ratio of 18.7 which indicates that the strategy is profitable in for intraday operation and achieves two objectives to maximize returns and minimize transaction costs.

Estimated 60 days of prices

Figures 7 a, b and c. Estimated prices of 60 days.



Pair Index: Rebalancing every 4.0808 days before 60 days of prices

In this case it is that in the 60-day window portfolio consists of pairs:

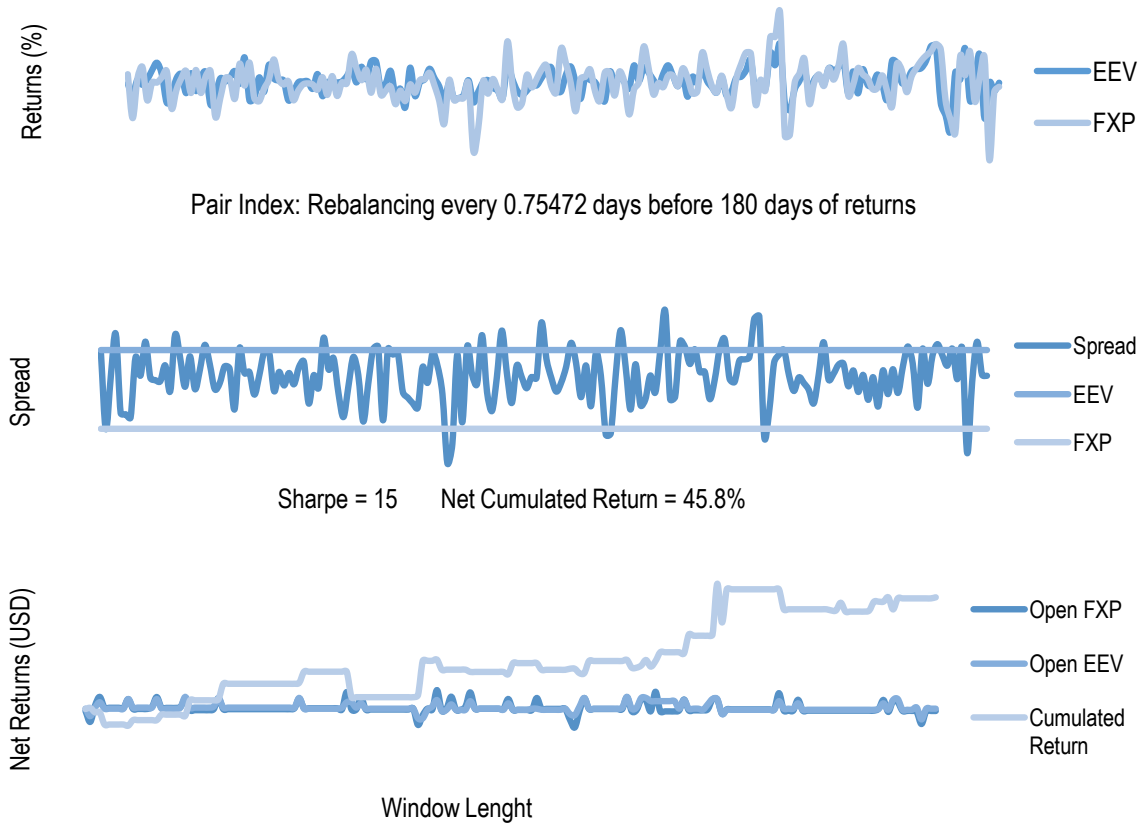
$$Z_t = P_t - 1.8081 Q_t - X_t$$

This means: initially I buy my Spread, I am long in FXP (overbought) for 1.80 shares, and short on EEV (sale) for 1 shares as undervalued, approximately every 4.08 days there is a rebalancing of the positions, the 15th they turn the positions and I sell my Spread the same applies to day 55 to day 60 my position became neutral by market conditions and the background only obtained got Cash inside because in this situation decided to unwind the positions to be reinvested in a more stable option. The strategy proposed in 60 days with prices earned a cumulative net performance of 67.7%, removing trade transaction costs by 0.05% (total $0.16 USD), and a Sharpe

ratio of 16.1. The strategy achieves significantly reduce transaction costs by making fewer signals, however fails to be as sensitive as to properly identify when an asset is undervalued or overvalued enough, in addition to the mean reversion it is much slower.

Estimated 180 days of log-returns

Figures 8 a, b and c. Estimated log-returns of 180 days.



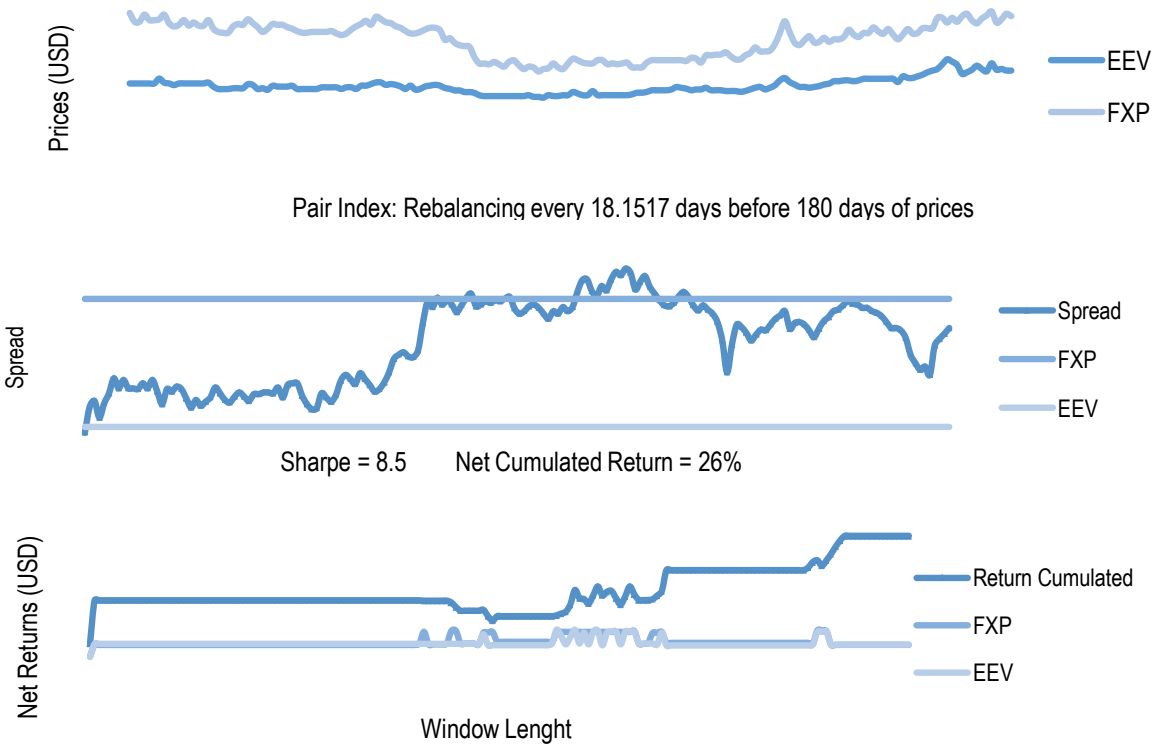
It is that in the 180-day window portfolio consists of pairs:

$$Z_t = \ln P_t - 1.2475 \ln Q_t - X_t$$

It means: I buy my Spread initially for 70 days at least, I am short and long in EEV FXP 1.24 shares for approximately every 0.75 days, a rebalancing of positions. Only three sell signals for the Spread which coincide with the sharp declines in yields FXP appreciate my position became neutral by market conditions and the background only got Cash inside for the day 179 there was a rebalancing pronounced and now I long FXP and 1.24 shares short 1 share in EEV. The strategy proposed in 180 days earned a cumulative net performance of 45.8%, removing trade transaction costs by 0.05% (0.34 USD), and a Sharpe ratio of 15 which indicates that the strategy is profitable.

Estimated 180 days of prices

Figures 9 a, b and c. Estimated prices of 180 days.



In this case it is that in the 180-day window portfolio consists of pairs:

$$Z_t = P_t - 0.5253Q_t - X_{tt}$$

It means: to start selling my 1st Spread 1-1 and for 70 days the strategy remains neutral, a day 80 start with small shopping from my Spread, until the day I meet 102 long and short in FXP EEV approximately every 18.5 days there rebalancing of positions. Only two sell signals appreciate my position became neutral by market conditions and the background Cash only got inside. The strategy proposed in 180 days earned a cumulative net performance of 26%, removing transaction costs for trade 0.05% (0.31 USD), and a Sharpe ratio of 8.5 which indicates that the strategy is not more efficient than the estimate by logarithmic returns, since it fails to identify adequately the market movements and transaction costs are very like.

The performance of EEM proposed as Benchmark 60 days was -17.12% and -14.34% 180 days, so any of the proposed strategies can overcome a Buy and Hold strategy based solely on the investment on the Benchmark.

Conclusions

- The proposed strategy is profitable in the short term, and allows it to be implemented as an active management strategy uncorrelated with the market.
- It is observed that is more efficient estimate logarithmic yields and allowing intraday send signals, estimating prices is much slower.
- The yields obtained with logarithmic estimate yields were higher than those obtained with the price-based strategy.

- It is noteworthy that despite the asymmetry in inverse ETF yields and poor individual performance, the strategy proposed allowed to form a synthetic asset that offered positive returns with exposure to emerging markets.
- This is a very aggressive strategy for Equity; we need to incorporate VaR calculation and Active Strategic Stats to follow up accurately.

For future work we could be including Bollinger Bands, besides the volatility estimate by mobile windows arises.

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Ensembles of Classifiers for Parallel Categorization of Large Number of Text Documents Expressing Opinions

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Abstract:

Opinions provided by people that used some services or purchased some goods are a rich source of knowledge. The opinion classification, applying mostly supervised classifiers, is one of the essential tasks. Computer's technological capabilities are still a major obstacle, especially when processing huge volumes of data.

This study proposes and evaluates experimentally a parallelism application to the classification of a very large number of contrary opinions expressed as freely written text reviews. Instead of training a single classifier on the entire data set, an ensemble of classifiers is trained on disjunctive subsets of data and a group decision is used for the classification of unlabelled items. The main assessment criteria are computational efficiency and error rates, combined into a single measure to be able to compare ensembles of different sizes. Support vector machines, artificial neural networks, and decision trees, belonging to frequently used classification methods, were examined. The paper demonstrates the suggested method viability when the number of text reviews leads to computational complexity, which is beyond the contemporary common PC's capabilities. Classification accuracy and the values of other classification performance measures (Precision, Recall, F-measure) did not decrease, which is a positive finding.

Keywords: text documents; natural language; classification; parallel processing; ensembles of classifiers; machine learning

JEL Classification: C38; C63.

Introduction

The discipline concerned with mining useful knowledge from large amounts of textual data, known as text mining, has gained great attention along with the growth of volumes of available textual data. Such a growth goes hand in hand with the expansion of many activities on the Internet that enables creating large repositories of textual data (Aggarwal and Zhai 2012). Communicating and expressing opinions of people and organizations have become very popular in the recent years. The places where such opinions can be expressed include electronic markets, recommender systems, social networks, personal blogs, discussion boards, electronic mail, and others (Dařena and Žižka 2013).

Current needs of individuals and organizations include not only retrieving the data but also analysing it in order to facilitate decision making. Typical text mining problems therefore include document classification, prediction, clustering, information extraction, text summarization, word sense disambiguation, or text filtering (Aggarwal and Zhai 2013, Britsom, Bronselaer and Tre 2012, Sebastiani 2002, Weiss *et al*. 2010).

Text data classification, a problem of assigning a document to one or more predefined categories, is a major application category of the tasks belonging to supervised methods (Aggarwal and Zhai 2012). The goal is to find a function (classifier) that can be – according to labelled training data, represented by input data paired with desired outputs – used for predicting the labels of future unlabelled data. Text data classification includes, for example, document categorization, spam detection, authorship attribution, language identification, or sentiment analysis

(Manning, Raghavan and Schutze 2008). The importance of classification is given by the fact that many text mining tasks require that the data items to be processed have assigned labels categorizing the data.

A rich source of valuable knowledge for both commercial and non-commercial areas are opinions provided by people that used some services or purchased some goods. Typically, the more opinions are available the more valuable information and knowledge can be revealed after the analysis of the data. Thus, sentiment analysis and opinion mining have become very challenging and practical research topics where sentiment and subjectivity classification is the most widely studied subject (Liu 2012).

Having large amount of data available, manual processing, even by human experts, is unfeasible. Thus, the methods of automatic classification become very popular. For the classification of text data, several specifics, like large input space (many potential examples, huge amount of words and their combinations), noise (spelling errors, typos, wrong grammar etc., typical for natural languages), and computational efficiency (it is necessary to develop procedures able to handle large number of features) need to be taken into consideration (Joachims 2002). Today, methods from artificial intelligence and machine learning are used successfully for solving various tasks in many fields. As for text data classification, machine learning is a dominant approach in the research community (Sebastianiu 2002).

Besides the availability of data, automatic processing is enabled by the advancements of current technologies, particularly by increasing computing performance and memory capacities of the computers. However, the advancements are not always sufficient and the technological capabilities are still a major obstacle for certain tasks, especially when processing huge volumes of data. One of the major future challenges is therefore finding how to parallelize the methods for all kinds of text mining algorithms (Aggawral and Zhai 2012).

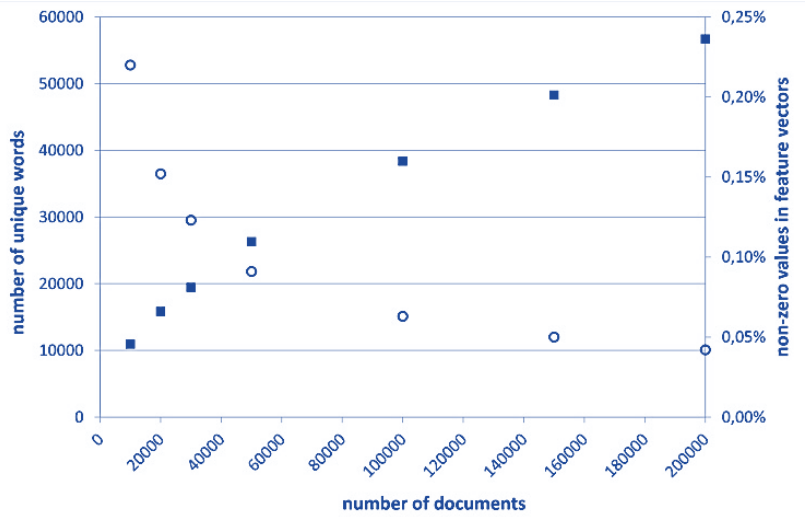
Parallel processing has a great impact in many areas of computer applications. Many applications, involving processing huge amounts of data or performing a large number of iterations require computing speeds and capacities that cannot be achieved by the current conventional computers (Roosta 2000). There can be found several applications of parallel approach in the text mining domain as well.

This study aims at an experimental evaluation of applying parallelism in order to technically manage classification of a very large number of contrary opinions expressed as freely written text reviews of a certain service. The main assessment criterion in this work is computational efficiency while maintaining satisfactory error rates. Maximizing the classification accuracy by tuning algorithm parameters, applying language (in)dependent pre-processing, and others is not the principal aim of the work. The main focus is also not on processing commonly used data sets like the Reuters corpus, 20 Newsgroups, and similar, but on the data generated by ordinary people in electronic environments. The analysis of this sort of data is very topical and empirical evidences of the applicability of advanced text mining methods are needed.

1. Reasons for the parallel approach to text data processing

Most of the algorithms that are used to mine knowledge from textual data require the data to be converted to a structured format. A widely used format is the vector space model proposed by Salton (Salton, Wong and Yang 1975). Every document is represented by a vector where individual dimensions represent the features the values of which are their weights (importance). Typically, a feature corresponds to a word in a document. Such a simple approach, known as the bag-of-words approach, is popular because of its simplicity and straightforward process of creation while providing satisfactory results (Joachims 2002).

Figure 1 - The graph represents a dependency between the number of documents and the number of unique words in a document collection. Squares – numbers of unique words for different dataset sizes. Circles – percentage of non-zero values of feature vectors representing the documents for different dataset sizes



The number of features is generally very high for large volumes of documents and with the increasing number of documents it is still growing, even though slower than linearly. When the number of unique words of every single document is compared to the number of all unique words in the document collection (a feature space), the vectors are usually very sparse. The data used in the experiments presented in this paper – largely relatively short documents – were represented by vectors where only some tenths or hundredths of a percent of values were not zero, see Figure 1. This is quite typical for posts in social networks, reviews evaluating products and services, instant messaging, and others. The high dimensionality and sparseness of the data increase the computational complexity and may lead to lower classification accuracy with basic machine learning methods (Phan, Nguyen and Horiguchi 2008).

In this investigated case, the computational complexity depends partly on the applied algorithm, partly on the number of reviews, and partly on the size of dictionary (*i.e.,* the number of unique words) generated from the reviews. While the complexity of an algorithm is given by its principle, the data volume given by the number of reviews and namely their unique words influences typically the time and memory non-linearly. Presumably, mainly decreasing the dictionary size can significantly reduce the complexity.

2. Related work

Generally, parallel data processing enables to reduce the demands for computing time and memory. Decomposing one large problem into several smaller ones often leads to a rapid decrease of the time needed for completing a certain task because the complexity mostly grows faster than linearly with the increasing amount of data. Often, it also reduces the sparseness of the vectors representing the data thanks to lowering the dictionary sizes of sub-problems reduced by the decomposition.

The parallel approach was used, *e.g.,* for the detection of web attacks. A classifier that labelled incoming requests as valid or dangerous based on document similarity ran on a parallel architecture instead of on a linear one. This enabled to process the requests in the real time (Ulmer 2011). The parallel approach was also used for the classification of multi-dimensional text collections (documents belonging to multiple sets of categories). The classifiers for every dimension were created and later used for classification in a parallel manner (Lertnattee and Theeramunkong 2005).

A parallelized approach was applied in (Žižka and Dařena 2012) to mine significant words expressing the semantics of customer reviews. The paper suggested a method of dividing the data set into subsets including a possibility of evaluating the mining results by comparing the unified outputs of individual subsets with the original

set. In (Zhao and Lu 2005), the authors decomposed a large-scale text categorization problem into a number of smaller two-class sub problems and combined all of the individual modular k-nearest neighbours' classifiers trained on the smaller two-class sub problems into a Min-Max modular k-nearest neighbours classifier. Parallel computing was also applied to speed up the neural network training process of the Improved back-propagation neural network used for the text classification (Li, Yang and Lin 2005). Improving the computational time in the learning and classification process when processing large document collections was achieved in (Kruengkrai and Jaruskulchai 2002). The authors used a novel parallel learning algorithm based on the combination of the naïve Bayes classifier and Expectation-Maximization algorithm on a large Linux PC cluster. In order to improve the classification performance and make the classification of very large data sets feasible, the ways of algorithms' work, data representation, or computer memory use together with the data partitioning (with possible subsequent parallelization) were changed in (Lee and Calvo 2005). This, however, required detailed knowledge of the applied methods, programming, and efficient memory management.

3. Applied parallelism design

The success of some of the above mentioned methods, *e.g.,* (Kruengkrai and Jaruskulchai 2002, Lertnattee and Theeramunkong 2005, Ulmer 2011), depends on using several interconnected computers. Such an approach needs to cope with asynchrony and failures, to achieve load balancing, to address mobility, heterogeneity and the dynamic nature of participating processes, or to face disconnecting in the network (Xiang *et al.* 2012). Having a necessary infrastructure is sometimes also not feasible. A manager of a small company might be interested in analysing the reviews of its products or services. In such a company, there might be only a small number of computers interconnected in an ordinary business network lacking readiness for complex parallel computations. As an alternative, we propose a method (which might use only one computer) that enables achieving results for which a parallel architecture would be needed. Instead of performing N tasks in parallel, the tasks might be performed sequentially while obtaining the same results. The process is therefore not literally parallel, although a strict parallel approach might be used as well when possible (this would lead to even bigger improvement of time intensity).

In order to evaluate the application impact of a parallel approach to text data classification, several steps needed to be carried out: collecting a sufficient amount of textual data, splitting the data into several groups for parallel processing, selecting machine learning algorithms, converting the data into a format suitable for the algorithms, training and testing the classifiers on the created data subsets, evaluating the results.

4. Experimental data description

For the experiments, a sufficient amount of labelled textual data needed to be collected. We used opinions of several millions of customers (from booking.com) who stayed in many different hotels all over the world. Such data is a typical representative of the source of valuable knowledge for commercial and non-commercial organizations.

Each review consists of two parts – a negative and positive experience with the hotel and its services, written in a natural language. From several tens of languages, we focused on English in the experiments. The English data set contains almost 2,000,000 reviews labelled as positive or negative. The text includes many imperfections, which is typical for natural languages. This brings certain consequences like the extension of the word list (dictionary) where a word can have many variations with only one correct, *e.g., behavoir*, *behavior*, *noise*, *nois*, *acomodation*, *accommodation*, *accomodation*, *acommodation*, and so like. Similarly, the customers often use interjections like *gooooood*, *goood*, *aaarrrghhhh*, *uuugly*, and the like, to express them dis/satisfaction with the service. Sometimes, the English text contains also non-English terms when a customer is not a native English speaker or when some reviews are written in two languages. For a more detailed description of the data see (Žižka and Dařena 2011).

In the experiments, a subset consisting of 200,000 training reviews was used because of the computational feasibility. The shortest review in the collection had only one word, the longest had 400 words, and the average length was 24 words. The number of positive and negative reviews in the entire data subset was almost balanced. The data was converted to the bag-of-words vector format where individual dimensions of the vectors were represented by the words contained in the reviews. Any words with global frequencies less than three were

removed. Such words usually bring no information, thus having no or negligible impact on the results. Removing such infrequent words also substantially reduces the dimensionality of the vectors.

The weights of every term are given by three components – a local weight representing the frequency in every single document, a global weight reflecting the discriminative ability of the term, based on the distribution of the term in the entire document collection, and a normalization factor correcting the impact of different lengths of documents (Salton and McGill 1983). The most popular methods for determining the weights of the words include term presence – the weights are binary (0 or 1), representing the absence or presence of the term, term frequency – the weights correspond to the numbers of times the word appeared in the text, and tf-idf (term frequency × inverse document frequency) weighting scheme, with the general idea that the more a term appears in a text the more important it is (tf factor), and the less the word is common among all texts the more specific and thus more important it is (idf factor). Inverse document frequency (idf) can be calculated as $idf(t_i) = \log(N/n(t_i))$, where t_i is the term, N is the number of documents in the collection, and $n(t_i)$ (also called document frequency) is the number of documents containing term t_i (Cummins and O'Riordan 2006).

5. The tested classifiers

Having examples of input-output pairs where the outputs were generated by an unknown function *y*, the goal of supervised learning is to find a function *h* (called hypothesis) that approximates y. Such a function can be subsequently used for assigning values to new, as yet unseen instances. In order to test the accuracy of a hypothesis, a testing set of samples, distinct from the training ones, is provided. After comparing the values of *y* and *h* for the testing samples, we can find out how well the hypothesis generalizes. When the values of *y* are discrete, we talk about classification (Russel and Norwig 2010).

Sometimes an ensemble of classifiers can be used instead of one single classifier in order to achieve better predictive performance. Each member of an ensemble provides a classification output and all outputs are combined into a single classification representing the ensemble decision. This combination of outputs is usually performed by majority vote. Decision ensembles demonstrated success in reducing classification errors in many tasks (Tsymbal 2000). This enables to reduce the negative impact of training the classifiers on lower volumes on data, which generally leads to higher classification error rates.

Classification algorithms used for categorization of textual data include probabilistic classifiers, decision trees, decision rules, example-based classifiers, support vectors machine, or neural networks. It is very difficult to compare individual methods because the published results of experiments of different authors often run under different circumstances, use different sampling, pre-processing etc. Generally, support vectors machine, instance based classifiers, neural networks, and decision trees bring acceptable results (Sebastiani 2002, Žižka and Dařena 2011). In our experiments, support vector machines, artificial neural networks, and decision trees were used. They belong to mostly used classification methods, provide good results, and their computational complexity in the training phase is high with high number of training examples.

An artificial neural network (ANN) is a structure consisting of interconnected primitive functions (neurons), typically organized in layers. During learning, a network self-organizes (the weights of connections are adjusted) to implement the desired behaviour (Rojas 1996). In the experiments, a neural network containing one hidden layer consisting of 50 neurons, the backpropagation training algorithm, the sigmoid activation function, and the term frequency weighing scheme for the document features was used.

Support vector machines (SVM) classifiers try to partition data by finding a linear boundary (hyperplane) between two classes. The margin widths between the class boundary and training patterns are maximized during the training process. When it is not possible to separate data in a given n-dimensional space linearly, a kernel function that projects the data to a space of higher dimension is used (Noble 2006). When using SVM, normalization of the data is strongly recommended, which improves the performance at a statistically significant level (Herbrich and Greapel 2002). In the experiments, SVM used the cosine normalization of the vectors, the polynomial kernel function of degree 3, and tf-idf weighting scheme according to the recommendations in (Joachims 1998).

A decision tree (DT) is a classifier that is used in order to give an answer to the given problem (here the answer is the category of the object to be classified) performing a sequence of tests. These tests are based on the

values of attributes characterizing the object. Although the decision trees are very simple they are very successful and their representation is natural for humans (Russel and Norwig 2010). One of the most popular tree generators is the algorithm that builds a tree using minimization of entropy. It comes out from the idea that the initial set of samples is heterogeneous because it contains a mixture of all classes. Thus, the entropy of such a set is high. Separating this heterogeneous set into more homogeneous subsets gradually decreases the entropy, which can optimally be zero (a subset containing samples belonging just to one class has the zero entropy). The splitting is driven by those attributes that provide the highest entropy decrease. The algorithm successively looks for an attribute that could separate the set into subsets with the lowest average entropy compared to the entropy of the set on the higher tree level (Quinlan 1993).

For the implementation, we utilized the Fast Artificial Neural Network (FANN) library implemented in C and C++, SVMlight – an implementation of Support Vector Machines in C, and C5/See5 – a sophisticated data mining tool enabling building decision trees or rules. The parameters of the above mentioned methods, *e.g.,* the architecture of the neural network or the support vector machines kernel function were determined according to preliminary experiments.

In order to measure the quality of the trained classifiers, *i.e.,* their ability to be used acceptably in the future, they are applied to test samples. The values representing correctly and incorrectly classified examples are used to compute measures of classifier effectiveness. In the two class classification, the classes might be labelled as positive and negative. The positive and negative examples that are classified correctly are referred as true positive (TP) and true negative (TN), respectively. False positive (FP) and false negative (FN) represent misclassified positive and negative examples. Commonly accepted classifier performance evaluation measures include Accuracy, Precision, Recall, and F-measure combining the values of TP, TN, FP, and FN into a single measure (Sokolova, Japkowicz and Szpakowicz 2006).

Splitting a computationally intensive classification task into several simpler ones should decrease the time needed for the computations. Because a lower number of examples is used for training, the classification accuracy could decrease for individual learners; this effect is expected to be eliminated by ensemble voting, which is usually significantly more accurate than a single classifier Zhou 2012). In order to combine accuracy change and time savings of an ensemble of classifiers into a single measure, the $score_k$ was introduced. This score enables comparisons of different methods presented in the paper. The proposed formula calculates with relative changes of accuracy and time, always compared to a baseline represented by the values for the case when a single classifier is trained and used on the entire data:

$$score_k = w_{time} \cdot (1 - time_k / time_1) + w_{Acc} \cdot Acc_k / Acc_1$$

where: $time_1$ is the time needed for training a single classifier, $time_k$ is the time needed for training an ensemble of k classifiers, Acc_1 is the accuracy of a single classifier, Acc_k is the accuracy of an ensemble of k classifiers, $1 \geq w_{time} \geq 0$ is the time significance weight, and $1 \geq w_{Acc} \geq 0$ is the accuracy significance weight, $w_{time} + w_{Acc} = 1.0$.

The impact of time is taken as a complement of the times ratio to 1 so time savings have a positive effect on the $score_k$ value. The $score_k$ value is a simple weighted arithmetic average of two components – accuracy change and time change. In order to give higher importance to one of the components, the weights in the formula might be changed (here, the experiments used 0.5 for both weights). Higher values of the $score_k$ mean better performance in terms of combination of the computational time length and classification accuracy.

Table 1. Time needed for training and values of classification performance measures for ensembles of different sizes.

ARTIFICIAL NEURAL NETWORKS														
N	100,000 documents							200,000 documents						
	Time (min)	Acc.	Recall	Prec.	F	$Score_k$	Not classified	Time (min)	Acc.	Recall	Prec.	F	$Score_k$	Not classified
1	875	0.9195	0.9218	0.9173	0.9195	-	-	10560	0.9132	0.9007	0.9289	0.9146	-	-
2	360	0.8671	0.9625	0.8973	0.9288	0.7658	2941	1740	0.8564	0.9613	0.8990	0.9291	0.8865	6456
3	222	0.9256	0.9253	0.9259	0.9256	0.8765		1080	0.9334	0.9399	0.9261	0.9330	0.9599	-
4	168	0.9055	0.9520	0.9160	0.9337	0.8964	1454	720	0.9061	0.9520	0.9252	0.9384	0.9620	3169
5	130	0.9334	0.9503	0.9147	0.9322	0.9333	-	600	0.9373	0.9511	0.9220	0.9363	0.9848	-
10	80	0.9228	0.9451	0.9258	0.9354	0.9561	658	240	0.9320	0.9554	0.9228	0.9388	0.9989	932
Support vector machine														
1	3945	0.9471	0.9657	0.9268	0.9459	-	-	14064	0.9506	0.9648	0.9352	0.9498	-	-
2	2400	0.9299	0.9728	0.9065	0.9385	0.6867	819	10800	0.9374	0.9731	0.9190	0.9453	0.6091	1396
3	1800	0.9422	0.9642	0.9185	0.9408	0.7693	-	7200	0.9480	0.9658	0.9290	0.9470	0.7427	-
4	1200	0.9337	0.9691	0.9074	0.9372	0.8408	492	5280	0.9409	0.9705	0.9201	0.9446	0.8072	796
5	1200	0.9401	0.9647	0.9137	0.9385	0.8442	-	3840	0.9458	0.9652	0.9250	0.9447	0.8610	-
10	500	0.9346	0.9679	0.9047	0.9352	0.9300	234	2100	0.9393	0.9661	0.9150	0.9399	0.9194	402
Decision trees														
1	305	0.9042	0.9247	0.9207	0.9227	-	-	5769	0.9085	0.9287	0.9238	0.9263	-	-
2	138	0.9159	0.9310	0.9335	0.9323	0.7801	2602	975	0.9193	0.9380	0.9329	0.9354	0.9215	4554
3	95	0.9102	0.9247	0.9302	0.9275	0.8471	-	572	0.9146	0.9333	0.9295	0.9314	0.9538	-
4	65	0.9121	0.9263	0.9318	0.9291	0.8972	1813	440	0.9173	0.9356	0.9319	0.9337	0.9667	3405
5	45	0.9084	0.9219	0.9300	0.9259	0.9281	-	364	0.9145	0.9319	0.9306	0.9313	0.9717	-
10	19	0.9061	0.9198	0.9282	0.9240	0.9694	613	183	0.9131	0.9306	0.9297	0.9302	0.9866	1190

6. Results

The experiments were designed to show whether using an ensemble of classifiers trained on disjunctive subsets of the original training data set could lead to the same or similar accuracy results as a classifier trained on the whole data set. The time needed to train the ensemble should be reduced compared to training a single classifier. Such reduction is the major objective of the research while classification accuracy should not be lowered significantly.

The biggest number of training documents that could be processed at once (with the selected algorithms, available resources, and within a reasonable time) was 200,000. In addition, a set consisting of 100,000 documents was used for the confirmation of the findings. The number of testing documents was selected for the training set so that the ratio of the set sizes was 3 training to 1 testing. Then the training set was gradually split into 10, 5, 4, 3, and 2 disjunctive subsets. For each of the subsets as well as for the entire training set a classifier was trained. The classifiers were then applied to the testing set in order to test classification accuracy. Having more than one classifier for the training data, the classifiers formed an ensemble deciding according to the majority. The selected classification performance measures (Accuracy, Precision, Recall, and F-measure) were calculated for each of the classification results and the total time needed for training the classifiers (the sum of training times for every single classifier) was measured.

The data and its distribution in the subsets were the same for all types of the used classifiers. The results obtained from the experiments are summarized in Table 1 and Figure 2.

The ensembles with even number of members sometimes could not decide unambiguously by majority (the same number of ensemble members vote for one class whereas the remaining ones vote for the other class). The worst situation was in the case of ensembles consisting of two classifiers. The number of unclassified documents decreased with the increasing even number of classifiers (below 1% of cases for ten classifiers). When the assignment of a class to such an item has the same probability, it can be done using a random decision, a vote of the classifier with the highest accuracy, or an additional classification by the nearest neighbour algorithm; the overall classification error will not be influenced in a negative way to a large extent. For two classes, an odd number of classifiers can decide but for three and more classes, the unresolved cases may appear.

When evaluating artificial neural networks, it was observed that the values of classification performance metrics are approximately the same, sometimes even better for a higher number of classifiers in the ensemble. The biggest difference can be seen in the time needed for training the ensemble. This value can be found in the column Time representing the time needed for training all classifiers in the ensemble. Replacing a single classifier by an

ensemble consisting of two members reduced the time to about a half. Further increasing of the number of classifiers improved the time efficiency even more significantly.

The characteristic of the results of the support vector machines classifier is similar to neural networks. However, the number of unclassified documents decreased and the accuracy is slightly better. The differences between accuracies for ensembles with different numbers of members are very small and no systematic improvements with the increasing number of members can be observed. The time efficiency is not as substantial as for neural networks, but still might be motivating.

In the case of decision tree classifiers, the reduction of time needed for the training was again quite significant while maintaining high classification accuracy. In order to find out how different parameters of the algorithms influenced the classification results, several additional experiments were carried out. For neural networks, the architecture was simplified and classification error given by the training data was lowered; for the support vector machines the kernel function was changed to radial. Because of the time needed for the computations the experiments were carried out only with the data set consisting of 100,000 documents. The achieved results were very similar to the presented results.

Figure 2. The percentage of time needed for training an ensemble of classifiers of given number of members compared to the time for training a single classifier and accuracies of ensembles of different sizes.

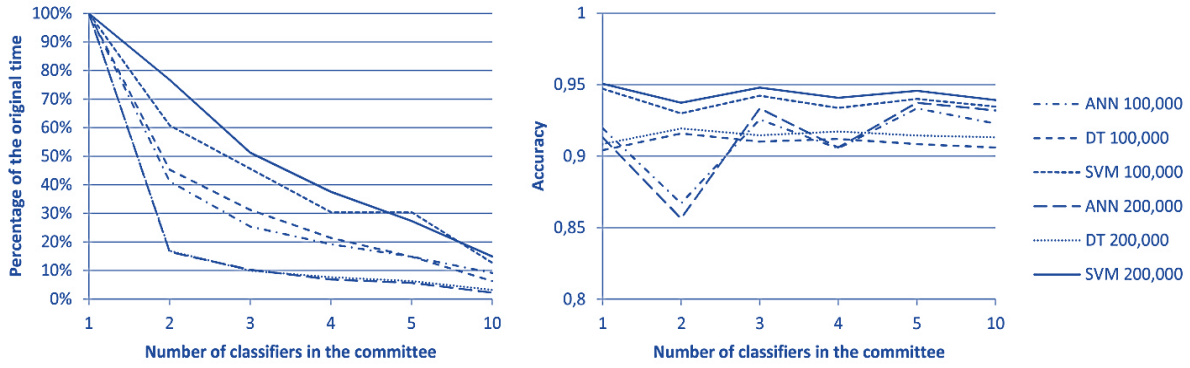
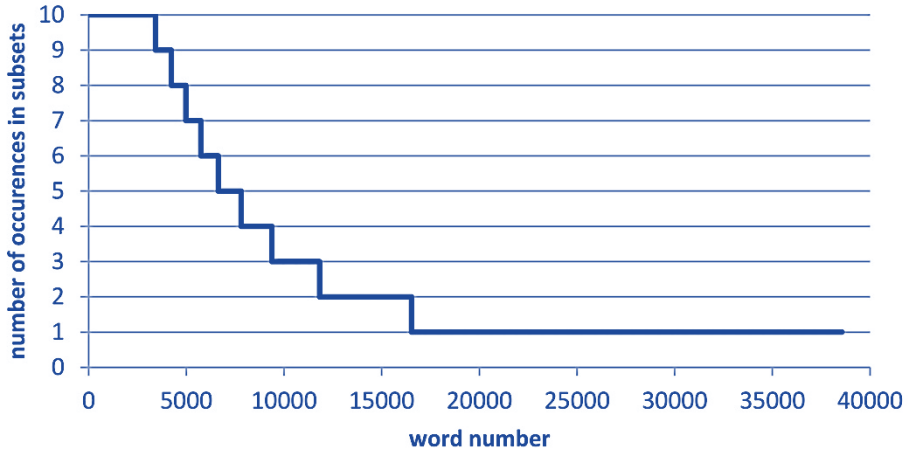


Figure 3. The figure shows in how many subsets from 10 created from 100,000 English reviews do individual words appear



7. Discussion

In order to achieve satisfactory results, some of the ensemble techniques require using different subsets of training data with a single learning method; other techniques use different parametrization of the algorithms, combine different learning algorithms, or apply the learners to different feature sets (Li, Zhong and Wang 2007, Moreira-Matias 2012). Generally, ensembles of different classifiers applied to the same feature set perform better than any

individual classifier and using one learning algorithm together with different feature sets outperforms a single learner (Xia, Zhong and Li 2011). For a good performance of an ensemble, all important attributes should be submitted to the ensemble (coverage), the base classifiers (ensemble members) should include at least one important attribute (usability), and their feature spaces should not be identical (diversity) (Gangeh and Kamel 2010). Splitting the original large data set into several smaller ones and processing them as described above complies with the above mentioned requirements.

The attributes of the created subsets are not the same, as illustrated by Figure 3. We can see that about one tenth of the words are present in all of the subsets, about one fifth of the words appear in five and more subsets, and slightly more than a half of the words are contained only in one of the subsets. Because no data items are omitted, all important attributes are submitted to the ensemble, too. The sum of global frequencies of the words that are present in all subsets is about 95% from the total number of words in the entire collection. Rare words, that form a significant portion of the dictionary (about a half), have a very small or no significant impact on the classification results and are not important for the classifier. As it was found in (Žižka and Dařena 2012), the more a word was significant for the entire collection the more times it was significant for individual subsets. Although the lists of significant words for the entire collection and for the individual subsets were not identical they were very similar while keeping some variability.

Generally, higher computational costs when compared with a single classifier system is a weakness of the ensemble systems. When the base classifiers are not trained on entire feature sets the increase of computation costs is not that high (Xia, Zong and Li 2011). Computation costs of most of the classification algorithms are a function of the number of features and the amount of training data. In our experiments, the number of training data decreased significantly thanks to splitting into several disjoint sets; the numbers of features in these sets was reduced too. For example, the subset containing 100,000 English reviews contained about 38,500 unique words, but each of the 10 subsets created from it contained only about 10,700–11,100 unique words. As a result, the computational costs were reduced substantially as illustrated in Figure 2.

Based on the obtained results some findings can be discovered. Splitting a large document collection into several smaller ones and building classifiers for each of them separately leads generally to the reduction of time needed for building the classifiers compared to the situation when a single classifier is trained on the whole original data set. The changes in accuracy are, however, very small and therefore the ability of correct classification is not negatively influenced. The biggest improvement in time efficiency was achieved for neural networks and decision tree classifiers. In the experiments, it was demonstrated that the support vector machines provided the best results expressed by the highest accuracy. Satisfactory classification results were achieved also with the application of decision trees and artificial neural networks. Time reduction, when applying parallelism to the support vector machines classifier, was not as big as in the case of decision trees and artificial neural networks. When a single classifier was used the ratios between the times needed for the training based on 200,000 labelled reviews were of about 1:45 (SVM:ANN) and 1:25 (SVM:DT). In the case of training an ensemble of ten members these ratios changed significantly to about 1:7 (SVM:ANN) and 1:5 (SVM:DT). At the same time the classification accuracy for the support vector machines slightly decreased while it slightly increased for the others. As expressed by the introduced $score_k$ measure, artificial neural networks and decision trees benefited from the application of parallelism most of all the examined classifier types.

Conclusion

In this paper, a method making the classification of large amounts of text data feasible was presented. The experimental testing of selected classification algorithms that worked in parallel as classification ensembles members demonstrated clearly viability of the suggested method when the number of text reviews leads to too high computational complexity, which is beyond the contemporary common PC's capabilities. Expectedly, the computational time was notably reduced to a certain degree with the increasing number of the classification ensemble members, namely for decision trees and artificial neural networks. With the increasing number of ensemble members, the time needed for training the classifiers was reduced dramatically, which made the entire

process feasible when using an ordinary PC. Classification accuracy and the values of other classification performance measures did not decrease (sometimes the results were even better), which is a positive finding.

The theoretical background of the presented method viability is supported by the analysis of the properties of the investigated data sets and their subsets. It was found that the processed text data had the characteristics needed for successful application of the proposed method based on the findings from ensemble categorization domain.

The algorithms and their results were, of course, driven by the specific experimental text data. However, such a data type (not too long users' or customers' opinions provided via web) appears very often. The results can be thus generalized for similar tasks. In the future work in the field of text mining, the parallel processing will certainly play even a more important role. The upcoming research will focus on processing data written also in different natural languages, analysing the impact of application of various pre-processing techniques (*e.g.*, stop words removal, stemming, spell checking), finding an optimal size of decision ensembles, and the investigation of the process of data division among the individual ensemble members.

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Assessment of Competitiveness of the Leading Russian Metallurgical Enterprises

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Abstract

This study assesses the competitive status of the leading Russian metallurgical enterprises. The authors have demonstrated that the imperfection of the applied ranking methodology does not allow to use the existing ratings in order to assess the competitiveness of businesses. Due to this, it is concluded that the assessment of the impact of recessionary effects on the performance of the largest domestic metallurgical companies could only be accomplished through the application of analytical methods for assessing competitiveness. The basic methods of assessing the competitiveness of enterprises were reviewed. The authors substantiated that the most appropriate method to assess the competitive status of several businesses was to use dynamic method of assessment of the competitiveness of enterprises. The mathematical apparatus of the dynamic method of assessment of the competitiveness of enterprises was provided; its methodological principles were revealed. The calculations of the level of competitiveness of the leading Russian metallurgical enterprises were provided. Their competitiveness both in the domestic market and in the international arena was estimated. Competitive advantages and disadvantages of the companies were identified, and the basic ways to increase their competitiveness were defined. In conclusion, the authors determined the areas of further research on the subject.

Key words: competition; competitiveness; competitiveness of the enterprise; assessment of competitiveness of enterprises; dynamic method of assessment of competitiveness of enterprises

JEL Classification: C13; D41

1. Introduction

In terms of macroeconomic instability and focus on import substitution, the issue of assessing competitiveness of the leading Russian metallurgical enterprises in relation to foreign competitors is very relevant. Conclusions about the success of the implemented measures to improve the competitiveness of domestic producers can only be made only on the basis of such an assessment.

At the same time, we should note that in order to assess the effectiveness of these measures, it is necessary to evaluate not just the level of competitiveness, but also the gradient of the change of the competitive status of the

business under the influence of the applied measures. Thus, it is necessary to estimate the dynamics of the level of competitiveness of the company in time to achieve this goal.

On the one hand, the dynamics of quotations of the company's securities on the stock markets can be used to assess competitiveness. At the same time, fluctuations in the stock value may fail to reflect changes in real competitiveness of the enterprise, as price volatility is often determined by market factors (geopolitical, technological, speculative, etc.).

This thesis can be proved by the example of a sharp increase in the stock quotations of Russian state-owned companies (Gazprom, FSK UES, ALROSA, Rosneft, etc.), which occurred in spring 2016 after the decision of the Russian Government to increase the dividends of state-owned companies to the level of at least 50% of profits (previously this value was at least 25%). Obviously, this decision leads to a significant reduction in the investment program of state-owned companies, which leads to a decrease in their competitiveness. At the same time, the increase in dividends led to an increase in stock profitability of these companies, so that the growth of their securities prices has ranged from 10 to 17% over a short period.

Thus, fluctuations in the exchange quotations of securities largely reflect changes in the expectations of the stock market participants regarding their investment attractiveness, rather than actual changes in the company's competitive potential. For this reason, the use of stock market indicators for the assessment of the competitive status of the business is incorrect.

Various ratings of the largest companies in the world, published by the world's leading news agencies – Forbes Global 2000 (Forbes 2016), Fortune Global 500 (Fortune 2016), Financial Times Global 500 (Financial Times 2016) – can also be considered a tool for assessing the competitiveness of enterprises at the international level. Nevertheless, we believe that an analysis of the level of competitiveness with the help of such ratings is impossible. The main reason for this is that most of the ratings are based on elementary ranking of companies by revenue volumes (or market valuation). Neither operational efficiency (profitability) nor financial stability is taken into account. As a result, positions of the companies in these ratings and their actual competitiveness may differ significantly. Thus, Mechel, SU-155, Transaero were among the best Russian companies in the rankings following the 2014 results. The headline-making bankruptcy of these businesses in 2015 eloquently demonstrates that the absolute revenue volumes do not always reflect the competitive status of the company.

In addition, ratings are very lean tools for an analyst in terms of development of measures to improve competitiveness. This is due to the fact that the rating does not provide an integral quantitative measure of the level of competitiveness, but only allows to use the enterprise position in the ranking list. Thus, these ratings do not allow to quantify the differences in the level of competitiveness between the two companies, which results in an inability to identify and analyze the factors of the formation and dynamics of competitiveness of the analyzed company.

Therefore, imperfection of the applied ranking technique does not allow to use the published ratings to assess and analyze the competitive status of the leading Russian metallurgical enterprises. This leads to the necessity to carry out analytical assessment of competitiveness rather than ranking, and this study will be devoted to this.

2. Choosing the method of research

Analysis of economic literature reveals the following key methods to assess the competitiveness of businesses:

- *Matrix methods* (based on the assessment of the company's product portfolio) (Arutyunova 2010);
- *Product methods* (based on the assessment of the competitiveness of the company's products) (Fatkhutdinov 2008);
- *Operating methods* (based on the assessment of the various components of the company's operations) (Faskhiev 2003);
- *Methods for business valuation* (based on the assessment of the market valuation of the company) (Krivorotov *et al.* 2013);
- *Dynamic methods* (based on the assessment of the company's key economic indicators over time) (Voronov 2001).

Analysis of the practical aspects of application of these methods allows to establish the lowest possibilities of practical application of most of them (for more detail see (Voronov 2013)). In particular, only the current level of competitiveness of one company (under study) can usually be determined as a result of their use. When it is necessary to determine the level of competitiveness of several businesses or to analyze the change in the level of competitiveness over several years, the solution of this problem is very complex and time-consuming procedure for most of the methods (Voronov 2015).

The exception is a dynamic method that allows for very effective assessment of competitiveness both under static conditions and over time. The use of this approach makes it possible to analyze time series of general and specific indicators of competitiveness of both individual companies and entire groups of enterprises. At the same time, the methodological basis for assessing the competitiveness of the business is so simple that it enables to conduct calculations for not only the current period (under study), but also with hindsight, which, in turn, allows to carry out a deep factor analysis of the change in competitiveness of the enterprise on the basis of the time series and forecast it in the future.

Therefore, use of a dynamic approach is most advisable for assessment and analysis of the competitiveness of the leading Russian metallurgical enterprises.

Let's briefly explain the essence of the approach and its mathematical apparatus. The dynamic method involves identification of key indicators of the business activity and application of dynamic analysis to them. Operational efficiency (profitability of economic activities), strategic positioning (change in market share) (RIM Porter 1998), as well as financial stability (liquidity) (Sheremet 2009) are considered as the key indicators of the company's activities. Further, by integrating these indicators into a single index, the level of competitiveness of the enterprise under study is assessed:

$$K = K_R \cdot K_I \cdot K_L \quad (1)$$

where: K is level of competitiveness of the enterprise under study; K_R is operational efficiency coefficient; K_I is strategic positioning coefficient; K_L is financial stability coefficient.

The operational efficiency coefficient is defined as follows:

$$K_R = \frac{R_A}{R_S} \quad (2)$$

where: R_A is operational efficiency of the enterprise under study; R_S is sample operational efficiency.

Let's clarify that a sample means the totality of the competitors, which is necessary and sufficient for comparison with the business under study. The sample may consist of a single competing enterprise – in this case, the individual indicator of competitiveness of the enterprise under study compared with the selected competitor is considered; of several competing enterprises – the competitiveness of the enterprise in comparison with a group of selected competitors is considered; of all the competing enterprises in the industry – here a sectoral indicator of the enterprise competitiveness in comparison with all existing enterprises in the industry is "established".

$$R_A = \frac{S_A}{E_A} \quad (3)$$

where: S_A is sales of the enterprise under study in the reporting period;
E_A is expenses of the enterprise under study in the reporting period.

$$R_S = \frac{S_S}{E_S} \quad (4)$$

where: S_S is sample sales in the reporting period; E_S is sample expenses in the reporting period.

Expenses refer to all expenses of the enterprise (including both direct costs and commercial, administrative and other expenses of the enterprise), as well as the collection of mandatory payments to the budgets of all levels not included in these categories of expenses. In general, the composition of expenses must satisfy the following condition: the net profit of the company sales net of expenses. We should note that depending on objectives of the

study and the presence of the original data, structure of expenses may vary. In particular, it is acceptable to take only operating costs as expenses in the analysis of the competitiveness of core activities.

Strategic positioning coefficient

$$K_I = \frac{I_A}{I_S} \tag{5}$$

where: I_A is index of changes in the sales of the enterprise under study in the reporting period;
I_S is index of changes in sample sales in the reporting period.

$$I_A = \frac{S_A}{E_{0A}} \tag{6}$$

where: S_A is sales of the enterprise under study in the reporting period;
$S_{0\,A}$ is sales of the enterprise under study in the preceding period.

$$I_S = \frac{S_S}{S_{0S}} \tag{7}$$

where: S_S is sample sales in the reporting period; $S_{0\,S}$ is sample sales in the preceding period.

Financial stability coefficient:

$$K_L = \frac{L_A}{L_S} \tag{8}$$

where: L_A is liquidity of the enterprise under study at the end of the reporting period;
L_S is sample liquidity at the end of the reporting period.

$$L_A = \sqrt{\frac{CA_A}{CL_A}} \tag{9}$$

where: CA_A is current assets of the enterprise under study; CL_A is current liabilities of the enterprise under study.

$$L_S = \sqrt{\frac{CA_S}{CL_S}} \tag{10}$$

where: CA_S is sample current assets; CL_S is sample current liabilities.

We must explain that the square root of the classical liquidity ratio is required in order to reduce the statistical variations of the values of the financial stability coefficient. Otherwise, due to the greater statistical variation, the value of liquidity becomes the main factor in shaping enterprise competitiveness indicator, which is not correct.

Then, in view of equations (2), (5) and (8), we obtain

$$K = \frac{R_A}{R_S} \cdot \frac{I_A}{I_S} \cdot \frac{L_A}{L_S} \tag{11}$$

The criterion values of the competitiveness coefficient can be determined as follows: the higher K, the more competitive the enterprise under study relative to the sample. When $0 < K < 1$, the competitiveness of the enterprise relative to the sample is low (the closer to zero, the lower competitiveness). When $K = 1$, the competitiveness of the enterprise is identical to the competitiveness of the sample. When $K > 1$, the competitiveness of the enterprise is higher than that in the the sample.

Considering equation (11), we should note that the numerator of this ratio contains indicators reflecting the efficiency of economic activities of the enterprise under study, while the denominator contains the efficiency of economic activities in the sample. Consequently, the numerator and denominator of equation (11) can be considered as integrated values reflecting the efficient use of economic resources of the business under study and the sample, respectively. This allows us to provide a general indicator of competitiveness of the enterprise in the context of matching objects.

Suppose

$$K_A = R_A \cdot I_A \cdot L_A, \quad (12)$$

where: K_A is coefficient of efficiency of use of resources of the enterprise under study;

$$K_S = R_S \cdot I_S \cdot L_S \quad (13)$$

where: K_S is coefficient of efficiency of use of resources of the sample.

Then the indicator of the competitiveness of the enterprise can be represented as follows:

$$K = \frac{K_A}{K_S} \quad (14)$$

The values of the coefficient of efficiency of use of resources cannot be strictly normalized. However, given that the value of each of the factors involved in the calculation of this coefficient in the aspect of ensuring the effectiveness has a desired value greater than one, it can be argued that the recommended value of the coefficient of efficiency of use of resources is also greater than one.

The expansion of the indicator of the enterprise competitiveness into matching objects in conjunction with the analysis of the dynamics of these indicators allows to draw conclusions about the main cause of the current level of competitiveness: the high efficiency of the business under study, low sampling efficiency, etc.

It is obvious that without taking into account the dynamics, even the value of the most important indicator does not allow to form a comprehensive picture of the process under study. Conversely, any information dynamics of the economic indicator makes the picture of the process much fuller. In methodological respect, a key principle of the dynamic approach is conducting calculations not only for the reporting period, but also for past periods. The resulting time series provide the representativeness of the data array and significantly improve the accuracy of the assessment of the competitiveness of enterprises.

3. Defining matching and analyzed objects

Once we have chosen the method of research, we need to determine analyzed objects and matching objects. Russian metallurgical enterprises whose competitiveness will be calculated and analyzed in the framework of this publication will be analyzed objects. At the same time, based on the research objectives, it is necessary to select the most competitive domestic companies as analyzed objects. Otherwise, the results of the assessment of the competitive status at the international level will not reflect the effectiveness of measures to improve the competitiveness of domestic metallurgists.

We should emphasize that the undertaken assessment of competitiveness is not the marketing research of the metallurgy market. We do not analyze the metals market conditions and prevailing market structure in this publication. We are interested in the dynamics of the leading domestic metallurgists.

Foreign competitors included in the sample (in terms of formulas (1)-(14)), in comparison with which the competitiveness will be assessed, will be matching objects. For the purpose of an objective assessment of competitiveness, it is necessary to take the companies that are most in competition with the object of analysis in terms of the range of products, geographic or other market segmentation, as well as scale of activities, as matching objects.

Competitiveness of the largest Russian metallurgical enterprises in comparison with domestic competitors was analyzed in detail in (Voronov 2016). Here we should note that it is necessary to distinguish between the ferrous and non-ferrous metallurgy companies, whose matching is not entirely correct by virtue of technology and assortment specificity. Therefore, we will further define two objects of analysis: in the ferrous and non-ferrous metallurgy.

The largest Russian producers of non-ferrous metals are RUSAL, Norilsk Nickel and UMMC. RUSAL specializes in aluminum, UMMC specializes in copper and zinc, and Norilsk Nickel specializes in nickel, palladium and copper. As such, they compete with each other to a very small extent. The only segment in the non-ferrous metallurgy where competition is observed is production of copper, where UMMC and Norilsk Nickel compete. At

the same time, revenue from sales of copper makes up only about 20% of Norilsk Nickel revenue (Norilsk Nickel 2016), so the said competition is not acute.

As such, it can be argued with a certain degree of conditionality that each of these enterprises holds "monopoly" position in the relevant Russian segment, whereby their competitive matching is not made. The mentioned does not mean that these companies can take advantage of their "monopoly" positions. As a global company, each of them is experiencing stiff competition from the world's leaders of non-ferrous metallurgy.

With regard to the definition of the object of analysis in non-ferrous metallurgy, the present study will carry out assessment of the competitiveness of Norilsk Nickel. This choice stems from the fact that this company is the most diversified by the structure of production, which is why we estimate Norilsk Nickel as having the highest competitiveness among Russian non-ferrous metallurgical enterprises.

The following companies are the main competitors of Norilsk Nickel in the world markets: Anglo American (UK), Vale (Brazil), Glencore (Switzerland) and BHP Billiton (UK). These competitors are taken by us as matching objects and will be included in the sample during the assessment of Norilsk Nickel international competitiveness.

Analyzing the market of ferrous metallurgy, we should note that the structure of this market is oligopolistic, and competition between steel producers is very intense. Therefore, in contrast to the non-ferrous metallurgy, it is quite correct to match the key market participants. To do this, let's refer to Table 1, which presents the results of calculations of the level of competitiveness of Russian enterprises of ferrous metallurgy (detailed calculations are carried out in (Voronov 2016)). We should explain that this table shows the values of the integral indicator of competitiveness of the enterprise according to equation (1). At the same time, the companies are ranked by descending level of competitiveness as of the end of 2015.

The calculations show that the clear current leader of the domestic steel industry is Novolipetsk Steel (hereinafter – NLMK), which demonstrates the high levels throughout the period under study (2012-2015) and is confidently ahead of all competitors following the results of 2014 and 2015. Severstal and Metalloinvest also show consistently high competitive status.

The competitiveness of other participants is unstable and fluctuates considerably from year to year. We should highlight the extremely low level of competitiveness of Mechel (since 2013). Since low competitiveness over the long period of time with a high probability implies the failure of the business, the bankruptcy procedure carried out at the moment towards Mechel seems quite natural.

Table 1. Competitiveness of Russian enterprises of ferrous metallurgy

No.	Company name	Level of competitiveness *(K)**			
		2012	2013	2014	2015
1	Novolipetsk Steel (NLMK)	1.370	1.742	2.148	2.409
2	Severstal	1.176	1.124	1.318	2.005
3	Metalloinvest	1.515	2.346	1.734	1.447
4	Magnitogorsk Iron&Steel Works	0.841	0.969	1.458	1.419
5	Chelyabinsk Pipe-Rolling Plant	0.591	1.060	1.262	1.113
6	Evraz	0.980	1.300	1.151	1.067
7	TMK	1.045	1.568	1.249	1.022
8	Mechel	0.812	0.279	0.159	0.150

Note: * Level of competitiveness of the enterprise is calculated according to equation (1).

Thus, we take NLMK as an object of analysis in ferrous metallurgy. The main competitors of the enterprise in the world markets are the following steel producers: Arcelor Mittal (Luxembourg), Nippon Steel (Japan), POSCO (South Korea) and Angang Steel (China). The listed companies are taken by us as matching objects and will be included in the sample during the assessment of NLMK competitiveness at the international level.

Assessment of competitiveness will be based on the annual figures for 2012-2015. The calculations will be based on the performance of the consolidated financial statements prepared according to international standards (IFRS, GAAP). The source of information was the financial statements officially published by the companies on their websites in accordance with current legislation, as well as on disclosure servers. To match the accounting

values, preliminary conversion into US dollars at market rates was made, if necessary (Investing 2016): balance sheet figures were converted at the exchange rate at the balance sheet date; indicators of income statements were converted at the average rate for the reporting period. Background information for the calculation of competitiveness indicators is presented in Tables 2-5.

Table 2. Income of the largest metallurgical companies in the world, USD mln.

Company	Reporting period			
	2012	2013	2014	2015
Non-ferrous metallurgy				
Norilsk Nickel	12,366	11,489	11,869	8,542
Anglo American	28,680	29,342	27,073	20,455
Vale	48,753	47,486	38,236	26,047
Glencore	214,436	232,694	221,073	170,497
BHP Billiton	70,477	53,860	56,762	44,636
Ferrous metallurgy				
NLMK	12,157	10,818	10,396	8,008
Arcelor Mittal	84,213	79,440	79,282	63,578
Nippon Steel	52,884	55,041	51,033	40,875
POSCO	56,467	56,511	61,804	51,403
Angang Steel	12,396	12,253	12,017	8,395

Table 3. Net profit of the largest metallurgical companies in the world, USD mln.

Company	Reporting period		
	2013	2014	2015
Non-ferrous metallurgy			
Norilsk Nickel	765	2,000	1,716
Anglo American	-961	-2,513	-5,624
Vale	585	657	-12,129
Glencore	-8,046	2,308	-4,964
BHP Billiton	11,223	13,832	1,910
Ferrous metallurgy			
NLMK	145	773	967
Arcelor Mittal	-2,545	-1,086	-7,946
Nippon Steel	2,422	1,949	1,211
POSCO	1,257	594	160
Angang Steel	125	151	-731

Table 4. Current assets of the largest metallurgical companies in the world, USD mln.

Company	Reporting date		
	31.12.2013	31.12.2014	31.12.2015
Non-ferrous metallurgy			
Norilsk Nickel	6,492	5,685	6,625
Anglo American	16,159	14,308	13,797
Vale	24,377	20,234	15,473
Glencore	53,656	53,219	42,198
BHP Billiton	18,953	22,296	16,369
Ferrous metallurgy			
NLMK	5,045	3,861	3,721
Arcelor Mittal	34,025	28,057	22,326
Nippon Steel	21,182	17,868	17,663
POSCO	30,144	29,827	24,815
Angang Steel	4,840	4,290	3,634

Table 5. Current liabilities of the largest metallurgical companies in the world, USD mln.

Company	Reporting date		
	31.12.2013	31.12.2014	31.12.2015
Non-ferrous metallurgy			
Norilsk Nickel	2,706	2,182	3,376
Anglo American	39,494	39,593	35,444
Vale	9,612	10,737	10,545
Glencore	45,825	43,947	40,872
BHP Billiton	20,139	18,064	12,853
Ferrous metallurgy			
NLMK	2,320	1,628	1,314
Arcelor Mittal	25,235	21,123	18,041
Nippon Steel	15,438	13,376	14,333
POSCO	19,268	19,999	17,119
Angang Steel	6,245	5,922	6,623

4. Assessment of competitiveness of Norilsk Nickel

Using the source data using equations (1)-(14), the calculation of competitiveness indicators for all enterprises of nonferrous metallurgy (by periods) was conducted. We should note that the indicators of expenses used in these formulas are calculated from the source data by finding excess of income over the value of net profit.

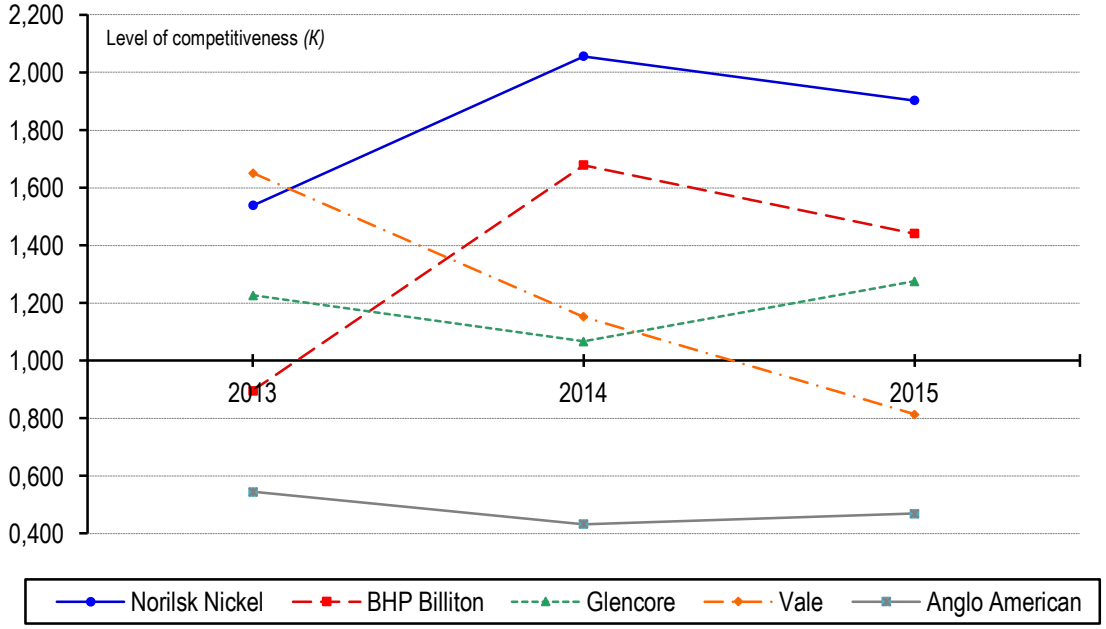
The results of calculation of the competitiveness level are presented in Table 6, where companies are ranked in descending order of values of the coefficient of competitiveness as of 2015 year-end. We should also note that for the implementation of the factorial analysis of competitiveness in the above table for 2015, not only the final competitiveness coefficients (K) are calculated according to equation (1), but also are operating efficiency coefficients (K_R, equation (2)), strategic positioning (K_I, equation (5)) and financial stability (K_L, eq. (8)).

Table 6. Competitiveness of the leading companies in non-ferrous metallurgy

No.	Company	2013	2014	2015			
		K	*K*	K_R	K_I	K_L	*K*
1	Norilsk Nickel	1.538	2.056	1.351	0.944	1.493	1.903
2	BHP Billiton	0.895	1.679	1.142	1.040	1.213	1.441
3	Glencore	1.227	1.067	1.109	1.036	1.109	1.275
4	Vale	1.651	1.152	0.702	0.884	1.311	0.813
5	Anglo American	0.545	0.433	0.827	0.992	0.571	0.469

These data suggest that Norilsk Nickel is the most competitive among the world's leaders of non-ferrous metallurgy. At the same time, the sources of its competitiveness are operational efficiency and excellent financial stability (values of the corresponding coefficients are substantially greater than one). Also, a high level of competitiveness is typical for BHP Billiton and Glencore. Vale and Anglo American, in contrast, have a low level of competitiveness. We should especially “note” Anglo American, whose extremely low level of liquidity makes the company uncompetitive. In order to analyze the dynamics of indicators of the analyzed companies, let’s turn to Figure 1.

Figure 1. Dynamics of competitiveness of the leading companies in non-ferrous metallurgy



Dynamics of the coefficients suggests that a high level of competitiveness is typical for Norilsk Nickel for the entire analyzed period. Moreover, there was a significant improvement in the competitive status of the company under study in 2014-2015 (24%). BHP Billiton also demonstrates a positive trend (61% increase). A significant loss of competitiveness in the analyzed period is typical for Vale (51%), while the level of competitiveness of Anglo American is consistently low.

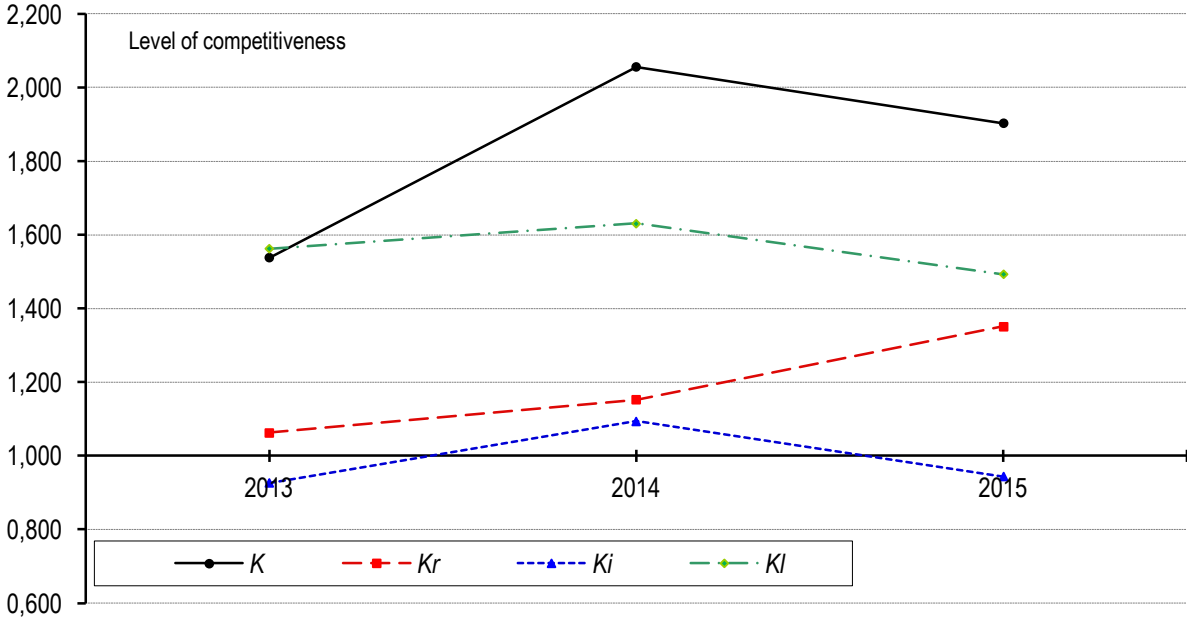
Next, let's carry out the factorial analysis of the competitiveness of the company under study, which will identify the main reserves of increasing the competitiveness of the business under study. As part of the dynamic approach, the detailed factor analysis is possible through the decomposition of the final competitive factor in terms of sources (K_R, K_I and K_L indicators – see equation (1)), as well as in terms of matching objects (indicators K_A and и K_S – see equation (14)). Source data for factor analysis of competitiveness are presented in Table 7.

Table 7. Norilsk Nickel competitiveness indicators

Indicator	Reporting period		
	2013	2014	2015
K_R	1.063	1.153	1.351
K_I	0.926	1.094	0.944
K_L	1.562	1.631	1.493
K_A	1.542	2.005	1.262
K_S	1.002	0.975	0.663
K	**1.538**	**2.056**	**1.903**

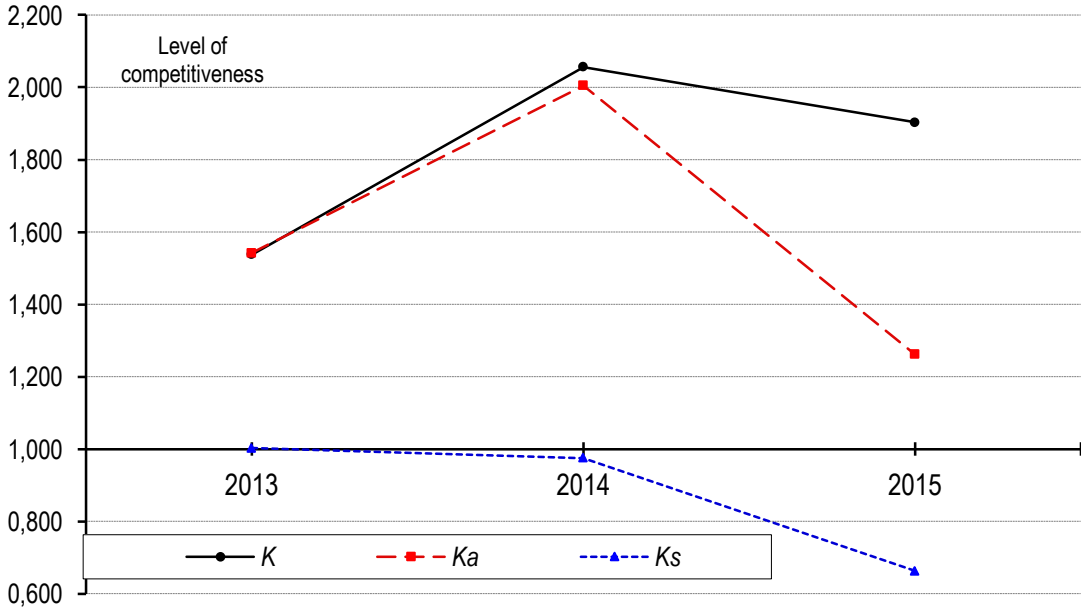
First, we will perform the decomposition of the competitiveness indicator by sources. The calculation results are reflected in Figure 2. Analysis of the results leads to the conclusion that the decrease in the level of competitiveness in 2015 was primarily due to a decrease in the level of strategic positioning of the company under study.

Figure 2. Dynamics of Norilsk Nickel competitiveness in terms of sources



Analysis of the indicators leads to the conclusion that Norilsk Nickel is characterized by very high liquidity over the analyzed period. We should also note a significant increase in the operating efficiency of the company, one of the drivers of which was the devaluation of the Russian currency, which took place in 2014 and 2015. However, the weakening of the national currency didn't impact the sales dynamics in the best way, which resulted in the strategic positioning decline. Thus, we should recognize the increase in sales as the main reserve for increasing the Norilsk Nickel competitiveness. Next, we will carry out the decomposition of the competitiveness indicator in terms of matching objects (see Figure 3). This will allow to isolate the factors of the enterprise competitiveness dynamics in terms of their localization: the company under study or a sample of competitors.

Figure 3. Norilsk Nickel competitiveness dynamics in terms of matching objects



Analysis of the dynamics of indicators leads to the conclusion that growth of competitiveness of the business under study in 2014 was due to the improvement of activities of the enterprise at the relative stability of the competitors' performance. In 2015, the opposite situation is observed: the turbulence on the world markets of non-ferrous metals led to a reduction in the coefficient of efficiency of use of resources of Norilsk Nickel by 37%, while the sample saw "only" 32% reduction, which resulted in a slight decrease of a final index of competitiveness of the company under study (by 7%).

Thus, the level of competitiveness of Norilsk Nickel can be considered high and with a tendency to further increase. The improvement of the strategic positioning of the company by carrying out measures to increase the volume of production and sales can be noted as a reserve for the growth of competitive advantages.

5. Assessment of competitiveness of Novolipetsk Steel

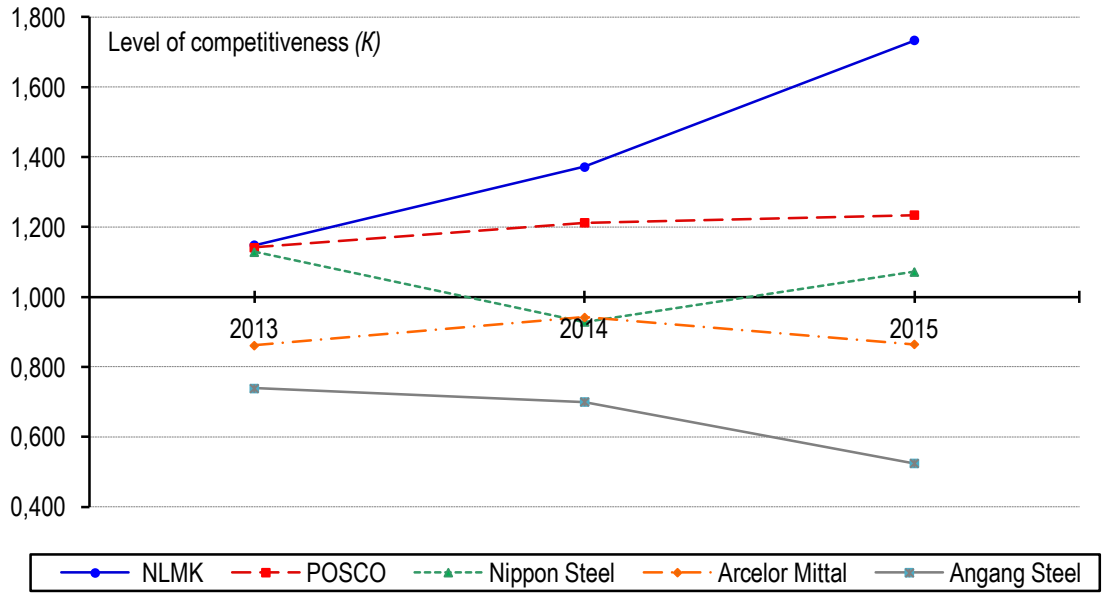
Using the source data (see Tables 2-5), the indicators of competitiveness of the enterprises of ferrous metallurgy were calculated (with breakdown by reporting periods). Competitiveness calculation results are presented in Table 8, where companies are ranked in descending order of values of the coefficient of competitiveness following the results of 2015.

Table 8. Competitiveness of the leading companies in the ferrous metallurgy

No.	Company	2013	2014	2015			
		K	*K*	K_R	K_I	K_L	*K*
1	NLMK	1.148	1.372	1.188	0.957	1.524	1.733
2	POSCO	1.141	1.212	1.057	1.051	1.111	1.234
3	Nippon Steel	1.129	0.928	1.090	0.997	0.987	1.072
4	Arcelor Mittal	0.862	0.942	0.876	0.998	0.989	0.864
5	Angang Steel	0.739	0.700	0.951	0.863	0.638	0.524

Presented data indicate a high level of NLMK competitiveness. At the same time, the main source of competitiveness is financial stability of the company. POSCO is also described by a high level of competitiveness. Nippon Steel has an average level of competitiveness. The competitiveness of Arcelor Mittal and Angang Steel can be described as low. In order to examine the dynamics of indicators of the companies under study, let's turn to Figure 4.

Figure 4. Dynamics of competitiveness of the leading companies in the ferrous metallurgy



Analysis of the data leads to the conclusion that the levels of competitiveness of NLMK, POSCO and Nippon Steel in 2013 were almost equal. Over 2013-2015, NLMK competitiveness increased by 51%, POSCO increased by 8%, while the competitiveness of Nippon Steel even suffered a decline of 5%. The levels of competitiveness of Arcelor Mittal and Angang Steel are low throughout the analyzed period.

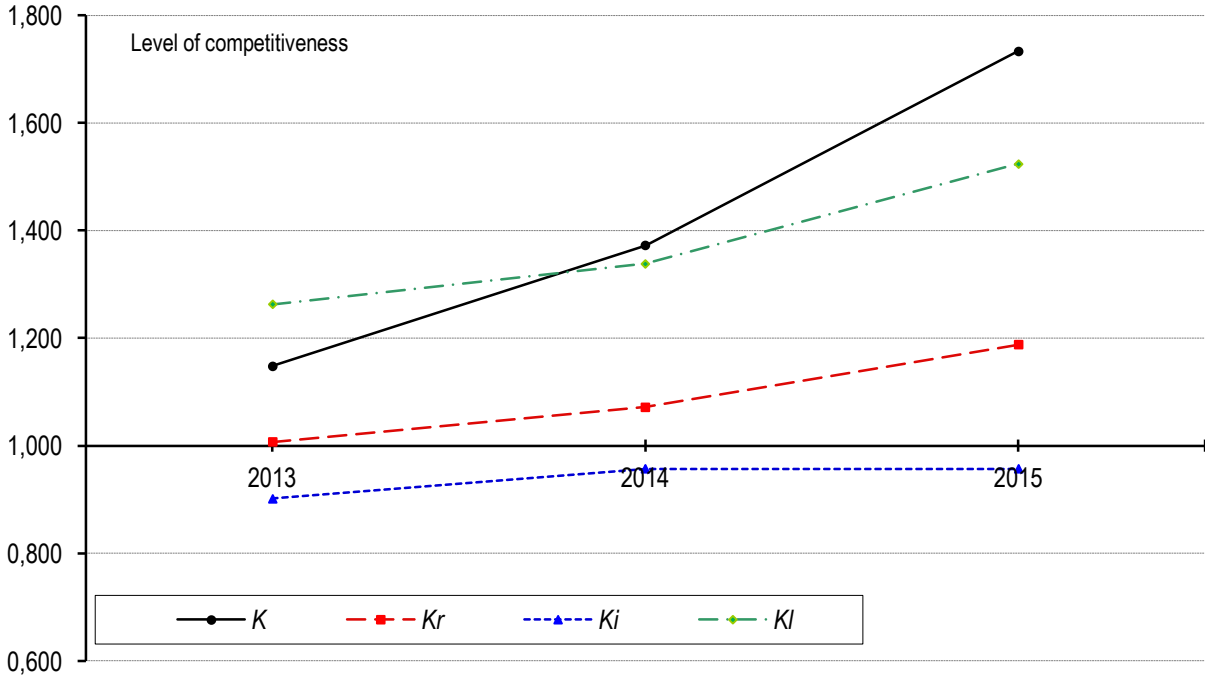
Next, we will carry out the factor analysis of NLMK competitiveness. Initial data for factor analysis of competitiveness are presented in Table 9.

Table 9. NLMK competitiveness indicator

Indicator	Reporting period		
	2013	2014	2015
K_R	1.007	1.072	1.188
K_I	0.902	0.957	0.957
K_L	1.263	1.338	1.524
K_A	1.330	1.599	1.474
K_S	1.159	1.165	0.851
K	**1.148**	**1.372**	**1.733**

First, we will carry out the decomposition of indicators of competitiveness by sources. The calculation results are reflected in Figure 5. Analysis of the results leads to the conclusion that the decrease in the level of competitiveness in 2013 was primarily due to a decrease in the level of strategic positioning of the company under study.

Figure 5. Dynamics of NLMK competitiveness in terms of sources



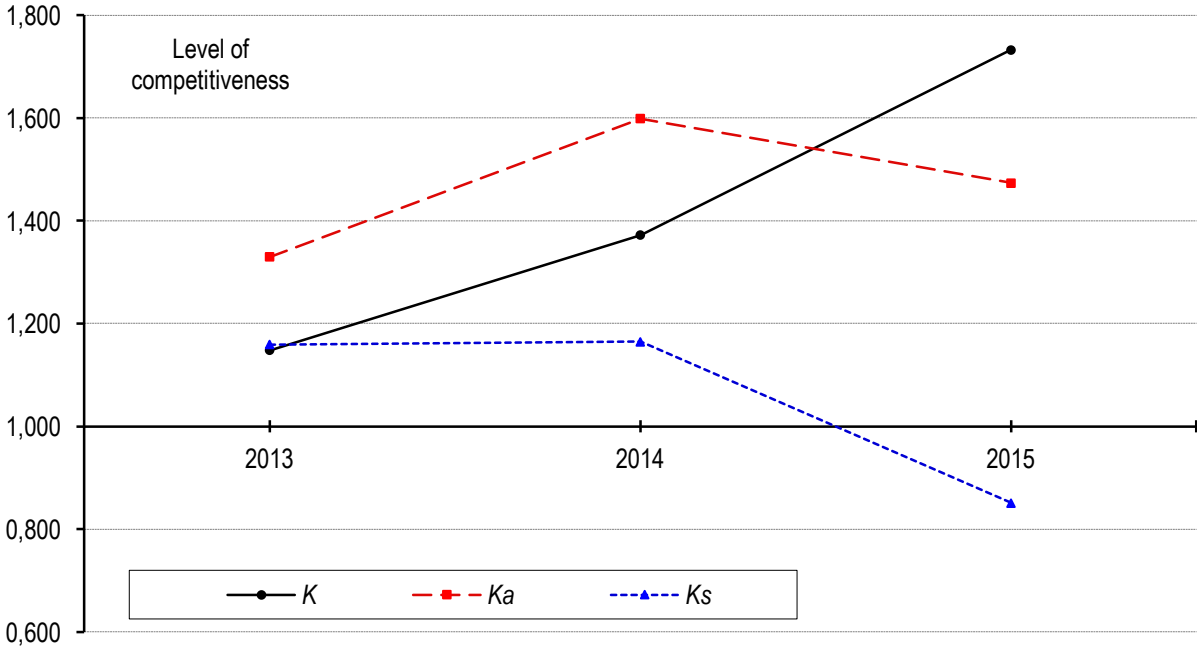
Analysis of the indicators leads to the conclusion that drivers of NLMK competitiveness growth in 2013-2015 were an increase in the level of financial stability (21%) and operational efficiency (18%). The level of strategic positioning in this case increases insignificantly (by 6%). We should note that devaluation did not cause reduction of the strategic positioning coefficient with respect to NLMK.

Next, we will carry out the decomposition of the competitiveness coefficient in terms of matching objects (Figure 6). Analysis of the presented data leads to the conclusion that NLMK competitiveness growth in 2014 was

caused by the improvement of the activities of the enterprise at the relative stability of the competitors' performance. In 2015, the situation on the world steel markets led to a decline in the efficiency of the use of resources of the company under study (by 8%). At the same time, deterioration in major international competitors has been so significant (by 27%) that it resulted in the increase in NLMK competitiveness (by 26%).

Thus, the level of competitiveness of Novolipetsk Steel should be recognized as high and with a pronounced tendency to further growth. The increase in sales volumes can be noted as a reserve for building competitive advantages.

Figure 6. Dynamics of NLMK competitiveness in terms of matching objects



6. Key findings of the study

Summarizing the key findings of the study, we can draw conclusions about the high competitiveness of the leading Russian metallurgical enterprises in comparison with the leading global competitors. This conclusion is valid both for non-ferrous and ferrous metallurgy. At the same time, the main sources of competitiveness of Russian companies are high financial stability and operational efficiency. Reserve of the growth of domestic companies lies in improvement in strategic positioning through measures to increase sales.

It is noteworthy that following the results 2015, in the conditions of a significant drop in demand in the world markets of raw materials (including metallurgical), the Russian metallurgists show growth in competitiveness. Thus, we can conclude that the measures to ensure the import substitution of the Russian economy reach their goal, resulting in the increase of competitiveness of domestic producers.

Conclusion

The implemented assessment of the competitiveness of the leading Russian metallurgical enterprises leads to the conclusion of the high competitiveness of domestic metallurgy. At the same time, the recession of the world markets of raw materials did not have a negative impact on the high competitive status of domestic metallurgists.

*In the applied aspect***.** The implemented analysis has shown that the level of competitiveness of Norilsk Nickel and NLMK in comparison with the world's leading competitors can be assessed as high and with a tendency to growth. At the same time, the main competitive advantage of Russian companies is high financial stability.

*In the methodological aspect***.** The implemented study has confirmed the universality of the dynamic method of assessment of the competitiveness of businesses. The dynamic approach does not only provide a quantitative assessment of competitiveness, but also allows to highlight the factors and sources of competitiveness of enterprises.

*In the promising aspect***.** The results of this research can be used to develop measures to improve the competitiveness of the company and industries, government regulation of the economy, investment analysis, etc.

We should note the relevance of assessing the competitiveness of other Russian industries among the areas for further research. In addition, the dynamic approach can be used to predict the competitiveness of the businesses under study.

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Today Situation in Online Buying of Food Products in the Czech Republic

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Abstract:

Actual news from abroad confirm that online buying is very frequent also in FMCG business. In the Czech Republic, iTesco.cz Rohlik.cz Koloniál.cz and Košík.cz are pioneers in this area. The newest trends are mapped by professional media, especially the digital ones. Although online buying in the FMCG segment has not reached so significant market shares as in United Kingdom or in France, this year the situation is expected to be changed dramatically. The iTesco concept prepares expansion in new regions and Rohlík.cz, already operating three quarters of year in Prague and surroundings, acquires new customers every week, Košík.cz has already started too and Koloniál.cz starts the sales at the beginning of the third quarter of 2015. The aim of the article is to present current situation in the area of online food products retailing in the Czech Republic and to outline the future development trends. This is a comprehensive study dealing with description of Czech online food products market and could be a first step for further research.

Keywords: food products; online buying; Czech Republic

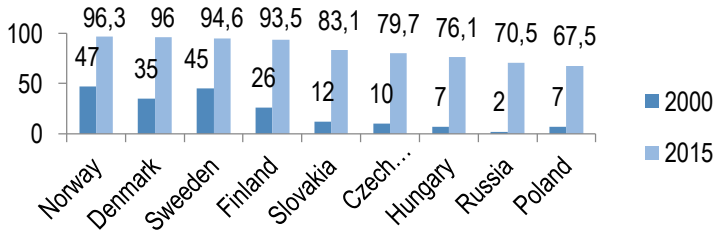
JEL Classification: L66; M31

1. Introduction

A goal of the study is to describe nowadays situation in the Czech market of online food products. The main research question is to find out, how many subjects operate on the Czech food products market and what products and services they do offer.

A prerequisite of food products online buying on the Internet is an information skill to use the Internet, which is expressed in Internet penetration in the population. The attached chart shows how the rate of Internet use has changed in chosen European countries. In the Czech Republic internet coverage increased from 10% in 2000 to 79.7% in 2015. In the group of 20 - 30years old people internet coverage is even higher than 90%. (Data are from the years 2000 and 2015.)

Figure 1. Internet penetration in the population in 2000 a 2015, in %



Source: http://www.internetworldstats.com/stats4.htm#europe

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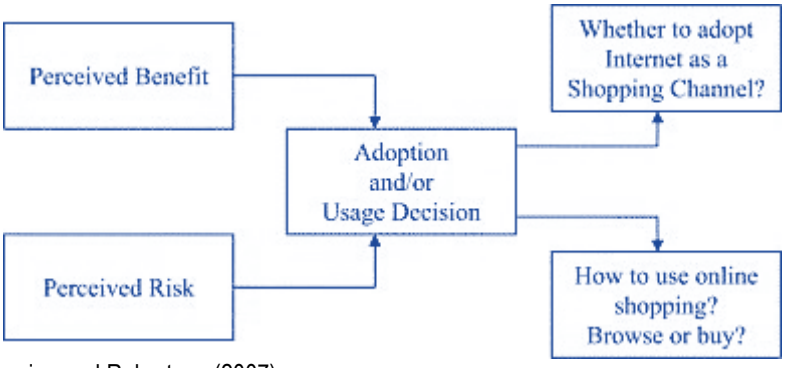
GfK company and its consumer panel analyzed how Czechs buy food on the Internet. It is a research finding, which is representative for the Czech population, and it was found out that the average Czech consumer buys food 5 times a year, 58% of respondents bought repeatedly and the average purchase accounted for 747 CZK (GfK Consumer Panel 2014).

How does the food products online shopping look like? This topic was analyzed by the company IGD (in Koubek, 2014), and their research shows that 40% of grocery e-shops users make basic regular purchases, 39% make large monthly purchases (usually after the pay packet), 10% more common basic purchases, 6% supplementary purchases and 4% occasional purchases.

But not only internet penetration is an important factor why customers use online buying more or less frequent. Soopramanien and Robertson offers conceptual framework for adoption and usage behavior of online shopping, which includes new variables, such perceived benefits, perceived values, adoption and/or usage decision, whether to adopt internet as a shopping channel and how to use online shopping and if browse or buy (2007).

Figure 2. Framework of adoption online shopping



Source: Soopramanien and Robertson (2007)

In the future there is obviously plenty of space in the Czech market for expansion of food products shopping on the Internet. According to the research Future Buy (2014), Czechs, when buying food online, evaluate this way of shopping as cool, simple, effortless, organized and safe, which corresponds with their high trust in e-shops in general. Among the advantages of online grocery shopping Czechs mention mostly good value, time-saving, wide choice of options and convenient delivery. Conversely, Czech consumers perceive as disadvantages the cost of delivery, they are also worried about the quality and freshness of the goods as well as they mention an obstacle when they are forced to wait for delivery of goods and merchandise they cannot see and try in advance in person. Also, the fear of a possible claim plays a big role (GfK FMCG e-Shopping, 2014).

2. Materials and methods

In this part authors would like to describe nowadays trends in the world market of food products online buying and what is the today´s situation in the Czech food products market.

A case study methodology (Yin 2003) was adopted as qualitative approaches are most appropriate to deeply investigate and understand complex phenomena, such as the one under investigation, as well as to develop hypotheses that later can be tested with confirmatory approaches. This case study was conducted according to the guidelines and suggestions for qualitative methodologies provided in relevant literature (Pratt 2009). It focuses on four online shops with food products. Data collection was carried out from web pages of each online retailer and further secondary data were collected from databases, reports and other publications (such as annual reports, newspapers, articles, master's theses, blogs about food issues, books produced about the company, etc.).

In the Czech Republic in 2015 operate four online shops with food products and all of them were put into our sample.

The share of food purchased on the Internet varies between countries. On the one side there are countries like South Korea and China, which, for example, offer a choice of food during a journey in the subway using smartphone and until they reach home, they can expect their purchase at the door. On the other side, Great Britain dominates in the share of online food products shopping in Europe and it is no accident that Tesco has pioneered this service in the Czech Republic too. Other European countries with the exception of France and the Netherlands show the share of online purchases only around one percentage point. For example, the largest Spanish retailer Mercadona company, focuses more on the sale of fresh products and private label food and its strategy of using online sales significantly.

The sales growth rate of food products on the Internet in 2014 and 2015 is interesting too. Between these years there was an increase in sales of food on the Internet around 34% in China, 22% in South Korea, 20% in Britain and 12% in France. In China, these services are most widespread in big cities such as Beijing, Shanghai and Guangzhou.

Table 1. Share of online purchases of food in total sales in 2014, in %

Country	%
South Korea	13.2
United Kingdom	6.0
France	4.3
Taiwan	3.9
China	2.6
Netherlands	2.1
Germany	1.4
Russia	1.2
Spain	1.2
Denmark	0.9
Czech Republic	0.8
USA	0.8
Poland	0.7
Belgium	0.6
Portugal	0.6
Slovakia	0.4
Brazil	0.2
Malaysia	0.2
Vietnam	0.2

Source: Kantar Worldpanel, Europanel, IRI US (2015)

In the future, experts expect that in 2025 the share of food purchased on the Internet should account for 10% in France, 10% in Britain, 15% in China and 30% in South Korea.

When we analyze the categories of frequently purchased products in online shops, we conclude that, depending on individual countries, these vary considerably. While in South Korea and China moist wipes, baby food, diapers, powdered milk and dog food are the most commonly purchased goods, in Europe mineral water, canned and wet wipes are at the forefront of the popularity. All these named products have one feature in common: they are typically of spatially bulkier packaging, which is more difficult to bring back home by public transport, so customers often choose the delivery of online shop. Therefore, this list does not contain fresh and basic foods. We also need to mention the finding that 55% of shoppers are still buying the same item repeatedly (Kantar 2015).

Research (Kantar 2015) also found out what are the main motivators for buying food online. In South Korea these are mainly savings in time, cost and the ability to shop using smartphone and its applications in China, consumers are also looking for competitive prices, home delivery service and a larger selection of products than is available in a physical store. European buyers also prefer saving time and home delivery service, which does not need to take special care, especially when buying heavy products. In the UK, consumers also look for e-shops,

which offer lower prices than classical stores and French consumers highly value the advantage of the availability of e-shops for 24 hours a day.

3. Case study: Current situation in the Czech Republic

Online shops with food productss have been moving from Prague to other and smaller cities. Among the leading companies we can mention the service "Potraviny online (Food productss online)" by Tesco, which expanded to the region of Benešov in March 2015 and now it serves already four millions of customers in seven counties of the Czech Republic. Tesco is shortly followed by the ambitious shop called "Rohlík.cz (Roll.cz)", which entered the second largest Czech city – Brno in July, whereas the other competitors have been planning similar steps.

The sales in the online food productss market are expected to reach up to 5.5 billion CZK this year. Last year Czech customers purchased online food productss in the total value of 4.3 billion CZK (including alcohol and tobacco) (ČTK 2015). According to newest information sources there are roughly 10 companies operating in the Czech food productss market sold online. The biggest competition can be found in Prague, followed by Ostrava, Brno or Jihlava.

The Tesco retail chain started its e-shop "Potraviny online" at the beginning of 2012, soon after that it expanded to Brno and to the other areas of South Moravia (Blansko, Hodonín), Central Bohemia (Mladá Boleslav, Kladno, Kolín, Nymburk, Kutná Hora) and other big cities, such as Hradec Králové, Pardubice, Liberec and Jablonec nad Nisou. The online service of Tesco had over 200,000 of registered customers in July 2015 (Aktuálně 2015).

If we look at the biggest iTesco.cz competitors, we need to mention mainly the specialized online shops such as Rohlík.cz. This company was established in September 2014 by the Miton and Enern groups and mainly by Mr. Tomáš Čupr, who is also the founder of Slevomat.cz or the service provider DámeJídlo.cz. Rohlík.cz expanded from Prague to Brno in July 2015, even though this should have happened in spring 2015 followed by expansion to other big Czech cities. For example, in Prague this shop completes more than 1,000 orders per day. Since spring 2015 we can observe the activities of another competitor – the e-shop Košík.cz, so far operating in Prague with almost seven thousand registered customers, who generate 70-110 orders per day (Aktuálně, 2015).

We also need to mention another ambitious project, called Koloniál.cz backed by the E-commerce holding, co-owned by the Rockaway group (which is owned by Mr. Jakub Havrlant and the Czech Media Invest company). Koloniál.cz has been in the market since June 2015 and the company is directed by Mr. Petr Vyhnálek, the former CEO of the Czech branch of the Globus retail chain. The main competitive advantage of Koloniál.cz should be the fact, that the company is supplied directly by producers. According to the newest information from Koloniál.cz it completes around several hundreds of orders per day.

The traditional retail chains consider starting their own e-shop, but they are rather reluctant, which means the lag between the above mentioned companies and the traditional food productss retailers is getting bigger and bigger. Of course, the project of a food productss e-shop is very demanding in terms of financing and logistics. For example, Billa, Kaufland, Lidl or Globus have expressed their intention not to step in the market of online shopping in the close future.

Besides the big players there are several smaller ones in the Czech Republic, such as My Food, which offers only durable food productss (and the logistics is performed by regular courier) in the area of Brno and 30 km around the city (it also owns a chain of classical shops).

Other companies to be mentioned are Z-Market, operating in Prague since 2001, satisfying around 100 orders per day. This company serves the area of Prague and the outskirt areas (up 30 km distance from the city), or Potravinydomu.cz, also operating in Prague (this shop has free transport in case the value of the purchase is over 990 CZK) (Potravinydomu.cz, 2015).

4. Comparison of the most successful food products retailers selling online

In the further text we will analyze and compare the most important/ successful food retailers selling online in the Czech Republic, namely the following ones: iTesco.cz, Rohlík.cz, Kolonial.cz and Košík.cz. In each of the case, the most important competitive strengths and weaknesses from the marketing perspective will be mentioned.

iTesco.cz

Strengths

iTesco.cz has a very wide and deep assortment (more than 20,000 items) (Tesco 2016). The online shopping service is available in many big and even smaller cities in the Czech Republic, therefore the accessibility of the service is perhaps the best in the country. Thus, in comparison with its competitors it has the biggest coverage within the Czech Republic and it can serve up to 4 mil. customers in 7 counties in the Czech Republic (Tesco 2016).

It is also important that there is not a financial limit, nor minimum in the value of the order, moreover customers can pick up the ordered goods personally in the Tesco shops (Tesco 2016). Tesco as a company has a great advantage in the brand awareness and it can gain a lot from its size, even though its reputation has suffered a lot recently due to the accounting scandals.

If we are to evaluate the graphical level and user friendliness of the iTesco web site, the result is rather positive. The displayed products are well depicted and described, on top of that iTesco.cz offers quite well organized and logical loyalty program for its customers (Tesco 2016).

Weaknesses

So far iTesco.cz does not allow to pay in cash for the online orders, which may restrict customers with limited banking skills as well as several age groups of citizens. Last but not least, we need to mention, that the delivery day and time are strongly dependent on the actual traffic and ordering situation and thus may vary a lot (Tesco 2016). In some cases the delivery time may last up to 24 days and is actually the longest from all the competitors compared. Moreover, the price/ fee for delivery depends on the capacity of the delivery vehicle and in what extent this is used (Jušková 2016).

Rohlík.cz

Strengths

One of the most important positive factor in this e-shop is the ease of the registration and very simple orientation at the e-shop´s web site. The company also concentrates on the food of higher quality, which slightly restricts its target audience, but on the other hand it allows the company to work with higher margins too. The company thus tries to capture the current trends in food retailing, such as the bio products or farmers´ food.

Shopping at Rohlík.cz is easy, as the company offers such a service, that customers can only send them a picture of their shopping list and the rest is done by the staff of the shop (Rohlík.cz).

The payment can be performed both in cash and by payment/credit card. Rohlík.cz is trying to guarantee fast delivery times (usually within 90 minutes after the order is sent), the costs of delivery are relatively low (from 29 to 99 CZK, in case the total purchase value is within 1,500 CZK) (Rohlík.cz, 2016). In comparison to its direct competitors it offers the actually the shortest delivery time.

Last but not least, we need to mention the service of cash refund, in case customers are not satisfied.

Weaknesses

The assortment of Rohlík.cz is not very wide and deep (currently around 5,000 items/SKUs) (Rohlík.cz, 2016), so, compared to its competitors, the assortment is rather average and substantially smaller than in the case of iTesco, cz, for instance.

And there is also one big disadvantage to be mentioned – the online order and delivery service is performed in the full extent just in the area of the capital Prague.

Koloniál.cz

Koloniál.cz is a relatively new e-shop, operating in the Czech market since the middle of the year 2015 (Jušková 2016). It offers around 7000 food items and 3000 non-food items currently and it is able to deliver goods in Prague and most of the big cities in Central, West, North and East Bohemia (Koloniál.cz 2016).

Strengths

Koloniál.cz uses a very nice and well laid out web sites, which make the orientation of the shopper quite easy. It has an average assortment and it can serve its customers in the biggest cities in Bohemia with the exception of South Bohemia. The delivery times are fairly fast in Prague (only) as well as the price of delivery, which is comparable to its competitors.

Weaknesses

This e-shop still can only offer the average number of items – compared to iTesco, for example. However, the company has been permanently listing more items in order to increase its assortment (internal information from Koloniál.cz, 2016).

On the other hand, there is still big space for improvement in the area of coverage of the delivery service – in the whole area of Moravia and South Bohemia. Based on the experience of some shoppers the delivery time even in Prague could be faster (Jušková 2016).

Last but not least, the customers would definitely appreciate the option of cash payment after delivery, which is offered by some of the competitors.

Košík.cz

Košík.cz is a relatively new e-shop, founded in spring 2015 with a wide range of products (in total 13,000 items/ SKUs), the offer contains both food products (around 75 %) and drugs/ non-food products (25 %) and the target of the company is to be competitive both by the wide and deep assortment and affordable prices. Košík.cz claims their prices are 10% lower than the prices of the direct competition (Košík.cz 2016).

Even though the service and products were initially only available in Prague, now the company is able to deliver another big city in the Czech Republic, namely for example Brno, Ostrava, Hradec Králové, Plzeň, Jablonec nad Nisou, Liberec, Teplice, Ústí nad Labem, Kladno and Beroun (Košík.cz 2016).

Strengths

Košík.cz has a very wide and deep assortment, even though iTesco.cz can still offer more products. It offers a wide variety of fresh food, meat, fish, bakery, fruit and vegetable.

Košík.cz is able to deliver in most of the biggest cities in the Czech Republic, both in Bohemia and Moravia. On top of that, it enables various forms of payment, such as the cash payment after delivery, or online payment after the order completion.

Another advantage might be a relative fast delivery time (around 3 hours) and also delivery free of charge in the case of any purchase in value over 1000 CZK.

Weaknesses

Košík.cz is growing very fast currently, trying to diminish any drawbacks in comparison with its competitors. In fact it could still offer wider and deeper assortment (like iTesco, for instance). Last but not least, the payment by card after delivery would be appreciated by most of its customers. And finally, the coverage of Košík.cz in South Moravia and South Bohemia is rather poor currently.

Table 2. Share of online purchases of food in total sales in 2014, in percent

Retailer/ e-shop	Assortment (No. of items)	Delivery time	Transport costs	Payment	Availability
Tesco.cz	20 000	Several hours	49 – 99 CZK	Online payment/Credit card after delivery	7 counties, 4 mil. potential customers
Rohlík.cz	5 000	Within 90 min	29 – 99 CZK, free of charge for purchase over 1,500 CZK	Credit card/ Cash after delivery	Prague
Koloniál.cz	10 000	On the same day (only in Prague) or day after (other cities), (based on choice/ situation)	29-49 in case of delivery on the same day and purchase below 1000 CZK, otherwise free of charge	Online payment by card after order completion, payment card after delivery in case of food sold by weight (fruit, vegetables, etc.)	Prague, Central, West, North and East Bohemia
Košík.cz	13 000	Within 60 min – 3 hours, or next day (based on own choice)	45 CZK if delivered on the same day and purchase below 1000 CZK	Online payment by card/ in cash after delivery	Prague, Brno, Ostrava, big cities in North, West, East and Central Bohemia, North Moravia

Source: authors

Conclusion

The paper is focused on the analysis of online buying of food products in the Czech Republic and on the description of nowadays trends in the Czech online market. Research shows that the average Czech consumer buys food 5 times a year, 58% of respondents purchased repeatedly with the average purchase in the value of 747 CZK. 40% of users of e-shops with food usually make basic regular purchases, 39% make large monthly purchases (after payment), 10% more frequent basic purchases, 6% supplementary purchases and 4% occasional purchases. In comparison with other analyzed countries, the share of online purchases in the Czech Republic is rather mediocre. Pioneers in internet food sales in the Czech market are concept online stores such as iTesco.cz, Koloniál.cz, Rohlík.cz and Košík.cz. The conventional retailers, however, are rather reluctant to enter the Internet market. If we are to compare the already existing food e-shops, iTesco.cz offers the widest range of available products (over 20,000 items) in comparison with Rohlík.cz - its assortment contains approximately 5,000 items. But Rohlík.cz and Košík.cz are the leaders in delivery time (no longer than 60 minutes in the case of Košík.cz and 90 minutes in the case of Rohlík.cz). These two online shops do not even charge transport costs (in case the purchase is over 1,000 CZK). Even though some of the e-shops still only operate in Prague (Rohlík.cz) the other ones expand to the other big cities in the Czech Republic, mainly in Bohemia and partly in Moravia, but some parts of the country, such as South Bohemia and South Moravia still remain uncovered (which is the case of Koloniál.cz and Košík.cz).

And what shall bring the future? It is quite hard to predict the further development of online food retailing. One of the visible trends is the further expansion of online food shopping from Prague to other big and even small cities in the regions, even though this process seems to be a little slower than it was expected. We still believe that the online food market will be extended by the entry of new competitors and the whole market will become more and more saturated. On the other hand, many competitors will certainly not survive in the long term and the market will tend to be rather concentrated, which is actually the same scenario as in the case of the traditional food retailers in most European countries. A questions remains, if and when the conventional retailers introduce online selling of food. The decisive factor, in our opinion, will be the speed and extend in the change of shopping behaviour of the Czech consumer.

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The Relationship between Research & Development Investment Expenditure, Foreign Direct Investment and Economic Growth: Panel Causality and Cointegration Analysis for G-7 Countries

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Abstract:

In this study, it is aimed to investigate the relationship between research and development (R&D) expenditures, foreign direct investment and economic growth over the period 1996-2011 in the sample of G-7 countries. In the empirical part of the study, Pedroni and Kao Cointegration Tests, Panel Granger Causality have been employed. It has been observed that the series are cointegrated in the long-run. As a result of the causality analysis, it is concluded that there is a unidirectional causality runs from foreign direct investments to R&D expenditures and to economic growth, there is a unidirectional causality runs from economic growth to R&D expenditures.

Keywords: R&D expenditures; G-7 countries; foreign direct investments; economic growth; panel causality; panel cointegration

JEL Classification: F21; O32; O47

1. Introduction

Today, income and economic growth differences between countries are based upon the current level of technology, skilled labor, natural resources, and economic stability phenomenon (Smith 1994). Even though countries are in different levels of development, they have similar macro objectives in the economic context (Erçakar and Karagöl 2011). Therefore, countries strive to develop new methods bothto have a say in the international arena and to ensure sustainable economic growth (Akıncı and Sevinç 2013). To achieve its growth targets and to ensure sustainable economic growth, world countries promote research and development activities (R&D) and foreign direct investment (FDI) (Göçer 2013). FDI is one of the most important factors that led to the globalization of the international economy (Erdal and Tatoğlu 2002). It is regardedfor many countries that FDI is a significant factor for development and growth strategy and these investments have a lot of numbers of impacts (Crespo and Fontoura 2007). FDI has numerous advantages for countries that are home to investment. These advantages include introduction of new technology, competition and increased efficiency in production, low cost and high quality manufacturing growth, and a positive contribution to production and employment (Göçer *et al.* 2012). FDI contributes to the accumulation of capital in the country (Ağayev 2010, De Mello 1999), and brings along abstract

inputs such as know-how, and brand and management knowledge. Moreover, FDIs generate a spillover effect through technology transfer (Zhang 2006). FDIs result in decreasing the limitations on foreign capital flows and facilitating capital inflows (Agenor 2001).

Another factor which is effective in increasing the dynamics of the economy and the globalization is R&D investment. The importance of this investment was emphasized by many scholars. For example, Romer (1989), Grossman and Helpman (1991), and Aghion and Howitt (1992) stated that increase in resources allocated to the creation of new technologies (R&D expenditures) has a significant contribution to the stabilization of economic growth. The most important factors behind the economic growth of developed countries are R&D and innovation activities (Stokey 1995). Currently, it is known thatcountries which allocate the highest share to R&D expenditures are the ones that have a voice in the world economy (Karagöl and Karahan 2014).

It is quite clear that countries which reserve and increase their share in R&D expenditurescould achieve significant accomplishments. For instance, it is observed that Asian Tigers[2] (East Asian countries) which give importance to R&D activities in recent times can acquire sustainable growth. R&D investments affect growth in many different ways. These ways involve innovation, capital accumulation, and qualitative increase in human capital (Bor *et al.* 2010). It is also inevitable for countries to adapt to the increasing competition in the world. Hence, ensuring the sustainable growth of the countries is greatly correlated with R&D investments (Erdil 2015).

Updating the production structure of the countries is bound to following technology. In this case, countries have two alternatives, they either import the current newest technology or they increase the present level of technology to the next level. Thus, R&D investment is of great importance. R&D activities are essentially investments that require substantial capital. It is known that many R&D investments held all over the world are realized by multinational corporations (Blomström *et al.* 2000). In this context, FDI can be regarded as one of the most important factors that affect the spread of cross-border technology (Kathuria 2008). However, FDI activities in R&D activities of many countries require a number of necessities especially including human capital, infrastructure, the presence of institutional quality, intellectual property rights etc. In this respect, developed countries are in a far better point than the other countries. Additionally, this can ensure FDI in developed countries to be active in R&D activities.

Furthermore, it is an undeniable fact that FDI all over the world mainly prefer developed countries. For example, UNCTAD data in 2014 reveals the fact that 40% of FDI was attracted by developed countries (UNCTAD 2014). The most important factors underlying this are higher levels of infrastructure of this country group, the existence of political and economic stability, and the existence of dynamic internal market etc. (Erçakar and Karagöl 2011).

In this sense, the purpose of this study is to analyze the relationship between R&D investment expenditure, foreign direct investment, and economic growth in the sample of G-7 countries, which are the best representatives of developed country group. Based on the previous studies, it was found that the literature on this topic focuses basically on R&D-growth or FDI-growth relationship. Therefore, this study is differentiated from the others in that it firstly examines the existing literature and then policy recommendations in light of the findings are given in the application part.

2. Literature review

2.1. Studies on the effects of reserch & development investment spending and economic growth

Recently, many empirical analyses were conducted about the relationship between R&D investment spending and growth. Literature on this relationship is summarized in Table 1. In a general sense, these studies suggested that there is a causal relationship from R&D investment spending and growth. This means that R&D spending of countries result in economic growth.

[2]South Korea, Hong Kong, Singapore, Indonesia, Malaysia, Taiwan and Thailand, see. Papageorgiou and Spatafora (2012).

Table 1. Literature summary on R&D investment spending and economic growth

Authors	Sample	Method	Findings
Sylwester, K. (2001)	20 Members of OECD	Multivariate regression model	While there was no correlation between R&D spending and growth in 20 countries of OECD, it was found out that while R&D spending of G-7 countries that are members of the OECD increased, economic growth also increased.
Falk, M. (2007)	15 Members of OECD	Panel GMM	Increase in R&D investmentresult in increase in GDP.
Altın, O. and Kaya, A. (2009)	Turkey	VEC Method, Granger Causality	In the short term, although there is no correlation between Research and Development grants and growth, there is causality from R&D to economic growth in the long term.
Yaylalı, M. Alkan, Y. Işık, C. (2010)	Turkey	Johansen Cointegration, Granger Causality	While it was concluded that there was causality from R&D grants to growth, there was no relationship from growth to R&D grants.
Genç, C. Atasoy, Y. (2010)	34 Countries	Panel Causality	It was concluded that there was causality from R&D grants to growth.
Korkmaz, S. (2010)	Turkey	Johansen Cointegration	Increase in R&D spending raises economic growth.
Gülmez, A. Yardımcıoğlu, F. (2012)	21 OECD countries	Panel Cointegration, Panel Causality	Study results suggested that a 1% increase in R&D grants result in 0,77% growth in the long term.
Akıncı, M. and Sevinç, H. (2013)	Turkey	Johansen Cointegration, Granger Causality	Study results suggested that while there was causality from R&D grants to growth, there was no cointegration relationship between the series.
Meçik, O. (2014)	OECD Countries	Cobb-Douglas, Hausman Panel Data Analysis	It was found out that positive effects on economic growth are based on labor, capital and R&D spending.

2.2. Studies on the effects of research & development investment spending and foreign direct investment (FDI)

It was found out that very few studies were conducted about the relationship between R&D investment spending and foreign direct investment. Relevant literature is given in Table 2.

Table 2. Literature Summary on R&D Investment Spending and Foreign Direct Investment

Authors	Sample	Method	Findings
Barrell, R. and Pain, N. (1997)	Germany and England	Long-term cointegration analysis	The increase of international trade routes resulted in the increase of the activities of foreign investors. In addition to these increases, it was proposed that the future of technological products and therefore technological advances would increase.
Xiaohui, L. and Chenggang, W. (2003)	China	EKK Method, Chow Test	According to the findings of this study, Foreign Direct Investment is regarded as a way of promotion of technological products to the host countries. Thereby, FDI positively affects the technological advances in host country.
Simon, F. and Yifan, H. (2007)	China	ROBUSTLS	Analysis results suggested that if a company is supported by FDI, initially their R&D spending is decreased. As FDIs at sector level have more foreign presence, more positive results than the efforts of companies on R&D spending were obtained.

Authors	Sample	Method	Findings
Zhang, K.H. (2014)	China	Panel Data Analysis	It was concluded that as China's industrial competitiveness increased, FDIs became driving force behind their industrial performance. Additionally, it was found out that FDI and technology transfer have positive expansion on economy.
Erdal, L. and Göçer, İ. (2015)	10 Developing Countries in Asia[3]	Panel Causality and Cointegration	Analysis results suggested that an increase in R&D and innovation activities was observed with the entrance of FDI to the country. Moreover, FDI also increased national wealth with high-tech exports.

2.3. Studies on the effects of economic growth and foreign direct investment (FDI)

Studies conducted about the relationship between foreign direct investment (FDI) and economic growth differ from one another in terms of methods and findings. In this sense, direction of the correlation between these variables is mainly based upon the characteristics of countries that are to be invested in. The most basic reasons involve capital level, income level, and the level of sophistication of the financial system of the host country. Relevant literature is given and summarized in Table 3.

Table 3. Literature summary on economic growth and foreign direct investment

Authors	Sample	Method	Findings
Borensztein, Gregorio and Lee (1998)	Sample of 69 developing countries	Panel Data Analysis	Increase in the FDI activities of the countries with income levels above a certain level resulted in positive effects on economic growth.
De Mello (1999)	32 Non-Member Countries of the OECD	Panel Data Analysis	It was found out that the effects of FDI on economic growth are dependent on domestic investments as well as complementarity and degree of substitution.
Nair-Reichert and Weinhold (2001)	24 developing countries	Panel Causality Analysis	According to the analysis results involving Turkey, the effects of FDI increase in the countries with the liberal economic policies on economic growth is more than those with no liberal economic policy.
Assanie and Singleton (2002)	67 developing countries	Panel Data Analysis	While positive results about FDI's effect on economic growth were obtained in countries with income levels above a certain level, no meaningful and significant results were found in countries with income levels below a certain level.
Mencinger (2003)	8 European Countries[4]	Granger Causality Analysis	Findings suggested in this study that there was causality relationship from foreign direct investment to economic growth.
Şimşek and Behdioğlu (2006)	Turkey	Cobb-Douglas production function - Correlation Analysis	Increase in foreign direct investment resulted in positive economic growth.
Alagöz, Erdoğan and Topallı (2008)	Turkey	Granger Causality Analysis	Study conclusions indicated that while there was no causality relationship between FDI and growth in the period between 1992 and 2007, regression analysis conducted for the period between 2002 and 2007

[3] China, South Korea, India, Iran, Pakistan, Malaysia, Singapore, Thailand, Saudi Arabia, Turkey
[4] Czech Republic, Hungary, Latvia, Estonia, Lithuania, Slovenia, Poland and Slovakia

Authors	Sample	Method	Findings
			suggested that there was correlation between FDI and economic growth.
Afşar (2008)	Turkey	Granger Causality Analysis	According to study results covering the period between 1992 and 2006, while there was causality from growth to FDI, no causality from FDI to growth was found.
Örnek (2008)	Turkey	Granger Causality Analysis -Johansen Cointegration	Study results concluded that short-term capital inflows and FDI had positive impacts on economic growth.
Mucuk and Demirsel (2009)	Turkey	Granger Causality Analysis -Johansen Cointegration	As a result of the study conducted about the relationship between FDI and growth in the period between 1992 and 2007, it was found out that there was bidirectional causality between these variables and FDI affected growth more.
Esso (2010)	10 African Countries	Toda-Yamamoto Causality - ARDL Bound Testing	In some of the sample countries, a positive long-term correlation between these variables was found. Moreover, it was concluded that there was causality relationship in some of the sample countries, while the other countries had the exact opposite relationship.

4. Empirical analysis

4.1. Data and Method

In this study, data on GDP, foreign direct investment, and R&D grants of 7 countries in the period between 1996 and 2011 was used. GDP data of the countries was derived from Penn World Table (version 8.1), and FDI and R&D data series were taken from World Bank Indicators (WDI). GDP series was included in the analysis by taking its logarithm, while logarithmic conversion was not conducted because FDI and R&D series were used in their percentage of gross domestic product (GDP).

4.2. Method

The methods used for panel data analysis were used in this study. The relationship between the variables of economic growth, foreign direct investments, and R&D spending is analyzed by the following model:

$$GDP_{it} = \alpha_i + \beta_i FDI + \theta_i RD + \varepsilon_i, \qquad i = 1,2,\dots\dots N, \quad t = 1,2,\dots\dots T, \qquad (4.1)$$

In this equation, GDP_{it} represents economic growth in year *t* in *i* country, and *FDI* stands for foreign direct investments (stocks denominated) in the country, while *RD* expresses R&D spending. Additionally,*i=1,2,…N* represents *N* number of cross section unit dimension, *t=1,2,….T* stands for time dimension, ε_i expresses error term, while α represents unobservable effects, and β and θ express cointegration coefficients.

Because of the fact that panel cointegration test was conducted to analyze long-term relationships between the variables in this study, firstly unit roots and their stationarity are controlled. Next, panel cointegration test was conducted and then panel causality analysis was done to identify the direction of causality.

4.3. Panel stationary tests

Before conducting the panel cointegration analysis, the variables of GDP, FDI, and R&D variables are subjected to unit root tests with the purpose of controlling for the stationary of the series. In this study, panel unit root test ofIm, Peseran and Shin (IPS) (2003), which is called as first generation unit root test, was used.

IPS panel unit root test equation is expressed above;

$$\Delta y_{it} = \alpha_i + v_i + \beta_i y_{it} + \sum_{j=1}^{k} \alpha_j \Delta y_{it-1} + \varepsilon_{it}, \quad (4.2)$$

where: Δ is a first-difference operator, y is the series whose stationary is controlled, α_i *and* v_i represent fixed effects and time impacts. In IPS unit root test, null hypothesis is "for each *i* (in all cross-sections)",

H_0:β_i=0 unit root

and the alternative hypothesis is that "for some *i*'s (at least in one cross-section)",

H_1:β_i<0 no unit root

While acceptance of the null hypothesis represents that each of the cross-sections is not fixed, accepting thealternative hypothesis means that one or more than one of the cross-sections in the panel data analysis are fixed (Im *et al.* 2003, 60-62).

Table 4. IPS panel unit root test results

Variables	Level				Primary Differences			
	Fixed		Fixed & Trend		Fixed		Fixed & Trend	
	IPSStat.	P value	IPS Stat.	P value	IPS Stat.	P value	IPS Stat.	P value
FDI	-0.6429	0.2601	-0.75883	0.2240	-8.36300	0.00*	-7.01842	0.00*
RD	0.4000	0.6554	1.62957	0.9484	-2.61849	0.0049*	-2.18763	0.0143**
GDP	-1.2882	0.0988	2.50269	0.9938	-3.68718	0.0001*	-1.04095	0.1489

Note: * shows that the series is 1% significant, and ** represents 5% significance. Modified Akaike Information Criterion (MAIC) was used in the selection of lag length.

Table 4 shows IPS panel root test results. As a result of the analysis, it was concluded that the series are not fixed based on the unit root test findings of IPS fixed and fixed-trend model involving the series of FDI, RD, and GDP, and the series became stationary after taking the difference.

4.4. Panel cointegration analysis

In this study, panel cointegration test, which was developed by Pedroni (1991, 2004), was used with the purpose of analyzing the long-term relationship between foreign direct investment and R&D spending. Additionally, panel cointegration test developed with the help of DF and ADF tests by Kao (1999) was used. Based on Pedroni's approach, regression model is to be predicted byLeast Squares Method.

$$y_{it} = \alpha_i + \beta_i t + \delta_i z_{it} + \varepsilon_{it} \quad (4.3.)$$

In this equation,*y* is dependent variable coefficient, *z* is explanatory variable coefficient, α_i represents fixed effects, and *t* is trend. It is estimated in the equation that dependent and explanatory variables are stationary in the first degree. Hypotheses of Pedroni's approach can be expressed as follows: (Pedroni 2004, 599).

H_0: There is no cointegration for all cross-sections

H_1: There is cointegration for all cross-sections

To test Pedroni's hypotheses, first four statistics are based on pooling along within-dimension whereas the last three tests rest on pooling along between-dimension. These tests are shown as follows: (Asteriou and Hall 2007, 374-376)

1) The panel *v* statistic:

$$T^2N^{3/2}Z_{v\hat{}NT} = \frac{T^2N^{3/2}}{(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it}^2)} \quad (4.4)$$

2) The panel *ρ* statistic:

$$T\sqrt{NZ_{\hat{\rho}NT}} = \frac{T\sqrt{N}(\sum_{i=1}^{N}\sum_{i=1}^{T}\hat{L}_{11i}^{-2}(\hat{u}_{it-1}^{-2}\Delta\hat{u}_{it}^{-2}-\hat{\lambda}_i}{\sum_{i}^{N}\sum_{i}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it}^2} \quad (4.5)$$

3) The panel *t* statistic (non-parametric):

$$Z_{tNT} \equiv \sqrt{\tilde{\sigma}_{NT}^2\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it-1}^{*2}}\,(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,(\hat{u}_{i,t-1}\Delta\hat{u}_{i,t}-\hat{\lambda}_i)) \quad (4.6)$$

4) The panel *t* statistic (parametric):

$$Z_{tNT} = \sqrt{\tilde{\sigma}_{NT}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\hat{u}_{it-1}^{*2}}\,(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\,(\hat{u}_{it-1}^{*2}\Delta\hat{u}_{i,t}^{*2}-\hat{\lambda}_i)) \quad (4.7)$$

5) The group *ρ* statistic (parametric):

$$T\sqrt{N}\bar{Z}_{\hat{\rho}NT} = T\sqrt{N}\frac{\sum_{t=1}^{T}(\hat{u}_{it-1}^2\Delta\hat{u}_{it}^2-\hat{\lambda}_i)}{\sum_{t=1}^{N}(\sum_{t=1}^{T}\hat{u}_{it-1}^2)} \quad (4.8)$$

6) The group *t* statistic (non-parametric):

$$\sqrt{N}\bar{Z}_{\hat{\rho}NT-1} = \sqrt{T}\sum_{i=1}^{N}(\sqrt{\hat{\sigma}_i^2\sum_{t=1}^{T}\hat{u}_{it-1}^2})\sum_{t=1}^{T}(\hat{u}_{it-1}^2\Delta\hat{u}_{it}^2-\hat{\lambda}_i) \quad (4.9)$$

7) The group *t* statistic (parametric):

$$\sqrt{N}\bar{Z}_{tNT-1}^{*} = \sqrt{T}\sum_{i=1}^{N}(\sqrt{\hat{s}_i^{*2}\sum_{t=1}^{T}\hat{u}_{it-1}^{*2}})\sum_{t=1}^{T}(\hat{u}_{it-1}^{*2}\Delta\hat{u}_{it}^{*2}) \quad (4.10)$$

Moreover, the other panel cointegration test which was used in this study is Kao Cointegration Test. Kao (1999) presented DF and ADF-type tests for cointegration in panel data (Baltagi and Kao, 2000: 13). Kao co-integration model is expressed as below (Asteriou and Hall 2007, 372).

$$Y_{it} = \alpha_i + \beta X_{it} + u_{it} \quad (4.11)$$

Hypotheses of this method are:

H_0 =There is no cointegration between the series

H_1 = There is cointegration between the series

Table 5. Pedroni cointegration test results

Alternative Hypothesis: Mutual AR Coefficient (Within-Dimension)				
	Statistic	Prob.	Weighted Statistic	Prob.
Panel v-Statistic	-0.873087	0.8087	-0.680892	0.7520
Panel rho-Statistic	0.296592	0.6166	-0.024632	0.4902
Panel PP-Statistic	-1.248464	0.1059	-1.876072	0.0303**
Panel ADF-Statistic	-1.382252	0.0834	-2.060871	0.0197**
Alternative Hypothesis: Different AR Coefficient (Between-Dimension)				
	Statistic		Prob.	
Group rho-Statistic	0.842047		0.8001	
Group PP-Statistic	-3.087848		0.0010*	
Group ADF-Statistic	-3.140920		0.0008*	

Note: Test results belong to fixed models. * is 1% and ** is 5% significance level.

Table 6. Kao cointegration test results

	t statistic	Prob.
ADF	-2.669085	0.0038*
Residual variance	0.000136	
HAC variance	0.000196	

Note: * means 1% significance level. Barlett Kernel method was used in Kao cointegration test and the bandwidth was identified by Newey-West method.

Having researched the long-term relationship between R&D spending, foreign direct investment, and economic growth in G-7 countries context, it was concluded that the hypothesis "H_0: there is no cointegration for all cross-sections" based on Pedroni's cointegration testwas rejected. According to test results, while the Panel PP-Statistic and Panel ADF-Statistic are 5% significant, the Group PP-Statistic and the Group ADF-Statistic are 1% statistically significant. In a general sense, it can be suggested that there is cointegration relationship between the series based on both panel and group statistics. On the other hand, according to Kao cointegration test, the hypothesis "$H_0 =$ There is no cointegration between the series" was rejected. Additionally, the existence of cointegration relationship between the series at 1% significance was found out based on the same test results. These results consequently deduce the fact that R&D spending, foreign direct investment and economic growth variables are in correlation in the long run, and they have a long-term relationship.

4.5. Panel causality analysis

After the cointegration test analysis, Granger causality test was used to identify the direction of the relationship between the series. Simple causality test developed by Granger is shown below:

$$Y_t = \sum_{j=1}^{m} c_i X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t \quad (4.12)$$

According to this model, if the X variable is the cause of Y, changes occurring in Y comes after the changes occurring in X. Granger causality analysis claims that variables must be made to be stationary in advance (Granger 1969, 431).

In this study, panel causality analysis developed by Holtz-Eakin, Newey and Rosen (1988) is used. The method used by Holtz-Eakin et al. (1988) is the Least Squares Method. Holtz-Eakin *et al.* (1988) model is defined below:(Holtz-Eakin *et al.* 1988,1373).

$$Y_{it} = \alpha_{0t} \sum_{l=1}^{m} \alpha_{lt} Y_{it-l} + \sum_{l=1}^{m} \delta_{lt} X_{it-l} + \psi_t f_i + u_{it} \quad (4.13)$$

where: f_i= fixed effects u_{it}= error term Y_{it} and $error$ $term$ $u_{it}$are correlated.

The model in which the difference was taken is shown below.

$$Y_{it} - Y_{it-1} = a_t + \sum_{l=1}^{m} \alpha_t (Y_{it-1} - Y_{it-l-1}) + \sum_{l=1}^{m} \delta_1 (X_{it-1} - X_{it-l-1}) + v_{it} \quad (4.14)$$

As seen in this equation, there is correlation problem between dependent variable and error term. Therefore, panel causality test suggested by Holtz-Eakin *et al.* (1988) is conducted through a two-step Least Squares Method (Ağayev 2010, 173).

The hypothesis of this causality analysis is as follows:

$H_0 = \alpha_0 = \alpha_1 =, \ldots \ldots, \alpha_m = 0$

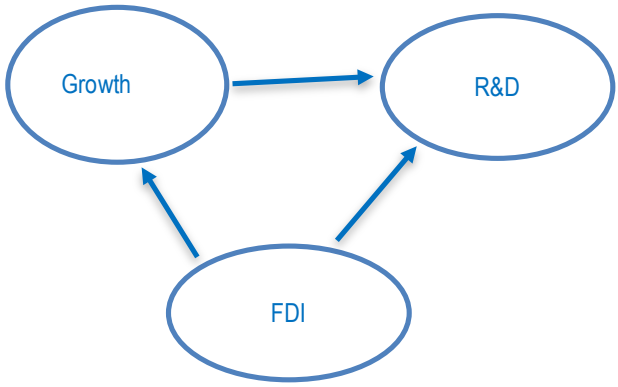
If H_0 hypothesis rejected, this means that there is causality relationship between the variables.

Table 7. Panel causality analysis

	F Stat.	Prob.
DRD→DGDP	1.03693	0.3111
DGDP→DRD	18.4479	0.0000*
DFDI→DGDP	27.6525	0.0000*
DGDP→DFDI	0.20247	0.6538
DFDI→DRD	9.56352	0.0026*
DRD→DFDI	0.05581	0.8138

Note: * is 1% significance level.

Figure 1. Visualization of causality analysis



Source: Prepared by the author

Analysis findings conclude that there is causality relationship from economic growth to R&D spending, from foreign direct investment to economic growth, and from foreign direct investment to R&D spending at 1% significance level.

Conclusion

In the globalizing world economy, it is widely accepted by many scholars that R&D spending and foreign direct investment are two significant actors for the countries to maintain their growth. This paper studied the effects of both of these variables on growth in the sample of G-7 countries which can greatly represent developed countries. As a result of the empirical findings, it was found out that R&D spending and foreign direct investment are correlated with growth. Moreover, theshort term relationships of each three series were examined. Findings showed that there is one-way relationship from growth to R&D spending, from foreign direct investment to both growth and R&D spending. In this respect, one can claim that there are many lessons to learn from this context for the developing countries. No one can deny that R&D spending is basically quite costly. Especially for developing countries, it is not always easy to increase R&D spending. Hence, it is significant to promote foreign direct investment in their countries. However, foreign direct investment of R&D in a developing country brings a number of requirements. In particular, measures of the elimination of lack of infrastructure, increasing the superstructure facilities, guaranteeing the intellectual property rights, and increasing the quality of human capital need to be taken. Steps taken for this direction can both promote foreign capitals in the developing countries to invest in more qualified fields and help the country grow by means of these investments. All in all, R&D investment of foreign capital can end up in the manufacturing of products which could not be produced previously. Also, many economic benefits can be obtained through the spillover effects in the economy of a country.

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Assessment of the Economic Potential of Sovereign Wealth Funds

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Abstract:

Being the total of the state funds, sovereign wealth funds are generally accumulated in budget revenues as the surplus from sale of fossil fuels or non-oil and gas resources and aim to achieve specific macroeconomic goals set. Applying the method of correlation analysis, we evaluated the nature and degree of the relationship between the selected parameters. The Pearson simple linear correlation coefficient was used to measure the link between the rows. The relationship of x and y is considered linear if a straight line drawn through the center of the cluster of points presents the most appropriate approximation of the observed correlation. Using the method of correlation analysis to study sovereign wealth funds, we could formulate and prove the following hypotheses. Sovereign wealth funds generated from non-commodity exports do not depend on the size of the country's GDP; the value of the correlation coefficient equaled 0.5998, which implies the weak dependence of the studied parameters. A similar pattern was observed when studying the sovereign wealth funds formed by hydrocarbon exports. Besides, no significant linear relationship was found when studying the dependence of the sovereign wealth funds and the impact of the potential of the country's explored reserves.

Keywords: macroeconomics; fiscal policy; sovereign wealth funds; export potential; GDP per capita; global energy prices

JEL Classification: C13; E17; E20; E65; F37

Introduction

Recent research on the development of the society considers various approaches to definition of the state's role in the formation and regulation of the market economy in both developed and developing countries. The degree of state regulation, its specific forms and methods can vary considerably from country to country. For instance, the followers of John Keynes's theory argue that the system of free market lacks an internal mechanism capable of maintaining a balance at the macroeconomic level. At the same time, John Keynes, being in favor of relatively mild

influence on the economy, noted that the optimum degree of state intervention in the economy can be achieved by lowering bank interest rates in times of crisis and increasing them during the periods of rapid economic growth. The state, according to the Keynesian theory, serves as an addition to the market, helping to improve the market conditions, and in some cases, it should contribute to the solution of major problems. The concept of monetarism proposes a different approach. According to this theory, market conditions are competitive and capable of self-regulation, which manifests itself in the macroeconomic equilibrium. At the same time, monetary policy is more stringent regarding government intervention, the latter taking the form of withdrawal of excessive money supply from the economy, the reduction of the state budget and other expenditures.

1. Concept headings

Sovereign wealth funds throughout the world are formed on the basis of the fundamental research drawing on Keynesian approach of countercyclical economic policy. For instance, British economist Harrod (1939), being a supporter of Keynesian theory, considered the operation of sovereign wealth funds as a way to carry out countercyclical policy of the state and functions of state crisis management. According to R. F. Harrod, activities of the sovereign wealth fund should be focused on solving problems and achieving goals of countercyclical fiscal policy. However, the formation of the fund should agree with the monetary policy pursued by the government, while the resources should be spent on tax cuts during difficult economic times, funding of the most important projects, and covering the budget deficit.

A different approach to the functions of sovereign wealth funds can be found in the works by A.H. Hansen (1949). According to this theory, sovereign wealth funds should act as a tool for regulating the money supply in the country. At the same time, sovereign wealth funds should ensure the stability of the national currency and stimulate the growth of real household disposable income.

Witte (1912) proposed a similar approach, and his theoretical developments highlighted the necessity of keeping the budgetary surplus in special funds being active treasury reserves. However, more economically developed countries where many costs are covered by the revenues from various sources of national income do not have to create such funds. Consequently, the purchasing power of the national currency is the primary and central object to be influenced by sovereign wealth funds.

Thus, in terms of modern economics, the theoretical studies carried out by Hansen and Witte provide a more narrow perspective on the creation and operation of sovereign wealth funds. At the same time, Harrod's idea highlights the dual nature of the sovereign wealth funds operation that is fiscal and monetary.

Countries forming their state budget on the basis of oil and gas exports are prone to serious macroeconomic risks arising from high dependence of their economies on the global hydrocarbon market. The changes in the budget due to variations in resources export necessitate adjustments regarding expenditures, changes in fiscal policies, borrowings to cover the resulting deficit. All this creates unjustified competition in the financial markets, which definitely has negative consequences. On the other hand, the period of high global energy prices which lasted over the past 20 years led to a situation when some states adopted a policy of easing budget constraints, which enabled them to form the budget surplus and to finance various large-scale projects. After the world prices for hydrocarbons went down, the funding of these projects also declined significantly, some government expenditures becoming ineffective in this situation. In other words, during the times of low global prices for hydrocarbons, the state has to increase the tax burden and reduce social projects. Thus, fiscal policy becomes pro-cyclical and its effectiveness is not justified.

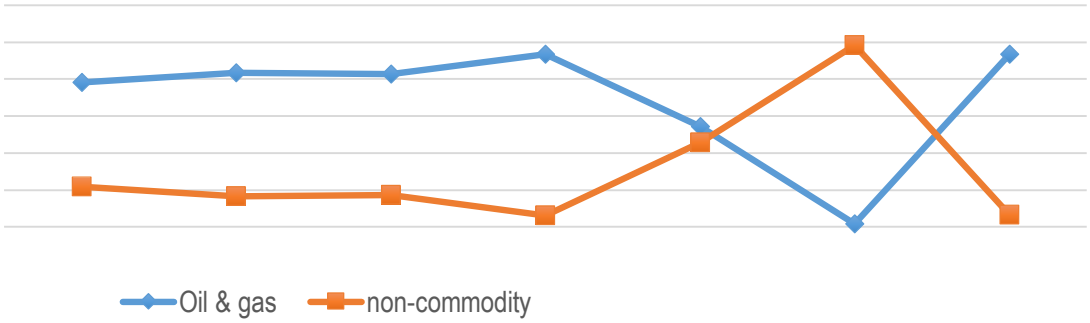
Objective macroeconomic conditions call for special principles of budget formation for the countries obtaining their income from fossil fuels. Consequently, at some points these countries should focus on the creation of a reserve fund, which will later help them to survive through difficult times, acting as a safety cushion of the country's sovereignty and the wellbeing of its future generations. At the same time, most resources are limited by their nature (Figure 1).

It should be noted that the basic approach that can help eliminate the influence of the current unfavorable market conditions is based on a uniform distribution of the budget income coming from the use of hydrocarbon resources over the period of their use. The main goal of such redistribution is to provide a balance of income and

expenditures of the country's budget. At the same time, the approach presently applied for management of resources revenues by the countries dependent on global energy prices includes the following fundamental rules:

- the policy of total saving of income received by resource revenues in the form of "total savings";
- saving only a part of resource revenues and using some of it to cover the budget deficit in the form of "constant consumption" or "average price".

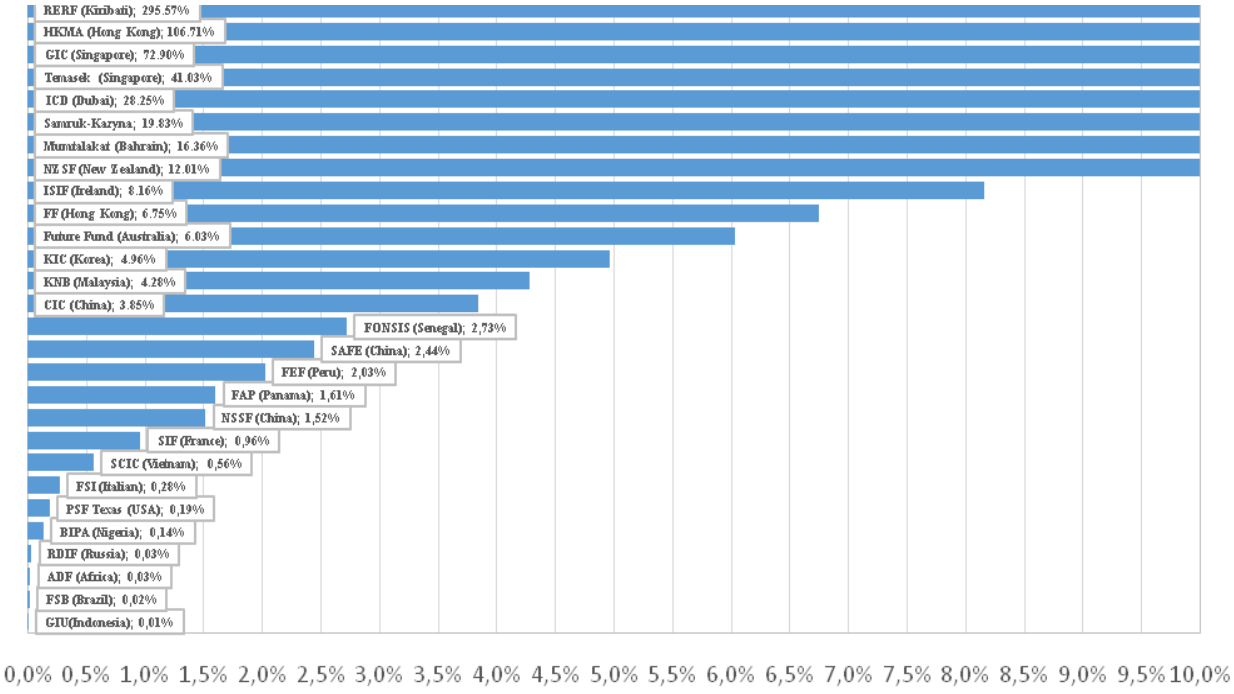
Figure 1. The ratio of the world's sovereign wealth funds generated by commodity and non-commodity exports, %



Source: original authors' estimation using the data of http://www.swfinstitute.org/sovereign-wealth-fund-profiles/ data

The rule of "total savings" includes keeping all received resource revenues in a sovereign wealth fund. At the same time, the non-commodity budget deficit or transfers, allocated from the sovereign wealth fund to cover the non-commodity budget deficit should not exceed the actual revenues from the investment of sovereign wealth funds. In this case, control over the budget dependence on resources and the size of the budget non-commodity deficit should be estimated as a percentage from GDP. Following the rules of the "total savings" policy requires increasing the sovereign wealth fund to the size of the country's GDP (Figure 2).

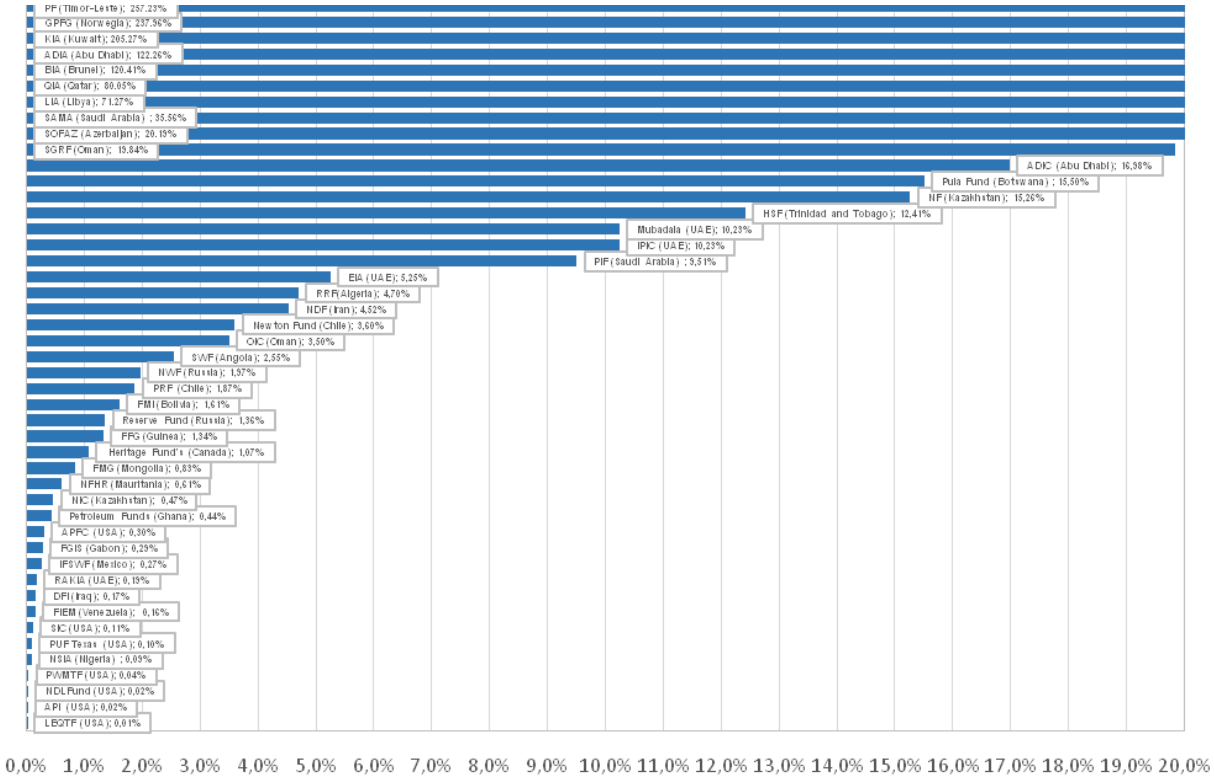
Figure 2. Distribution of sovereign wealth funds formed from non-commodity exports to the country's GDP, %



Source: original authors' estimation using the data of http://www.swfinstitute.org/sovereign-wealth-fund-profiles/

Along with it, the rule of "constant consumption" harshly restricts the country's budget expenditures due to limiting the resource revenues received and allows the country to carry out counter-cyclical fiscal policy. Thus, decreasing GDP the country can reduce budget costs by using resource revenues, and just the opposite, by increasing GDP the state increases budget spending due to the use of additional resource revenues. In this situation, this optimal transfer size to the budget from the resource revenues is the present value of the resource infrastructure of the country. The disadvantage of this method is the difficulty in determining the value of the national resources wealth. Countries that apply the rule of "constant consumption" accumulate all resource revenues of the budget in sovereign wealth funds and use resource revenues only to finance a strictly limited number of budget costs proportional to the country's GDP (Figure 3).

Figure 3. Distribution of sovereign wealth funds formed by the export of hydrocarbons to the country's GDP, %



Source: original authors' estimation using the data of http://www.swfinstitute.org/sovereign-wealth-fund-profiles/

The application of this rule requires the country to carry out fiscal policy aimed at increasing the budget revenues and maintaining a balance with the nominal GDP growth rate, but it also necessitates a gradual reduction in non-commodity deficit.

In turn, the rule of "the average price" implies drawing up and executing the budget according to the market conditions, when one singles out the revenues formed under the influence of the economic cycle out of all budget revenues. In this case, the concept of a structural budget balance or cyclic budget requires the adjustment of financial plans regarding the cyclical nature of some budget revenues. Therefore, the budget expenses incurred cannot be higher than the budget revenues singled out from cyclical revenues and budget deficit financing. Cyclical budget is the difference between the real budget, *i.e.* the budget at a specific stage of economic development (on average) and the structural budget (revenues and expenditures made at the peak or during recession of an economic cycle).

The cyclical budget reflects how the economic cycle influences the budget. During the economic downturn, the cyclical budget shows the difference between the government expenditures and revenues and the expenditures and revenues of economies with natural and normal economic development.

Therefore, the "resource revenues" of the budget can be estimated with the following relation:

$$RRB = BRRB + MRRB \quad (1)$$

where: BRRB are the basic resource revenues of the budget or revenues generated with an estimated average level of prices for resources; MRRB are market resource revenues of the budget or revenues generated by changes in actual or forecasted resource prices from the average price.

The volume of market resource budget revenues varies from one period to another and can turn either positive or negative, depending on fluctuations in actual or forecasted resource prices around the basic average price of resources. So, this great unpredictability of resource revenues must be taken into account when planning the budget.

Classifying the origins of the sovereign wealth funds in various countries receiving oil and gas revenues, one can divide them into the following groups:

- raw hydrocarbons and products that are generated by exports of some type of resources, either taxed or owned by the state;
- non-commodity exports that are created by the transfer of assets from official foreign exchange reserves of the state.

The current classification of the state welfare implies the formation of a sovereign wealth fund, which includes the creation of a stabilization fund, savings for future generations, retirement (reserve) fund, reserve investment fund, strategic national welfare fund.

The world economy counts 40 sovereign wealth funds, which, as a rule, are not involved in the formation of the country's macroeconomic policy, with the exception of the following: the transfer of funds into the budget (in exceptional cases) for the needs of the central bank or the restoration of the balance of payments. In 2003-2013 different states had a positive trend of increasing the amount of funds, with the fastest tempo for the countries obtaining their income from petroleum exports.

2. Statistical methodology

After structuring and systematizing the basic information on different countries that form sovereign wealth funds both through oil and gas revenues or non-commodity exports, we could formulate the following conclusion based on the data of statistical analysis. The sovereignty typical of the functional management of most funds is determined by their independence and limited information on some of them. However, we have summarized the main indicators of the sovereign wealth funds formed by hydrocarbon resources export in the context of the country's main macroeconomic indicators (Table 1).

Table 1. Financial performance indicators grouped according to the countries with formed sovereign wealth funds generated by hydrocarbon exports

Sovereign Wealth funds	Origin / Country	Volume of the generated fund bln. US $	Sovereign fund volume to GDP in 2015,share	Volume sovereign fund to GDP per capita in 2015, share	Proven reserves , bln . barrels / million tons
Brunei Investment Agency	Oil /Brunei Darussalam	40	1.204093919	95966.285	1.1
FSF	Coal/Mongolia	0.3	0.008317161	100.63765	150.0
Leste Petroleum Fund	Oil, gas /Timor	16.9	2.572298326	14404.871	0.0
Revenue Regulation Fund	Oil, gas /Algeria	27.2	0.047001901	681.52756	12.2
National Development Fund of Iran	Oil, gas /Iran	62.0	0.045222465	782.34865	157.8
DFI	Oil /Iraq	0.9	0.001654108	25.638669	150.0
Kuwait Investment Authority	Oil /Kuwait	592.0	2.052704577	144099.86	101.5
Libyan Investment Authority	Oil / Libya	66.0	0.712666019	10404.924	48.4
Oman Investment Fund	Oil /Oman	6.0	0.035005834	1561.2602	5.2
State General Reserve Fund	Oil, gas/ Oman	34.0	0.198366394	8847.1412	
Qatar Investment Authority	Oil, gas/ Qatar	256.0	0.800500313	105.74609	25.7
Public Investment Fund	Oil, gas/ Kingdom of Saudi Arabia	160.0	0.09506833	5.0956625	267.7
SAMA Foreign Holdings	Oil / Kingdom of Saudi Arabia	598.4	0.355555556	19.057778	
Abu Dhabi Investment Authority	Oil / United Arab Emirates	792.0	1.222599568	82647.731	97.8
Abu Dhabi Investment Council		110.0	0.169805496	11478.851	
Emirates Investment Authority		34.0	0.052485335	3548.0086	
IPIC		66.3	0.102346403	6918.6169	
Mubadala Development Company		66.3	0.102346403	6918.6169	
RAK Investment Authority		1.2	0.001852424	125.22383	
Government Pension Fund - Global	Oil / Kingdom of Norway	847.6	2.379562044	162762.040	6.5
National Welfare Fund	Oil /Russia Federation	73.2	0.019688004	500.07531	103.2
Reserve Fund		50.6	0.013609467	345.68047	
Fundo Soberano de Angola	Oil / Republic of Angola	4.7	0.025488069	186.06291	12.70
Pula Fund	Minerals/ Republic of Botswana	5.4	0.154994259	2541.9059	0.00
FFG	Oil / Republic of Equatorial Guinea	0.2	0.013351135	16.021362	1.10
Gabon - Sovereign Wealth Fund	Oil / Gabonese Republic	0.1	0.002891845	53.788317	2.00
Ghana - Petroleum Funds	Oil / Republic of Ghana	0.5	0.004359198	18.744551	2.00
Mauritania - NFHR	Oil / Islamic Republic of Mauritania	0.1	0.006138735	27.010436	0.00
Nigerian Sovereign Investment Authority	Oil / Federal Republic of Nigeria	1	0.000915751	5.5860806	37.10

Sovereign Wealth funds	Origin / Country	Volume of the generated fund bln. US $	Sovereign fund volume to GDP in 2015,share	Volume sovereign fund to GDP per capita in 2015, share	Proven reserves , bln . barrels / million tons
FINPRO	Silver/ Bolivia	1.2	0.0161312	104.8528	0.00
ES Fund	Copper/ Republic of Chile	15.2	0.035984848	845.64394	190.00
Pension Reserve Fund		7.9	0.018702652	439.51231	
Fondo Mexicano del Petroleo	Oil / Mexican United States	н/д			11.10
Stabilization Fund		6	0.002694207	47.14863	
HSF	Oil / Republic of Trinidad and Tobago	5.5	0.12412548	4046.4906	0.80
FIEM	Oil/Bolivarian Republic of Venezuela	0.8	0.00155129	25.906535	298.30
State Oil Fund	Oil/ Republic of Azerbaijan	34.2	0.20188902	3634.0024	7.00
National Fund	Oil, gas /metals/ Republic of Azerbaijan	65.5	0.152645071	3709.2752	30.00
NIC	Oil/ Republic of Kazakhstan	2	0.004660918	113.26031	
Alberta's Heritage Fund	Oil/ Canada	17.5	0.010723039	488.97059	172.90
Alabama Trust Fund	Oil, gas/ United States of America	2.7	0.000150418	8.3933148	48.50
Alaska Permanent Fund	Oil/United States of America	53.9	0.003002786	167.55543	
LEQTF	Oil, gas/ United States of America	1.3	7.24234E-05	4.0412256	
New Mexico State IC		19.8	0.001103064	61.550975	
North Dakota Legacy Fund		3.8	0.000211699	11.812813	
Texas Permanent University Fund		17.2	0.000958217	53.468524	
Permanent Wyoming Mineral Trust Fund	Minerals / United States of America	7.2	0.000401114	22.382173	

There is no doubt that the lack of information affects the reliability of data on operation of certain funds and explains weak correlation between the variables in the statistical sample. Thus, to conduct a thorough statistical analysis of the activities of sovereign wealth funds one should accurately assess the main parameters that characterize their efficiency (Table 2).

Table 2. Financial indicators grouped according to the countries with sovereign wealth funds generated from non-commodity exports

Country	Sovereign Wealth funds	Volume of the generated fund bln. US $	Sovereign fund volume to GDP in 2015, share	Volume sovereign fund to GDP per capita in 2015, share	Export 2015, bln US $
Commonwealth of Australia	Australian Future Fund	89.8	0.0603089	3944.2042000	184.4
Chinese People's Republic	Africa Development Fund	5.0	0.0002579	3.6358948	2270.0
	China Investment Corporation	746.7	0.0385095	542.9845300	
	National Social Security Fund	294.9	0.0152089	214.4450700	
	SAFE Investment Company	474.0	0.0244456	344.68283	

Country	Sovereign Wealth funds	Volume of the generated fund bln. US $	Sovereign fund volume to GDP in 2015, share	Volume sover eign fund to GDP per capita in 2015, share	Export 2015, bln US $
Hong Kong	Future Fund	28.0	0.067535	3829.233000	499.4
	Monetary Authority IP	442.4	1.0670526	60501.8810000	
Republic of Kiribati	Revenue Equalization Reserve Fund	0.6	2.955665	5320.1970000	0.1
Republic of Korea	Korea Investment Corporation	91.8	0.0496485	1812.1687000	535.5
Malaysia	Khazanah Nasional	34.9	0.0427906	1125.3923000	203.8
Republic of Indonesia	Government Investment Unit	0.34	0.0001196	1.3279381	152.5
New Zealand	New Zealand Superannuation Fund	20.2	0.1200951	4347.4435000	34.3
Republic of Singapore	GIC Private Limited	344.0	0.728968	62180.9710000	384.6
	Temasek Holdings	193.6	0.4102564	34994.8720000	
The Socialist Republic of Vietnam	State Capital Investment Corporation	3.1	0.0056129	33.6773490	158.7
Kingdom of Bahrain	Mumtalakat Holding Company	10.6	0.1635802	8195.3704000	14.08
United Arab Emirates	Investment Corporation of Dubai	183.0	0.2824946	19096.6350000	323.8
French Republic	Strategic Investment Fund	25.5	0.0096335	396.9021500	509.1
Republic of Ireland	Ireland Strategic Investment Fund	21.0	0.0815851	4527.972000	140.4
Italian Republic	Italian Strategic Fund	6.0	0.0027637	98.6642100	454.6
Russia Federation	Russian Direct Investment Fund	1.3	0.0003497	8.8811189	337.8
Federal Republic of Nigeria	Bayelsa Development and Investment Corporation	1.5	0.0013736	8.3791209	50.7
Republic of Senegal	Senegal FONSIS	1.0	0.0272554	68.1384570	2.3
Federative Republic of Brazil	Sovereign Fund of Brazil	0.6	0.000188	2.9323308	174.2
Republic of Panama	Panama Sovereign Wealth Fund	1.4	0.016055	350.0000000	15.9
Republic of Peru	FEF	7.9	0.0203033	247.6998200	36.4
Republic of Kazakhstan	Samruk-Kazyna	85.1	0.1983221	4819.2263000	45.4
United States America	Texas Permanent School Fund	34.5	0.001922	107.2479100	1598.0

Asa method of correlation analysis, which allowed us to evaluate the nature and strength of the relationship between the selected features, we used the Pearson indicator of simple linear correlation to measure of dependence between the rows.

The relationship of *x* and *y* is linear if a straight line drawn through the center of the cluster of points gives the most appropriate approximation of the observed correlation. One can measure how close the observation is to a straight line, which best describes their linear relationship by calculating the sample correlation coefficient with the following formula:

$$r = \frac{\sum_{i=1}^{n}(x-\bar{x})*(y-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x-\bar{x})^2*(y-\bar{y})^2}} \quad (2)$$

where: $\bar{x}$, $\bar{y}$ are sample means calculated as follows:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \quad (3)$$

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_i \quad (4)$$

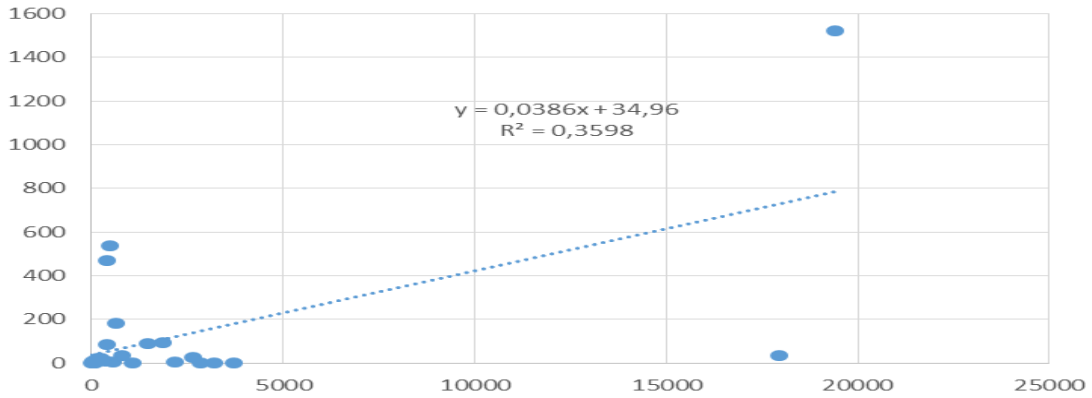
The coefficient of determination of the paired regression $R^2$is the same as the square of the correlation coefficient*r*.

3. Hypothesis

Sovereign wealth funds may exert different influence on the economic development of a particular state, so they can be classified into those with a significant impact on the development of the national economy (the stated goals are effectively reached by these countries) and those that do not influence the economic development or inefficient funds (with no clear objectives), or those whose degree of influence cannot be assessed (non-transparent activities or restricted information). In this regard, using correlation analysis to examine the formed sovereign wealth funds, we could propose the following hypotheses.

Hypothesis 1. The size of the sovereign fund formed by non-commodity exports is weakly dependent on the country's GDP (Figure 4)

Figure 4. Correlation field of the dependence of sovereign wealth funds formed by non-commodity exports on the GDP of the countries analyzed



When exploring the relationship between the numerical parameters of the non-commodity sovereign wealth funds and the volume of the countries' GDP we obtained the following values:

- the correlation coefficient estimated 0.5998, which denotes the medium dependence between the parameters considered in the hypothesis;
- the determination coefficient equaled 0.3598, which corresponds to the equation of the linear dependence $y = 0.0386x + 34.96$ and proves a weak dependence of the parameters considered in the hypothesis.

Hypothesis 2. The size of the sovereign wealth fund formed by non-commodity exports depends on the country's export potential.

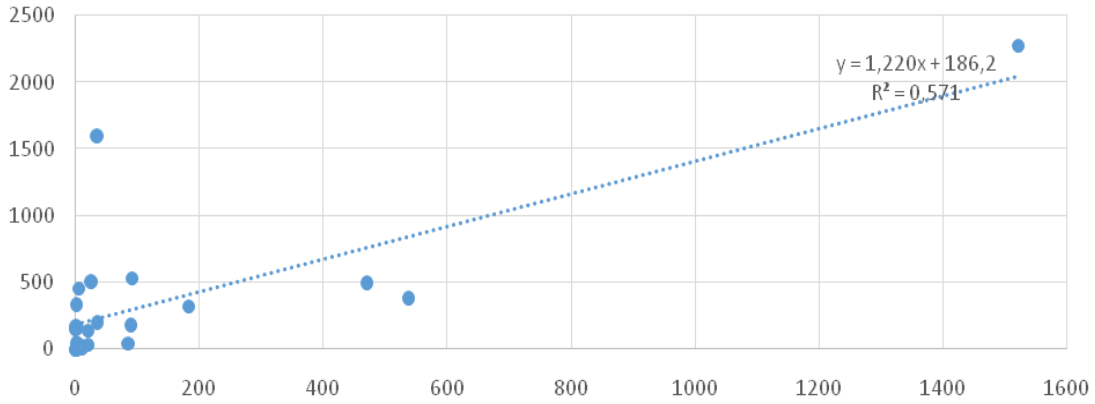
Analyzing the relationship between the numerical parameters of the no-commodity sovereign wealth funds and export potential (Table 2) of the countries, we obtained the following values (Table 3):

Table 3. Regression values

Multiple R	0.756246
R Square	0.571908
Adjusted R Square	0.551523
Standard Error	223.6095
Observations	23

In this case, the correlation coefficient estimated 0.756246, which proves a strong relationship between parameters considered in the hypothesis and corresponds to the equation of the linear dependence y = 1.2203x + 186.25. The value of the determination coefficient R^2 = 0.5719 means that 57% of the variation of variable y (the size of funds) is determined by the variation of the variable x (volume of exports). A graphical representation of the variations on the given parameters of the hypothesis is shown in Figure 5.

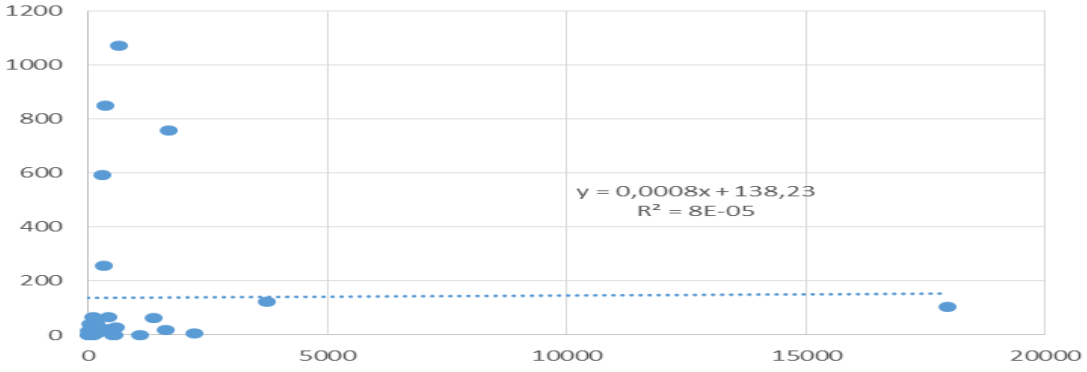
Figure 5. Correlation field of dependence of the size of sovereign wealth funds generated by non-commodity exports to the export potential of the country



Hypothesis 3. The size of a sovereign wealth fund generated by hydrocarbons export does not depend on the size of the country's GDP.

To prove this hypothesis, we used the method of regression analysis to identify the relationship between the studied parameters. The determination coefficient estimated $R^2 = 0$, which shows that there is no relationship between variables y (the size of funds) and x (GDP). Therefore, it can be concluded that there is no influence on the studied parameters of the hypothesis (Figure 6).

Figure 6. Correlation field of the dependence of the size of sovereign wealth funds generated by hydrocarbon exports to the country's GDP



Hypothesis 4. The size of the sovereign wealth fund generated by the hydrocarbons export depends on the country's GDP per capita.

When considering this hypothesis and identifying the relationship between the studied parameters, we found out that the determination coefficient estimated $R^2 = 0.1389$, which denotes the weak relationship between variables *y* (the size of funds) and *x* (GDP), which in turn suggests a weak influence of GDP (in general) on the formation of commodity funds (Table 4).

Table 4. Regression values

Multiple R	0.372736641
R Square	0.138932603
Adjusted R Square	0.104489908
Standard Error	0.56502112
Observations	27

At the same time, the conducted regression analysis of the studied parameters of commodity funds' size regarding GDP volume and GDP per capita for the countries considered showed that the correlation coefficient was 0.78864 (Table 5).

Table 5. Regression values

Multiple R	0.788640681
R Square	0.621954123
Adjusted R Square	0.613162359
Standard Error	0.379676876
Observations	45

Therefore, the identified relationship between variables *y* (the commodity funds size to GDP) and x (GDP per capita) is sufficiently stable and can be described with the equation of linear dependence $y = 0.111217 + 0.0000143x$. Here the value of the coefficient of determination R^2=0.62 indicates that this equation provides a fairly accurate description of the behavior of function *y* (the size of commodity funds to GDP).

To verify the hypothesis and obtained coefficient values we applied the t-test which showed that the coefficient 0.111216922 is weakly significant, since the relationship 1<1.873737<2, and the coefficient 0.0000143 is highly significant as 8.410874>3 (Table. 6).

Table 6. Testing hypotheses with Student's t-test

Coefficients	Standard Error	TStat
0.111216922	0.059355669	1.873737
0.000014300	0.000001700	8.410874

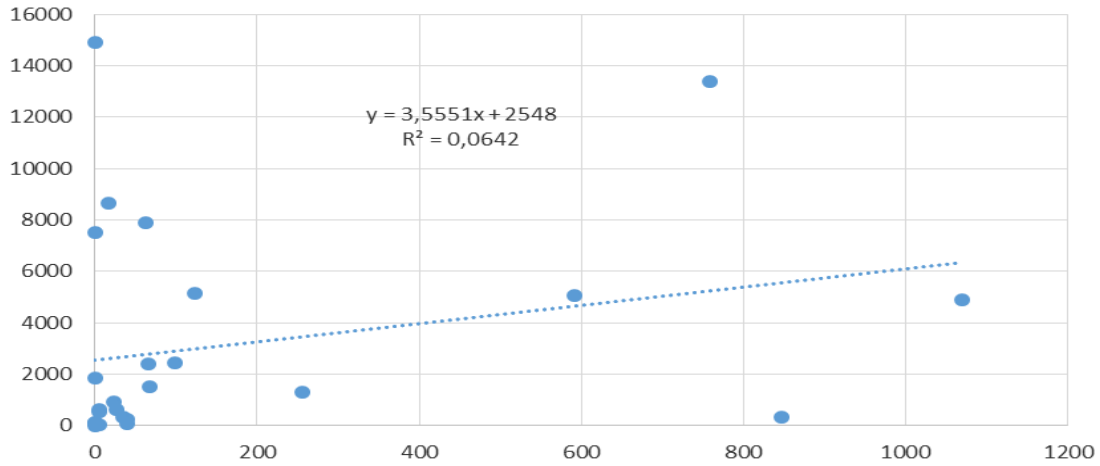
Hypothesis 5. The size of the sovereign wealth fund formed by hydrocarbon exports does not depend on the potential of the proven reserves of the country. Regression analysis of the studied parameters of the hypothesis showed that there is no significant linear relationship between the indicated values, which is confirmed by the value of the pair correlation coefficient of 0.253434 <1 (Table 7).

Table 7. Regression values

Multiple R	0.253434
R Square	0.064229
Adjusted R Square	0.025238
Standard Error	295.366700
Observations	26

In turn, the coefficient of determination equals 0.064229≪1 and forms the following linear equation *y= 2548 + 3.5551x*, which defines the studied variables as weakly significant regarding the description of the actual behavior of the function *y* (the size of sovereign wealth funds) (Figure 7).

Figure 7. Correlation field showing the dependence of the size of sovereign wealth funds generated by hydrocarbon exports to the country's GDP



4. Discussion

As a rule, stabilization funds are formed and used to ensure a balanced budget. In addition to that, these may include funds created for saving one-time big revenues and their future use. These funds are established to protect the budget from various market factors or other exogenous shocks (East Timor, Iran, Chile, and Russia). These funds are generated and used in the context of counter-cyclical fiscal policy, whereas their assets are invested in highly liquid and safe financial instruments. The largest part of the stabilization funds is invested in highly reliable government bonds in short-term investment programs and are managed in the course of conservative investment strategy.

Pension reserve funds are established to finance the identified future outflows associated with the provision of public pensions (Australia, Ireland, New Zealand, Norway, and Russia). The assets of these funds are generally placed in high-risk investments to make up for the increase in pension costs. The investment horizon is set as a long-term one. The assets of pension reserve funds are managed according to a balanced strategy, while the substantial share of the investment portfolio of the funds can be represented by equities and corporate bonds.

Provident funds are created on the basis of equitable distribution of welfare between generations. Budget revenues depending on market conditions and gold and foreign exchange reserves can be accumulated in the funds aiming at their effective investment and multiplying the funds so that future generations may benefit from these investments. The main objective of the provident funds is the redistribution of revenues obtained from nonrenewable natural resources into diversified renewable source – various assets (Libya, the United Arab Emirates, China, and Singapore).

The purpose of the development funds is to invest into and develop the priority sectors of the economy. The assets of the development funds are typically invested within the country into the priority economic and social projects: most often-in infrastructure, education, health care (United Arab Emirates, Iran, Australia, and Russia).

Despite the fact that stabilization funds and provident funds pursue different goals, both of them aim to smooth fluctuations in expenditures: the first ones do this in the short term, while the second ones – in the long run. In reality, sovereign wealth funds often have features of both and can aim at reaching several goals. Some countries have formed funds, which solve a range of stabilization and savings problems (Bahrain, Kuwait, Norway, Russia, and Trinidad and Tobago). Thus, such a classification cannot be considered the only one available, but the typical objectives of the funds remain unchanged.

It should be noted that the aims and objectives of most sovereign wealth funds correlate with the general macro-economic development goals of the country as the assets of the fund have an enormous impact on public finances, the overall balance of payments, as well as on the private sector.

Conclusion

The conducted research on the functions and methods of the formation of sovereign wealth funds in the world economy made it possible to identify a number of features that define them in the structure of the state budgetary resources. Sovereign wealth funds are characterized by their sovereignty and operation in the framework of legislative and legal acts of the state. As total of the state funds, sovereign wealth funds are generally accumulated in the budget revenues in the form of surplus from the sale price of hydrocarbons or resources and should achieve specific macroeconomic goals set. The size of the sovereign wealth fund formed both by the export of hydrocarbons and non-commodity sources is weakly dependent on GDP of a particular country.

As for the management type, sovereign wealth funds may be run by a specific government institution with public or private management, forming a vertically centralized structure or be run by the regional authorities only.

It should be noted that the size of the sovereign wealth fund generated by the export of hydrocarbons is dependent on GDP per capita. In turn, sovereign wealth funds formed by revenues from non-commodity exports depend on the country's export potential.

The most important trends in the development of the sovereign wealth funds management are the following:

- the growing number of sovereign wealth funds formed in countries that are not dependent on resources export;
- more funds are formed from non-commodity sources;
- most funds are formed in Asia, the region with significant gold and foreign exchange reserves.

Having studied the practices of the sovereign wealth funds of Norway, Australia, Chile, Alaska, Venezuela, we identified certain fundamental differences regarding the formation and use of assets, investment strategies and approaches to the management of funds, which allowed us to highlight the key features in the operation of the sovereign wealth funds. For instance, the analysis we had carried out showed that:

- throughout the whole period of the sovereign wealth funds operation there may be significant qualitative changes in the principles of formation and use of funds, as well as their organizational and management structure;
- the management the sovereign wealth funds imply the application of various practices regarding rules and methods of the formation and use of their assets, depending on the specifics of a particular fund and the conditions it operates in;
- in some countries sovereign wealth funds finance not only the non-oil deficit in both federal and regional budgets, but also deficits in the budgets of public companies (Venezuela);
- the revenues of a particular state company can become the source for formation of certain sovereign wealth funds (Chile);
- a characteristic feature of the most successful in terms of management funds is their information transparency and perfect compliance with the fiscal rules (Australia, Alaska, Norway, Chile);
- failures in fund management are associated with constant changes in the rules of formation and funds use, digressing from the goals the funds were to achieve and the lack of transparency of their operation (Venezuela);
- investments in infrastructure funds are typically self-liquidating and economically beneficial for the whole population (Australia).

In general, the rules of formation and use of funds in a particular country depend on various factors. These include climatic factors, the overall socio-economic status of the country, the demographic situation, the effectiveness of implemented monetary and fiscal policies, as well as the specifics and goals of the sovereign wealth funds themselves.

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Migration Processes in the Context of Political Collisions: Factors and Social and Economic Consequences

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Abstract

Europe is undergoing the strongest migration crisis that in terms of its importance can be compared with the migration crisis caused by the Second World War. This article researches the coherence of "catastrophic" hypothesis related to the current migration crisis in Europe, and considers the risks and consequences of this crisis for the social and economic development of the European region. The materials stated in the article enable the authors to make the following conclusions: Migration as an objective phenomenon that comes with globalization phenomena will always maintain its historical focus from the lagging regions of the world in terms of economic and social development to more developed and democratically free regions, The current migration crisis in Europe has been caused by an abrupt increase in the migrants' inflow to the region (2-5 times during 2015 as compared to 2014), as well as by the lack of coordination in the actions of representatives of the executive power of European countries, including the lack of distinct and efficient measures aiming at regulating the abruptly increased migration inflow, The "catastrophic" scenarios of the current migration crisis based on historical parallels (for example, the fall of the Western Roman Imperia and the Holy Roman Empire of the German nation) offered in some scientific and publicist articles have insufficiently objective grounds, Countries of Europe (and including the European Union) must take into account and forecast probable risks that will come with the current migration crisis (social and political instability that will cause destructive phenomena in economy), and The European region may extract potential profits from the migration crisis, successively pursuing the policy of securitization, integration and assimilation of migrants and herewith finding the balance between the efficient tolerance to newcomers and the required level of safety for the indigenous population.

Key words: migration; crisis; Europe; Eu; risks; threats; assimilation of migrants; multi-culturism; safety; tolerance

JEL Classification: F22; H56

1. Introduction

Europe undergoes the migration process that according to its scales, as well as consequences is unprecedented in modern times (OECD 2015). The mass stream of refugees from the North Africa, Middle East and South Asia is stipulated by geo-political transformations and social destabilization in these regions, including in the context of

military collisions and reactional tough actions of the local governments. The European leaders who initially were open for the dialogue with the forced migrants and provided them with the minimum required amenities for staying on the territory of the European Union states have changed their rhetoric over the recent year. Thus, for example, Francois Hollande (President of France) stated about the impossibility to further accept refugees and forced migrants because of the lack of free accomodation required for placing them. In spite of the calls of Angela Merkel (German Chancellor) and Juha Sipila (Premier-Minister of Finland), Theresa May (Premier-Minister of Great Britain) confirms that the problem of the forced migration must not be solved through prejudicing interests and needs of the indigenous population of European countries (Reuters 2016, The Guardian 2016, Independent 2016, BBC 2015).

The scientific community (economists, sociologists, political analysts) did not stay on the sidelines of the discussion about the reasons, consequences, and historical analogous of the current migration crisis in Europe either (Zaiceva and Zimmermann 2016, Bertoli *et al*. 2016, Falkner 2016). According to some scientists and researchers, it is undoubtedly necessary to consider reasons of the current migration crisis as military and political, and in the historical context, to compare it with the historical crisis that was observed in Europe during and after the Second World War. Other scientists and researchers do not deny the military and political basis of the migration crisis in Europe (2015-2016) and specify that it is also necessary to take into account social and psychological, and evolutionary and anthropogenic aspects (Holmes, Castaneda 2016). Here in a greater degree it is appropriate to make a historical analogue with the Migration Period in the first millennium A.D. (d'Oultremont, Martin 2015, Vereschagin 2015).

Without derogating scientific grounds of both positions, we believe that the current migration crisis in Europe must be considered in a wide global and evolutionary context, taking into account the formation of the multi-polar world and the change of the vector development from the European and American to the Eurasian. We mentioned it many times in our earlier works (Dudin and Frolova 2015, Dudin 2015). Thus, the problematics of the modern migration crisis in Europe where other regions of the world can be involved, and importance of the historical context of the research make this article urgent.

2. Methodology

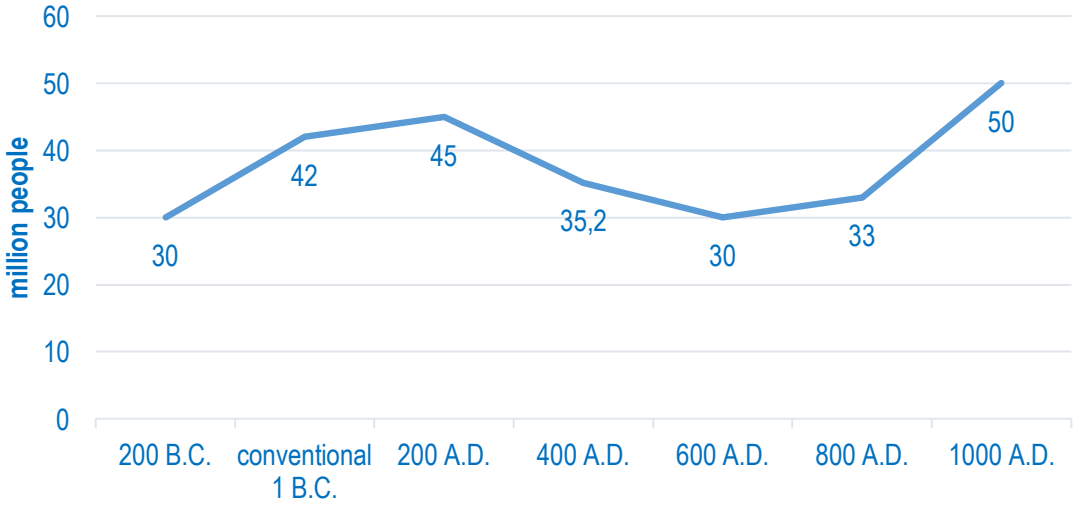
On the basis of statistical information placed on public websites (Eurostat 2016, Human Life-Table Database 2016, European Parliament 2015), as well as the content analysis of scientific publications and researches on the migration problem (its political, economic, social, and technological context) (Zuanna 2006, Sobotka 2008, Wilson *et al.* 2013, Harper 2016), this article makes a comparative and historical analysis of migration processes and the current migration crisis in Europe. It allowed to structure risks, threats, and to define basic consequences that may take places both in the European and other regions of the world.

3. Results

Considering a wide historical context of migration processes (starting since the Common Era till our times), it is possible to note that the geographical directionality of these processes is approximately similar (from the East to the West within Eurasia and from the South to the North according to the "Africa – Europe" vector). Herewith, at the beginning of the Common Era the number of the population of the region that is currently defined as Europe was about 42 mln. people.

During the fall of the Western Russian Empire (in 476 A.D.) and during almost four centuries after it, the number of the population in Europe constantly decreased. It is only by the moment when the Holy Roman Empire was established (962 A.D.), the number of the population of Europe had increased up to 50 mln. people (Figure 1).

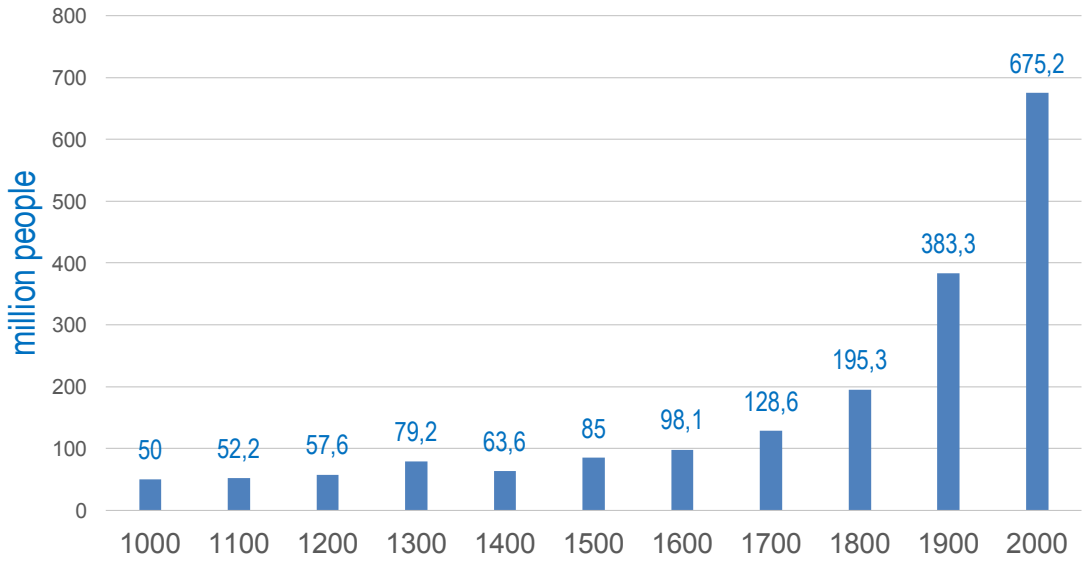
Figure 1. Number of the European Population since 200 till the Common Era and till 1000 of the Common Era (Lutz *et al* 2003, Blaut 2012).



It is obvious that before the fall of the Western Roman Empire the number of the population in Europe had increased 1.5 times, and after its fall the number of the population decreased proportionally. After the establishment of the Holy Roman Empire (and its concluding formation in the form of the Holy Roman Empire of the German nation founded in 1512), the number of the population in Europe increased with different dynamics (Figure 2):

- from the beginning of the first millennium of the Common Era to the XIV century, the growth of the population in Europe was about 58% with the critical decrease by 20% by the beginning of the XV century (pandemic of plague that claimed lives of 15 - 25 mln. people),
- from the beginning of the XVI century till the beginning of the XXI century almost exponential tempo of the growth of the number of the European population (every next century the tempos of the population growth almost twice exceeded the previous ones) was established.

Figure 2. Number of the population of Europe since the 1 Millennium till the Beginning of the II Millennium of the Common Era (Lutz *et al.* 2003, Blaut 2012, Eurostat 2016)



In the historical context we can observe that since the establishment of the Holy Roman Empire of the German nation till its fall in 1806 the population of Europe increased 2.3 times. Certainly, Europe has always been an attractive region for migrants and forced refugees. Especially it started bring evident after the Industrial Revolution. Processes of democratization of the society played an important role in increasing the European population. It allowed to increase the accessibility of the medical aid, education. Social basic guarantees were formed. It boosted the birth rate. For some countries the indicator of the birth rate exceeded 15-25% from the beginning of the XIX century till the middle of the XX century (Kirk 1969). That is why even in spite of the losses of population during the Second World War, Europe remained a leader according to the growth of the population for quite a long period of time (almost the whole mid-to late XX century). There is no need to search for reasons in socially-focused state programs that aimed both at quick recovery of economy after the war, and accelerated regeneration of the population.

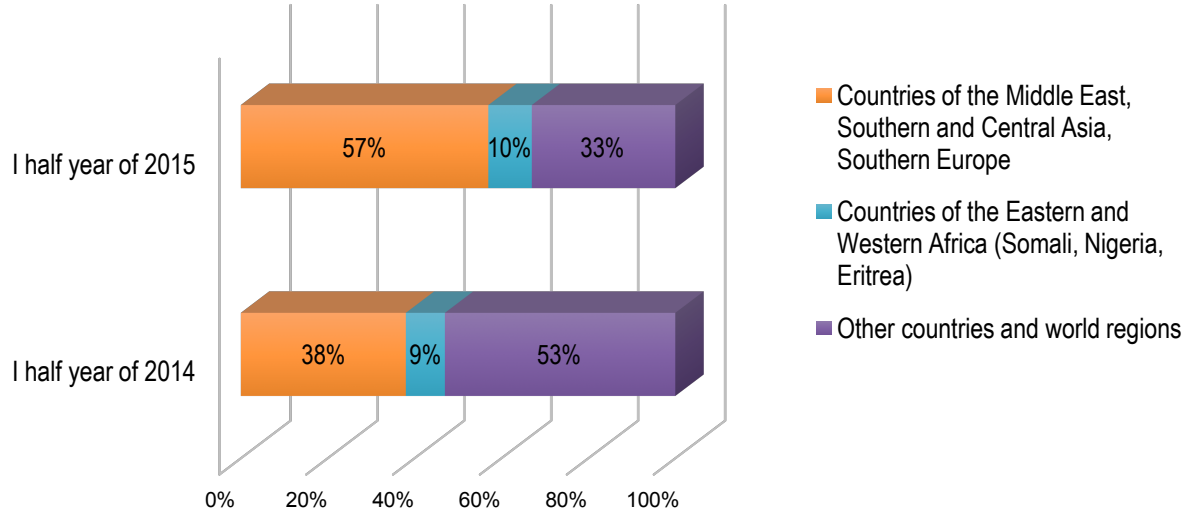
Thus, by this moment of the research we can conclude that the concept of the mainly migration growth of the population in European countries during the period from 1500 till and including 2000 is not entirely objective (although, certainly, the migration flow provided the growth of the population in this region), because it does not take into account the foolowing:

- *Firstly*, the outflow of the population from European countries after the Napoleon's wars (for example, in 1850 the migration outflow from Europe had been about 400 thous. people, and in 1880 it was already about 1 mln. people),
- *Secondly*, the internal European migration caused, for example, by famine in Ireland (1845-1852), and transfer to the capitalistic regime and desolation of small manufactures, farming and trading holdings in Germany, and
- *Thirdly*, a considerable according to its scales overseas migration of the population from European countries in the first quarter of the XX century (reclamation of America, "golden fever", etc.) and in the 1930-50s (migration of the war).

If we consider the data about the number of the population of Europe at the beginning of this century, it is possible to note that it was about 725 mln. people in 2005, about 751 mln. people in 2010, and 745 mln. people in 2015. Among them, the population of the European Union is about 508 mln. people (or 68%) as on 2015. Herewith, according to various estimates, for 2015 the migration flow to Europe from the Middle East, North Africa, and Southern Asia was from 1 mln. to 1.8 mln. people, including about 700 thous. of migrants to the European Union (in 2014 the migration flow to Europe was 280 thous. people) (Eurostat 2016; Human Life-Table Database 2016; European Parliament 2015).

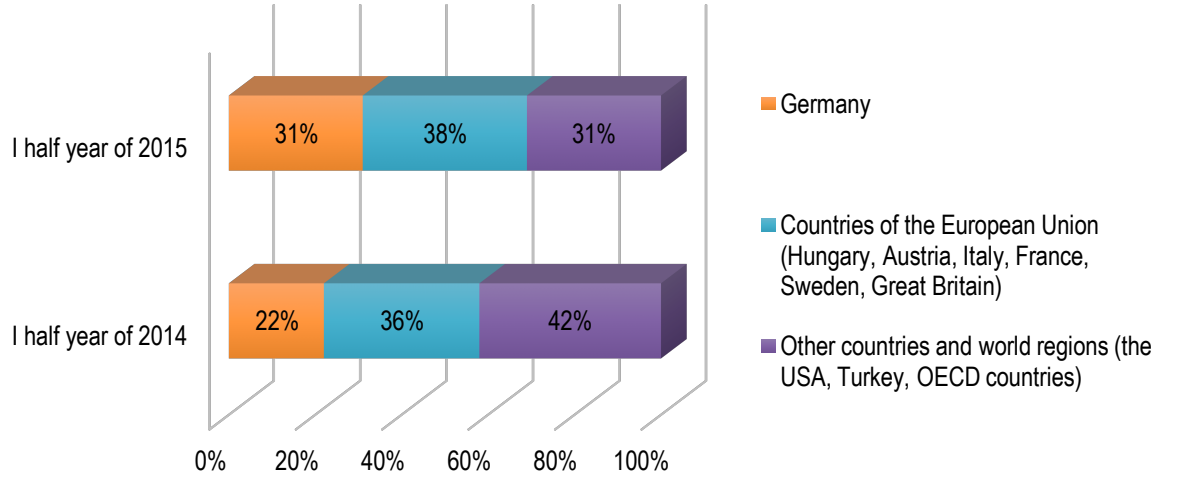
Herewith, over the two recent years the basic migration flow to Europe has been observed mainly from countries of the Middle East (Syria and Iraq), Asian countries (Afghanistan, Pakistan) and Southern European countries (Serbia/Kosovo, Albania). However, while in the first half of 2014 these countries accounted for 38% of the whole migration flow to Europe, in the first half of 2015 above half of all migrants came from these countries (Figure 3).

Figure 3. Structure of the Migration Flow to Europe (in 2014 and in 2015) according to Departure (Outcome) Countries (Eurostat 2016; Human Life-Table Database 2016; European Parliament 2015)



If we consider the recipient party (arrival party), it is possible to note that the basic share comes to countries of the European Union and its "main economy" – Germany (Figure 4).

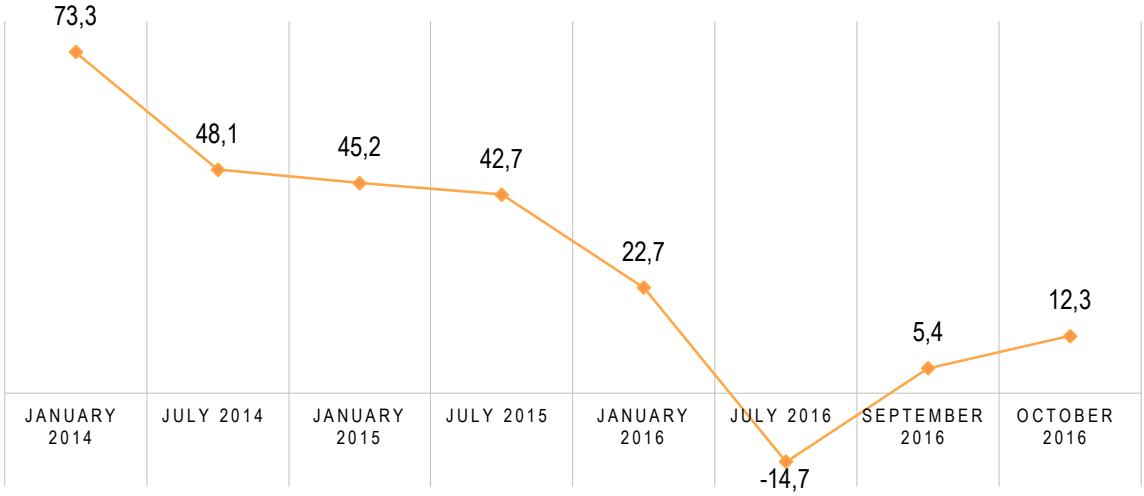
Figure 3. Structure of the Migration Flow to Europe (in 2014 and in 2015) according to Arrival (Recipient) Countries (Eurostat 2016; Human Life-Table Database 2016; European Parliament 2015)



It is evident that the basic pressure of the migration flow is to Germany because other European countries have taken defensive measures. Herewith, it is necessary to understand that Germany, being the strongest economy of the European Union, is sufficiently stable to such shocks because it has the required reserve of strength. It is possible to analogously speak about the reserve of the social and economic stability of the Eurozone, as a whole. In particular, if we consider the dynamics of the Index of Economic Expectations of the ZEW Institute that takes into account expert forecasts in relation to the business activity and social development, its critical

decrease accounted not for the period of the mass inflow of migrants (first half of 2015) but for the middle of this year. However, it is October 2016 when we can see the accelerating increasing trend of this indicator (Figure 4).

Figure 4. Dynamics of the Index of Economic of the ZEW Institute in January 2014 – October 2016 (on a Selective Basis) (Quote.ru 2016)



Thus, the existing statistical data do not enable us to say that the current migration crisis in Europe can cause the fall of the European civilization (on the analogy of the Western and Holy Roman Empire, as well as on the analogy of social and political transformations of the end of the XIX – the first half of the XX century). At the same time, it is necessary to think about the issue related to the consequence of the current migration crisis for the European civilization and its impact on the biological reproduction of the population and social substitution on the most developed European countries that make up the nucleus of the European Union.

4. Discussion

Researchers and politicians are seriously disturbed by the fact that Europe as a whole (and the European Union in particular) maintains a low birth rate. It has already caused de-population. Thus, for example, according to the results of 2014 the natural decrease in population was documented in Germany, Austria, Baltic countries (Lithuania, Latvia and Estonia), Belgium, Italy, Greece, and Bulgaria. However, on the other side, from 2009 to 2014 in Great Britain the number of families with four and more children doubled. According to the results of 2013 and 2014 in Finland every tenth new-born was born in families where there are already at least three children. Migration is traditionally specified as its basic reason. Certainly, according to their culture and social tradition families coming to Europe from Pakistan, Afghanistan, and other Asian or African countries give birth to more children than traditional European families. This aspect is reflected in the researches of the Eurostat (Service of Statistics of the European Union) showing that in 2013 and 2014 almost 25% of all new-born in the European Union came from foreign migrants' families (Eurostat 2016).

Taking into account the above, as well as based on the data of the UNO report about the replacing role of migration, on the one hand, it is possible to say that the migration flow provides the replacement of births in Europe whose population is characterized by aging and inability to simple reproduction. However, on the other hand, the scientific literature does not still have a unified definition of the birth replacing migration. It means that the discussion of the issue in the context of migration replacing birth is not tenable either in terms of science or practice. Here it is necessary to agree with Wilson and his co-authors that it is correct to consider migration in the context of the population replacement. Based on the works of D. Zuanna (2006) and T. Sobotka (2008), S. Wilson *et al.* (2013) and his co-authors offer to consider migration processes in Europe taking into account total replacement index.

This index compares two values: the number of those who were born and the number of mothers (originally the term "cohort" is used, *i.e.* cohort of new-born children and cohort of mothers).

Table 1 represents the data of the Total Replacement Index of female cohorts (born in 1975 and 1980 aged 0 and 30) in separate regions of Europe as on 2010-2012. The simplified interpretation of the Total Replacement Index that is represented for certain European regions in Table 1 as follows: the higher the value of the Index is, the higher is the impact that the migration has on the birth rate and replacement of population in the region.

Table 1. Data about State of the Total Replacement Index for Female Cohorts in Various Regions of Europe in 2010 –2012 (Wilson *et al.* 2013)

Region of Europe	Total substitution index aged 0		Total substitution index aged 30	
	1975 year of birth	1980 year of birth	1975 year of birth	1980 year of birth
Eurozone	0.95	0.88	1.08	1.04
Western Europe	1.02	0.98	1.13	1.14
Southern Europe	1.6	0.97	1.36	1.16
Central and Eastern Europe	1.94	0.98	1.06	0.93

We will not rest on studying methodological details related to calculating the replacement index. However, we will shortly comprehend the results obtained by Wilson and his co-authors:

- *Firstly*, if we consider the period of time that is important for the population statistics (for example, 20 years), it is possible to note that the cohort of those who were born in the *n* calendar year can change under the impact of the migrants' inflow (who were born in the same or adjacent year). It is regular and natural. As a rule, the population in the economically active age undergoes replacement. It can be also regarded as a regularity,
- *Secondly*, it is principle to differentiate the replacement of births and replacement of the population. Migrants do replace the insufficiency of population where the birth rate is lower than the growth of simple reproduction. However, it is more important to observe not the current but the postponed processes of migration when the people born by migrants, after achieving the peak of the child-bearing age, start replacing the indigenous population.

It is possible to conclude from these two theses that migration and the migration crisis as a whole that stroke Europe must be considered in the long-term postponed perspective. Here it is possible to single out several key moments: social and cultural, economic and political moment, and safety.

Every new generation of migrants coming to Europe bears its cultural traditions (and it does its best to keep them). Herewith, they prefer to use social European benefits and preferences. The conflict of interests between the indigenous population (and/or the one assimilated before) and migrants that occurs on the everyday level balances between maintaining tolerance and providing the parties with safety. In spite of the fact that cases when the conflict of interests transformed into an open confrontation of migrants and the recipient party are singular, they are rather resonant (terroristic acts in 2016 in Nice, Bavaria, hostage taking in Normandy). The death of the indigenous population and tourists in European countries at the hands of migrant terrorists make people speak about a high level of danger coming from the mass migration flow. That is why now a lot of European countries must take firm measures in terms of migration securitization.

Such measures were taken in the USA after the events in September 2001 (OECD 2015). European countries made attempts to securitize migration. However, probably they are not sufficient to solve the problem. Besides, migration affects the recipient parties by using "soft power". The migrated expat communities keep their language and cultivate national traditions. Firstly, they can be used by external powers as subjects for implementing criminal or politically aggressive intentions. Secondly, migrants can unconsciously promote their language and culture in the recipient country by attracting attention of mainly young indigenous population. Here subject to the first condition, "soft power" can be essentially transformed into hard power. That is why the securitization of migration must come with establishing standard requirements to the conduct of migrants and compliance with

national traditions by them in order not to create precedents for decreasing tolerance of the indigenous population in the recipient country.

It is necessary to understand that the "soft power" brought by the migration flow can have an impact not only on the social and political context of the recipient country's development, but also on the state of economy. Indisputable benefits from the migration flow for European countries include the fact that the economy is saturated with the lacking labor resources. On the one hand it can contribute to increasing efficiency, and growth of the national wealth. On the other hand, a great share in the migration flow is made up by "grey" labor migrants who perform their activity without official employment, obtaining special documents, and deducting taxes in the budget. It has delayed consequences – from decreasing the cost of labor resources to developing the mass shadow sector that will have a destructive impact on the economy of the country that accepts such migrants.

Stiffening of the legislation in the area of regulating labor relations, quoting work places for foreigners, and other similar measures, as a rule, are not efficient enough. That is why along with traditional measures to restrain illegal migration, it is necessary to take measures on its legalization. To our mind, in this case the most efficient measures are those aiming at assimilating and integrating migrants, as well as pursuing the multi-culturism policy.

Assimilation assumes full acceptance of cultural, social, and political traditions of the European civilization by migrants. Assimilation also assumes the migrants' full and unconditional acceptance of economic and legal regime of the country where they plan to stay for future living. In other words, assimilation is a way to transform the migrant flow into new citizens of the recipient country. Since at the same time assimilation of migrants is a tool of subsequent but relatively strong pressure, and tool of impact in the national self-consciousness of migrants, its use must be supplemented by special integrational measures with the use of the multi-cultural approach. The integration and the multi-cultural approach assume that the migrants' adaptation to social and economic, and political and legal realities has a two-way character. Herewith, for some time migrants can maintain their national culture and life style.

Subsequently, as a rule migrants refuse from their national traditions in favor of traditions of the recipient country. It happens under the impact of the promotion of basic values of the recipient country in the migration environment, and under the influence of civil freedoms provided to migrants by the recipient country.

Conclusions

Summarizing this article, we would like to specify that the migration processes must be considered as a regular consequence of the globalization of the modern world. Along with this, the migration can cause crisis tendencies. It is currently observed in European countries. However, the crisis is stipulated not so much by the phenomenon "migration" as the mass nature of the migration flow and inability of the recipient country's powers to efficiently and rationally manage it. We do not think that the modern migration crisis in Europe must be considered in terms of a catastrophe and make unconditional historical analogues with the fall of the Roman Empire (including the Holy Western Empire of the German nation), although there are certain correlation points here. It is necessary to understand that migration is stipulated by an aggregate of determining factors that have maintained and probably will maintain their urgency for the medium- and long-term observable perspective. In other words, migration (its power and directionality) is stipulated by disproportions between social and political, and economic and technological development of the donor and recipient parties.

The current migration crisis may have both negative and positive consequences both for Europe as a whole and the European Union, in particular. It is necessary to mention such negative consequences as a threat of social and economic stability, risks of strengthening the power and frequency of terroristic attacks, and formation of the large-scale "grey" segment not only in economy but also in politics. On the other side, Europe can extract profits from the migration crises because its aging population is not ready and is not capable to self-reproduction. For Europe to be able to use long-term advantages from the migration crisis, it is necessary to pursue coherent policy aiming at securitization, integration, and assimilation of migrants. It will allow to maintain not only a high level of the social and economic development, but also to provide the translation of democratic values to that part of the world community that lives in regions with the totalitarian regimes of governing. Efficient management of migration flows by using the above tools will allow to maintain the reasonable balance between the openness and tolerance, as well as threats and safety.

This article has not considered methodological issues related to estimating social and economic consequences of migration. The authors offer to consider these issues in future articles on this theme.

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Input-Output Analysis of Interregional Effects

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Abstract

Multiregional input-output model is a tool for tracing the effects of economic changes in a region on the total production in another region. This approach is noticeable due to interregional spillover and feedback effects, especially in regions of the country that economic interactions between them are numerous.

In this study a non-statistical method used to estimate two-regional input-output table of Isfahan Province and other regions of Iran. The table includes 71 sectors for each region. Then, decomposing the two-regional Leontief inverse matrix, we specified types of interregional effects, including: internal and external feedback effects and spillover effects. We calculated these effects for each sector in both regions when an exogenous shock occurs. Then, sectors with the largest impact were identified in each region and using them, the intensity of interregional effects were analyzed. It can be calculated that sectors in smaller region have stronger spillover effects, therefore, smaller region is more dependence to the larger region. However, about sectors with large comparative advantages and strong intraregional linkages in the smaller region, result can be inverted. Also, the feedback effects are small in both regions, but, in the larger region are smaller, except the sectors with less spillover effects in the smaller region.

Keywords: two regional input-output model; feedback effects; spillover effects; internal effects; external effects; exogenous demand shock

JEL Classification: P25; R12; R15; R58

1. Introduction

The impact of economic shocks on regional planning will be understood properly when interactions between regions are considered in the model. Paying attention to interregional models is crucial, especially in regions of the country that economic transactions between them are numerous and economy of each region is open to other regions (Hewings *et al.* 1999). Thus, changing in exogenous demands in each one would not only lead in initial change in that region, but also through interregional effects will lead to further changes in output of all regions.

Two-regional input-input approach can be used to specify intensities and types interregional effects in an economy. Using this approach, in addition to asses' exogenous shock effects on the output of each sector in each region, is applied to specify, import and export dependence specific sector in one region on sectors in another region or relative self-sufficient level of each region - in aggregate. These measures will help regional planners to identify regional economy and make appropriate policy decisions for better planning.

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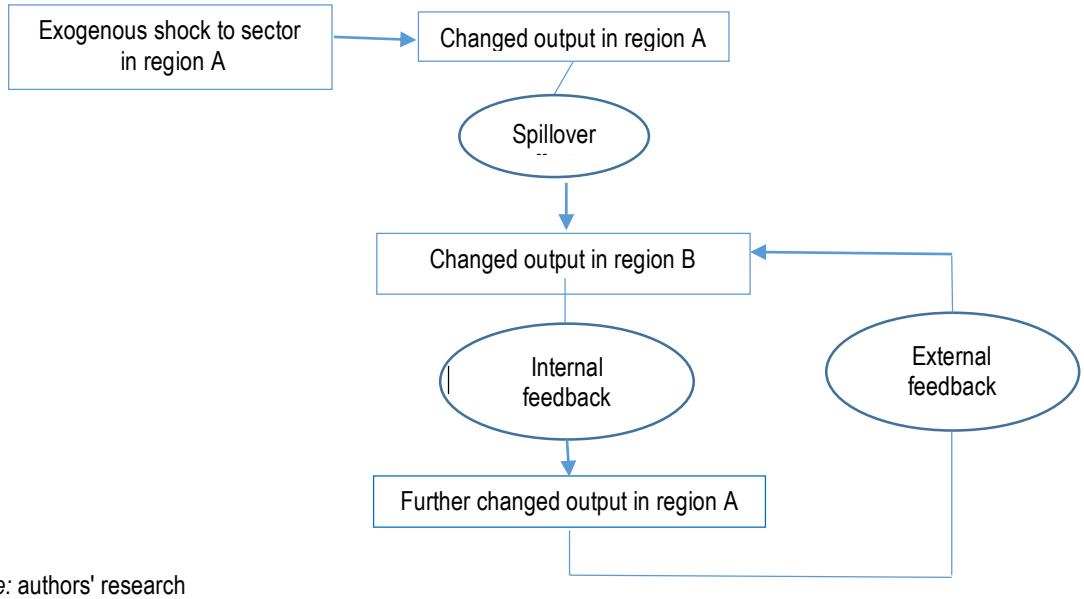
In this study, according to literature of two-regional input-output model, is developed two-regional input-output table for Isfahan province as the first region and the rest of Iran as the second region. Then, decomposing the two-regional Leontief inverse matrix, is specified how much would be variety of effects arising from interregional connections if a particular sector in one region is stimulated. It helps to be understood that by considering the relative region size, how would be the economic dependence of each region to another.

2. Literature of interregional effects

In 1970s, the importance of relationship between relative size of region and the propensity to import was considered by researchers. According to the Round research (1972) "the smaller size of the region relative to the nation, the more open the regional economy is likely to be and hence the more likely a significant proportion of goods and services will be imported from other regions" (Round 1972, 3). Also, this conclusion is provided by Richardson (1972) that is the propensity to import varies inversely with the size of region (Richardson 1972). On this basis, it can be proposed that larger regions tend to be more self-sufficient and to influence neighbors more. Multiregional input–output model allows to investigate this subject by identifying the intensities and types of spatial linkages among regions in an economy. First, in this section, types of interregional effects will be investigated, then some of the most important empirical results of intensities of them are expressed.

In framework of two-regional interregional input-output model, an increase in the final demand for one sector in a region leads to increase intermediate demand purchases from sectors in region B. This stimulus of new output in region B because of new output in region A is called an *interregional spillover*. Similarly, the increased demand for products in region B will increase the demand for inputs from sectors outside the region B that one of which might be a sector in region A. Further new output in region A is due to an *interregional feedback effect*. As the same way, the purchases loops of intermediate inputs will continue until the increasing productions in regions close to zero and the economy reaches to a new equilibrium level. This idea is illustrated in Figure 1 for more details.

Figure 1. Interregional feedback and spillover effects



Source: authors' research

Suppose that the economy consists of two regions A and B. If final demand for the output of sector *i* in region A increases, outputs of other sectors in this region will increase, because the requirements to satisfy the increased final demand within the region. This effect would be calculated with regarded to traditional coefficients inverse Leontief matrix and is called an "intraregional effect". Then, sectors in region A to satisfy their increased outputs buy some needed inputs from sectors in region B and lead to go up region B's output. Therefore, the downward arrow starts from "changed output in region A" to "changed output in region B" represents an

interregional spillover effect. Likewise, sectors in region B need more input from region A, then the further downward arrow from region B to region A is an interregional feedback effect that is called "internal feedback effect" because region A's output has increased again (in a feedback loop) due to the initial shock in itself.

In the next step, as a result of the increasing the region A's output, inputs demand of region B will be raised but in this case, increased output in region B is due to the interregional feedback effect not spillover. On the other hand, region B's output has increased again (in a feedback loop) due to the initial increase in region A's final demand, so is called "external feedback effect". Increased outputs in regions from this step onwards are caused by feedback effects.

Therefore, the spatial effects can be divided into two more general categories: internal effects and external effects. The sum of spillover effect (that is only in first round) and external feedback effect is total external effect of an increase in final demand of sector i in region A. The sum of intraregional effect and internal feedback effect is total internal effect of an increase in final demand of sector *i* in region A.

Retrospectively, there has been a large number of studies to investigate effects of interregional and their relation with relative size of regions. Although, internal feedback effects are considered in most of studies. The nub of them was primary work of Miller (1966) that suggested (internal) interregional feedback effects are very small (around 3% in the two-regional model with 10 sectors). He proposed that this result depends to intraregional linkages and degree of interdependence between regions. In contrast to, by using the eight-region model, Greytak (1970) estimated intraregional coefficient can be decreased by as much as 14 percent when interregional feedback effects are ignored. Riefler and Tiebout (1970) used a two survey-based regional model for the state of Washington and California and concluded that (internal) feedback effects are small (average error was obtained 2.95) but for Washington (small region) are larger than California. Beyers (1976) also obtained small effects for (internal) interregional feedbacks but he states key sectors in national level probably have weak linkages within region and conversely, sectors with strong linkages at regional level maybe are not considered as key sectors at the national level. In the framework of three-region model of Finland's economy, Eskelinen (1983) Recognized Feedback effects in all three regions are negligible and there is no relationship between the size of region and these effects. He states only spillover effects are the justification to use of interregional model.

Dietzenbacher (2002), decomposed interregional input-output multipliers for six Europe Union countries and also concluded feedback effects are very small. His results shows smaller countries have smaller production multipliers. Hioki (2005) developed a multi-regional model for china to provide insights on effects of coastal regions on less developed non-coastal regions. He suggested faster rate of economic growth of coastal regions lead to considerable spillover effects on non-coastal regional so that 20 percent of the total output in the inland regions is due to final demands of the coastal regions. Also, Zhang and Zhao (2005) decomposed two-regional model with 17 sectors for coastal and non-coastal of china and concluded spillover effects between them are larger than (internal) feedback effects. Bazazan *et al.* (2008), estimated the two-regional and 10-sectors model for Tehran Province and the rest of Iran by a non-surveyed method. They observed the feedback effects in model were small (about 3 percent) but spillover effects were obtained considerable. Also, Tehran (smaller region) left more spillover effects (about 17%) that means Tehran's economic dependence on other regions has been more.

3. Methodology

3.1. The estimation of two-region interregional Input–output coefficients

Two-Region interregional input–output model considers both intraregional flows within each region and interregional flows between two regions. Figure 1 shows the structure of this model for Isfahan and the rest of the Iran. Each one notations used in Figure 1 defined as follows: X^{EE}- flows between economic sectors in Isfahan; X^{EO} - flows from economic sectors in Isfahan to rest of the Iran; X^{OE} - flows from economic sectors in rest of the Iran to Isfahan; X^{OO} - flows between economic sectors in rest of the Iran; Y^{EE} - final demand of Isfahan for outputs of economic sectors in it; Y^{EO} - final demand of Isfahan for outputs of economic sectors in rest of the Iran; Y^{OE} - final demand of rest of the Iran for outputs of economic sectors in Isfahan; Y^{OO} - final demand of rest of the Iran for outputs of economic sectors in it; V^{E} - primary inputs (Value added) for economic sectors in Isfahan; V^{O} - primary

inputs (Value added) for economic sectors in rest of the Iran; X^E - total outputs of economic sectors in Isfahan; X^O - total outputs of economic sectors in rest of Iran.

Figure 2. Two-regional Interregional Input-output Table

Purchases / Producers		Intermediate demand		Final demand		Total output
		Isfahan	Rest of the Iran	Isfahan	The rest of Iran	
		Economic sectors	Economic sectors			
Isfahan	Economic sectors	X^{EE}	X^{EO}	Y^{EE}	Y^{EO}	X^E
The rest of the Iran	Economic sectors	X^{OE}	X^{OO}	Y^{OE}	Y^{OO}	X^O
Value added		V^E	V^O			
Total input		X^E	X^O			

Source: Bazazan *et al.* (2008)

The data requirements at the regional level are extremely detailed. IF two or more regions are to be connected in the model- in addition to intraregional flows data- tables of interregional flows are also needed. If there are no tables of interregional trade coefficients that can be used as "base" tables to be updated or exchanged, an approach is to regionalize the national input-output table. The regionalization of national input-output tables is a major problem in regional science because regional data is often unavailable (Jahn 2015). Because of inaccessibility to the data for interregional trade flows in Iran, the most appropriate way to regionalize national input-output table is using the location quotients [6](Banouei and Bazazan 2006). Then to estimate interregional trade coefficients, it is assumed that there is no cross-hauling. Therefore, as regards one region's (domestic) exports of a particular good in a two-region interregional model are the other region's (domestic) Import, If a region is found to be an exporter of good i, then it is assumed that all the requirements for i in that region will be met by local production and hence there will be no imports of i to region r, (Miller and Blair 2009) therefore, in the absence of import and export regional data can be written (Nevin *et al.* 1966):

$$a_{ij}^{OE} = \begin{cases} 1-(FLQ_{ij}^{E})a_{ij}^{n} & if\ FLQ_{ij}^{E} < 1 \\ 0 & if\ FLQ_{ij}^{E} \geq 1 \end{cases} \quad (3.1)$$

Let a_{ij}^{EO} denote import coefficient from the rest of the Iran to Isfahan. FLQ will be location quotients for economic activities in Isfahan. In the same way, import coefficient from Isfahan to the rest of the Iran is estimated.

After to estimate intraregional and interregional trade flows, total production for all activities in each region will be achieved. In the next section, according to the framework of Leontief demand-driven model, interregional effects are investigated.

3.2. Interregional effects

According to the rows of Figure 1, total production of all sectors in each region is equal to:

$$X^E = X^{EE} + X^{EO} + Y^{EE} + Y^{EO} + EX^E$$
$$X^O = X^{OE} + X^{OO} + Y^{OE} + Y^{OO} + EX^O \quad (3.2)$$

E and R denote Isfahan and rest of the Iran, respectively. By assuming that output is a linear function of inputs, intraregional and interregional coefficients are:

$$A^{EE} = X^{EE}(X^E)^{-1} \quad , \quad A^{EO} = X^{EO}(X^O)^{-1}$$
$$A^{OO} = X^{OO}(X^O)^{-1} \quad , A^{OE} = X^{OE}(X^E)^{-1} \quad (3.3)$$

To simplify suppose:

[6] Flegg location quotients (FLQ) that refined by Flegg and Tohomo (2013).

$$Y^E = Y^{EE} + Y^{EO}$$
$$Y^O = Y^{OO} + Y^{OE} \quad (3.4)$$

Replacement of (3.3) and (3.4) in (3.2) leads to:

$$\begin{bmatrix} X^E \\ X^O \end{bmatrix} = \left[\begin{pmatrix} I & 0 \\ 0 & I \end{pmatrix} - \begin{pmatrix} A^{EE} & A^{EO} \\ A^{OE} & A^{EE} \end{pmatrix} \right]^{-1} \begin{bmatrix} Y^E \\ Y^O \end{bmatrix} = \begin{bmatrix} I - A^{EE} & 0 - A^{EO} \\ 0 - A^{OE} & I - A^{OO} \end{bmatrix}^{-1} \begin{bmatrix} Y^E \\ Y^T \end{bmatrix} \quad (3.5)$$

(3.5) can be rewritten as:

$$X = LY \quad (3.6)$$

L is Leontief inverse matrix. If *n* is the number of sectors in each region, the dimensions of L will be 2n×2n. Leontief inverse matrix can be decomposed and used to investigate the feedback and spillover effects. For this purpose, it be rewritten as follows:

$$L = F.S.M$$
$$F = \begin{bmatrix} F^E & 0 \\ 0 & F^O \end{bmatrix}, S = \begin{bmatrix} I & S^{EO} \\ S^{OE} & I \end{bmatrix}, M = \begin{bmatrix} M^E & 0 \\ 0 & M^O \end{bmatrix} \quad (3.7)$$

So that:

$$M^E = (I - A^{EE})^{-1} \quad ; M^O = (I - A^{OO})^{-1}$$
$$S^{EO} = (I - A^{EE})^{-1} A^{EO} \quad ; S^{OE} = (I - A^{OO})^{-1} A^{OE} \quad (3.8)$$
$$F^E = (I - S^{EO} S^{OE})^{-1} \quad ; F^O = (I - S^{OE} S^{EO})^{-1}$$

In terms of intra- and interregional effects, M records intraregional effects, S includes interregional spillover effects and F contains interregional feedback effects (Round 1985, 2001, Dietzenbacher 2002). To isolate interregional effects, Stone (1985) proposed the additive, as follows:

$$L = I + (M - 1) + (S - 1).M + (F - 1).S.M \quad (3.9)$$

Therefore:

$$X = I.Y + (M - 1).Y + (S - 1).M.Y + (F - 1).S.M.Y \quad (3.10)$$

That means:

$$\begin{bmatrix} X^E \\ X^O \end{bmatrix} = \begin{bmatrix} M^E & 0 \\ 0 & M^O \end{bmatrix} \begin{bmatrix} Y^E \\ Y^O \end{bmatrix} + \begin{bmatrix} 0 & (S^{EO} - I)M^O \\ (S^{OE} - I)M^E & 0 \end{bmatrix} \begin{bmatrix} Y^E \\ Y^O \end{bmatrix} + \begin{bmatrix} (F^E - I)M^E & (F^E - I)S^{EO}M^O \\ (F^O - I)S^{OE}M^E & (F^O - I)M^O \end{bmatrix} \begin{bmatrix} Y^E \\ Y^O \end{bmatrix} \quad (3.11)$$

In this way, outputs equations of regions are written, as follows:

$$X^E = M^E Y^E + \underbrace{(S^{EO} - I)M^O}_{\widetilde{S}^{EO}} Y^O + \underbrace{(F^E - I)M^E}_{\widetilde{F}^{EE}} Y^E + \underbrace{(F^E - I)S^{EO}M^O}_{\widetilde{F}^{EO}} Y^O$$
$$X^O = M^O Y^O + \underbrace{(S^{OE} - 1)M^E}_{\widetilde{S}^{OE}} Y^E + \underbrace{(F^O - I)M^O}_{\widetilde{F}^{OO}} Y^O + \underbrace{(F^O - I)S^{OE}M^E}_{\widetilde{F}^{OE}} Y^E \quad (3.12)$$

The first term on the right-hand side of the first equation of (3.12) measures intraregional effects of Isfahan' economic sectors. The second term is the interregional spillover effects from the rest of the Iran to Isfahan that are shown with $\widetilde{S}^{EO}$. The third term is internal feedback effects, that are feedback effects from Isfahan to Isfahan $\widetilde{F}^{EE}$

and the fourth term is external feedback effects, that are effects of final demand changes of the rest of Iran on Isfahan' output in feedback loops. Similarly, the second equation of (3.12) captures intraregional and internal feedback effects ($\widetilde{F}^{OO}$) when final demand of sectors in the rest of Iran are changed, also, spillover effects and external feedback effects due to changing final demand of sectors in Isfahan.

Therefore, total internal effects of each region are achieved by summing the first and third terms of its equation but, the External effects of each region will equal the sum of the second and fourth terms of other region's equation.

Using relationship (3.12), we can measure how much would be a variety of effects arising from interregional connections. Quantification of interregional effects and recognition of sectors that can make the greatest economic regional and national impacts, are discussed in the first two parts of section 6. Also, by comparing the amount of interregional effects of each region, the economic dependence of every region to another is specified in the last part of that but, the statistical foundations of the study and the economic situation of Isfahan in Iran are discussed before that.

4. Statistical foundations

A major issue in regionalization is level of sectors' disaggregation. According to Lahr (1993) some authors have discussed that "smaller models are the best for small regions". However, it has been shown that aggregation leads to obscuring sectoral details and causes an aggregation bias, hence, Lahr (1993) concluded that regional input-output table should remain "as detailed as possible" and, that means, at a high level of disaggregation (Kronenberg 2007).

Statistical Center of Iran produced survey-based table every five years. Latest national input-output table coefficients is generated in 2011 and published in 2016 that is based to determine and calculate two-regional interregional input-output table of Isfahan and the rest of Iran. This table was published at 71-sector classes according to ISIC (International Standard Industrial Classification). Therefore, two regional input-output table is 142×142 including two regional input-output tables and two interregional tables that each of them is 71×71.

Also, statistics of regional production calculations of all provinces of Iran are published on an annual basis have been used to adjust national input-output table coefficients and to calculate FLQ modifier. Statistical tables of Iranian regional calculations include 72 sector that are widely adopted with national input-output classification 2011.

5. The economic situation of Isfahan in Iran

Isfahan province is situated in the center of Iran and its area covers 6/57 percent of country. In the year 2012, the province with about 5 million people was third most populous province that contained 6.5 percent of the population of the nation. Isfahan has 11.6 percent of total industrial employment and ranks as the second most important industrialized region in Iran after Tehran. The largest of the industries of Isfahan are the two steel mills which belong to basic metal sector. About 7.7 percent of total GDP was produced in Isfahan that the share of agricultural, industrial and service sector in province's GDP was 5.5 and 60/9 and 33.6 percent, respectively. The share of these sectors of the country's GDP have been 8/7, 51.8 and 39.5, correspondingly.

The largest sectors in Isfahan in terms of GDP were manufacture of coke, nuclear and petroleum products; manufacture of basic metals; and wholesale, retail and repair of motor vehicles and goods. Also, these sectors have had the largest purchases of intermediate input, in the same ranking and have created the most value added such that third sector was placed in first and the others have achieved second and third places, respectively. At national level, Wholesale, retail and repair of motor vehicles and goods; extraction of crude petroleum and natural gas; and manufacture of coke, nuclear and petroleum products are ranked as the largest sectors based on the GDP. However, manufacture of coke, nuclear and petroleum products; manufacture of food products and beverages; and wholesale, retail and repair of motor vehicles and goods have used the most intermediate inputs at national level. The most value added is created by extraction of crude petroleum and natural gas in Iran.

6. Empirical results

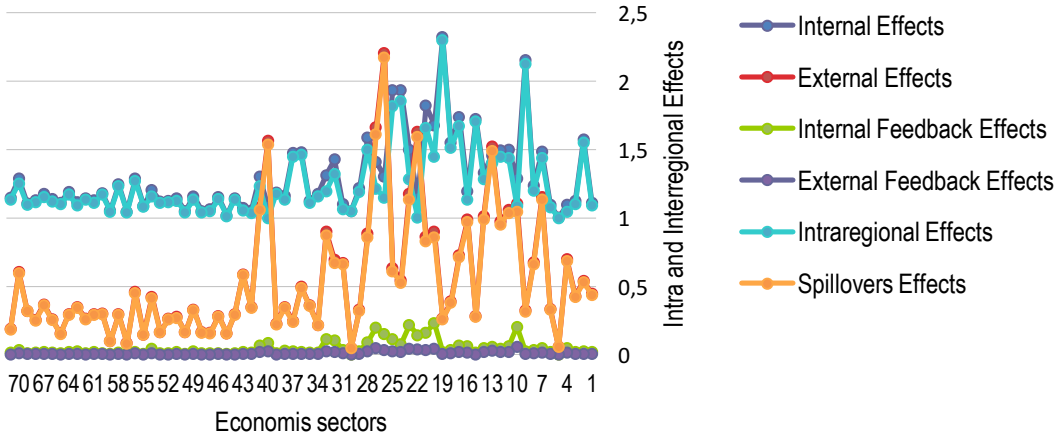
6.1. Analysis of decomposing the Isfahan Province Leontief model

Decomposing the Isfahan province Leontief model consists of two effects: internal and external effects. The internal effects show the effects of final demands changes in Isfahan's sectors on the output of this province and the external effects are indicatives the effects on the output of other regions of Iran.

Figure 3 included, all intra and interregional effects due to decomposing the Isfahan province Leontief model. The blue series specifies intraregional effects (M^E) resulting from a unit (one rial in Iran's currency) change in final demand of each sector in Isfahan on the total output of this province (total output multiplier). The most intraregional effect is caused by the manufacture of basic metals (19th No.) with multiplier 2/3. This means if not considered interregional connections, a monetary unit investment in the manufacture of basic metals (that is a case of final demand increase) will increase output of Isfahan province by 2/3. After this sector, the manufacture of textiles (9th No.) ranks second sector (multiplier 2/15) and both sectors including the manufacture of radio, television and communication equipment (24th No.) and the manufacture of medical, precision and optical instruments, watches and clocks (25th No.)), by a small margin have gained third place (multipliers about 1/93).

Green color series ($\widetilde{F}^{EE}$) indicates internal feedback effects that show if an initial increase in final demand of each sector of Isfahan occurs, how much Isfahan's output will increase only after feedback loops. In the other word, the amounts of this series indicate if interregional effects are not considered, how much of changing in Isfahan province- trough changing in output per sector- is not calculated. According to the results, the manufacture of fabricated metal products except machinery and equipment (20th No.) with multiplier 2/23, the manufacture of electrical machinery and apparatus n.e.c (23th No.) with multiplier 0/22, and the manufacture of leather and related products (11th No.) with multiplier 0/2, have the most feedback effects for Isfahan province, respectively. The sum of intraregional and internal feedback effects has been displayed in the series of internal effects, that is the total effect of increasing a monetary unit in final demand of each Isfahan' sectors on total production of this province. It shows the manufacture of basic metals has the most internal effect on Isfahan's output so that one-unit monetary increasing in final demand of this sector will affect the total production of the province up to 2/32. Internal effects are almost matched with intraregional effects due to small internal feedback effects.

Figure 3. Empirical results of decomposing the Isfahan province's Leontief model

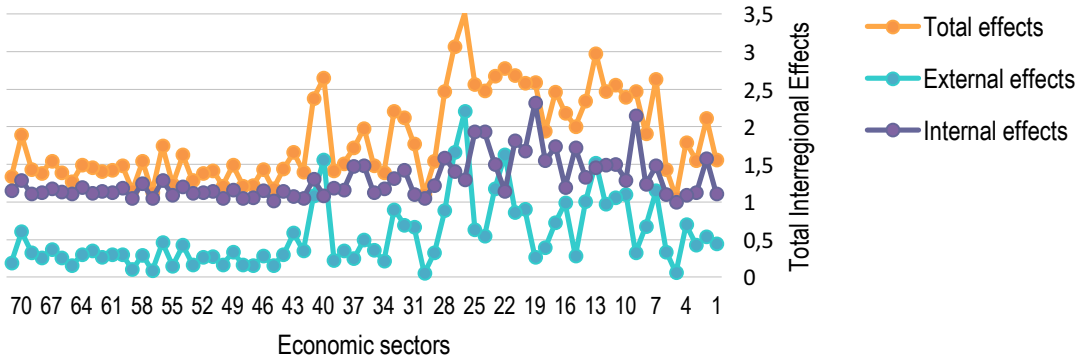


Source: results of research

Also, regarding the external effects of final demands changes in Isfahan's sectors, results in the orange series determine how much intermediate inputs are purchased from other regions of Iran if final demand increases

in Each of the 71 sector in Isfahan, that is spillover effects ($\widetilde{S}^{OE}$). It can be seen that the manufacture of motor vehicles, trailers and semi-trailers (26th No); the manufacture of other transport equipment (27th No); and the manufacture of office, accounting and computing machinery (22th No), leave the most spillover effects, respectively. The violet series ($\widetilde{F}^{OE}$) shows the external feedback effects that are obtained very small. Results in this series state the manufacture of wearing apparel (10th No) with multiplier 0.06 ranks as the first. It means increasing of final demand in Isfahan' manufacture of wearing apparel as a result of internal feedback effects changing the output of other regions by 0.06 in further feedback loops. After this sector, the manufacture of other transport equipment (multiplier 0.05); and the manufacture of electrical machinery and apparatus n.e.c (multiplier 0.05) of Isfahan have the most external feedback effects for other regions. Taking together the two series of external spillover effects and external feedback effects, the overall external effects (ΔX^{O}) caused by the increase in final demand of the province is calculated. Because the external feedback effects are very small, the total external impacts are almost identical with spillover effects, hence, the results show the manufacture of motor vehicles, trailers and semi-trailers (26th No) has the most external effect in the province so that one-unit monetary increasing in final demand of this sector induced production of the rest of Iran by 2.21.

Figure 4. Total effects of exogenous shocks in sectors of Isfahan



Source: results of research

Finally, Figure 4 shows the impact of increasing in final demand of Isfahan' sectors on total production of Iran that it becomes of adding the total internal effects (ΔX^{E}) and the total external effects (ΔX^{O}). As specified, a change in final demand of the manufacture of motor vehicles, trailers and semi-trailers (26th No) in Isfahan will have the greatest impact on the total production of the country. Comparing the three series in Figure 4 shows that taking into account the spillover effects has much influence on ranking the sectors in terms of changing total production, such as the manufacture of basic metals (19th No) which has the largest internal effects, is ranked the tenth in total effects.

The last column of the both table shows similar numbers that means it is not matter that one-unit investment in one sector in which region is done. The main reason for the similarity between the total effects in both region is the comparative advantages of each region resulting of formation of regional trade. In the other word, interregional spillover and feedback effects that come from comparative advantages of each region leads to uniformity of total effects one sector in both regions.

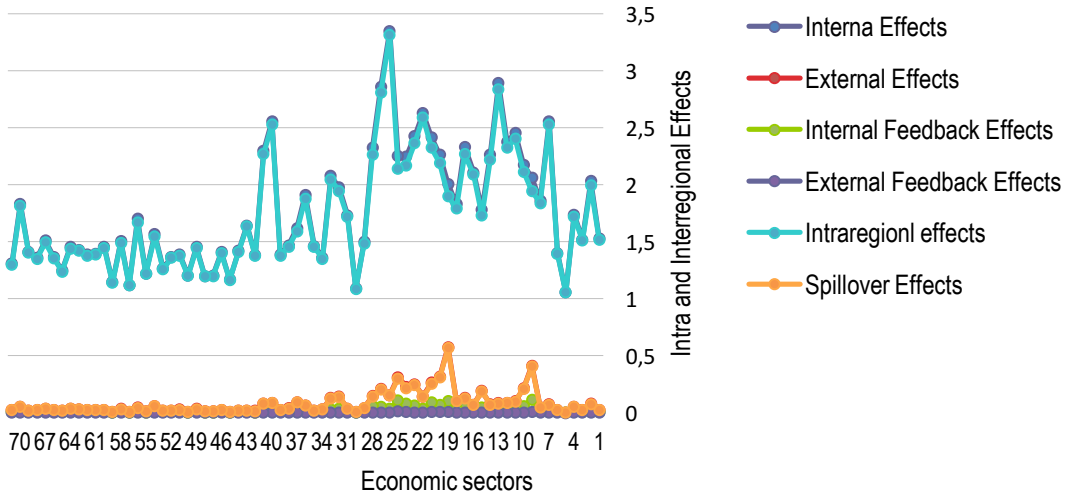
6.2. Analysis of decomposing the Leontief model of the rest of Iran

Figure 5, shows the internal and external impacts due to changing final demand of the rest of Iran. The part of internal effects series is related to intraregional effects that shows if interregional effects are not taken into account, the manufacture of motor vehicles, trailers and semi-trailers (26th No); the manufacture of paper and paper products (13th No); and the manufacture of other transport equipment (27th No) have the greatest impacts on the total

production of region- their regional production multiplier are 3/32, 2/84 and 2/81, respectively. According to the sectors with the greatest spillover effect in Isfahan, it can be seen that the economy of Isfahan has the greatest dependence on sectors of the rest of Iran with strong intraregional linkages (the manufacture of motor vehicles, trailers and semi-trailers; and the manufacture of other transport equipment). Also, the manufacture of paper and paper products; is placed on fourth of this ranking after the manufacture of office, accounting and computing machinery (22th No).

The other part of internal effects of economic sectors in rest of Iran is the internal feedback effects ($\widetilde{F}^{OO}$) that have been obtained very small. The manufacture of textiles (9th No); the manufacture of medical, precision and optical instruments, watches and clocks (25th No); and the manufacture of basic metals (19th No) have created the greatest influences on total production of region in feedback loops. Total two series of intraregional and internal feedback effects that are caused by stimulating the rest of Iran's final demand show the most internal effect belongs to the manufacture of motor vehicles, trailers and semi-trailers so that one unit monetary increasing in final demand of this sector raises the output of the region by 3/35.

Figure 5. Empirical results of decomposing the Leontief model of the rest of Iran



Source: results of research

Also, Figure 5 specifies the external effect in the sense that, one monetary unit increase in final demand in the rest of the country how much influence the total production of Isfahan province. The part of it shows the spillover effects ($\widetilde{S}^{EO}$) so that, based on the results, the manufacture of basic metals (19th No); the manufacture of textiles (9th No); and the manufacture of fabricated metal products, except machinery and equipment (20th No) have the most dependence to Isfahan' economy (their impact multipliers are 0/57, 0/4 and 0/31 respectively). Also, according to external feedback effects series($\widetilde{F}^{EO}$), the manufacture of medical, precision and optical instruments, watches and clocks (25th No); the manufacture of machinery and equipment n.e.c (27th No); and the manufacture of radio, television and communication equipment and apparatus (24th No) left the most external feedback effects- the impact multipliers are 0.012, 0/011 and 0/01, respectively. Total of spillover effects and feedback's series (total external effects) shows the manufacture of basic metals has the most of external effects so that one increase in final demand of this sector, raises the production of Isfahan by 0.57.

In this model, the total effects that are not so different with internal effects because external effects are small. This result is because of the larger economy of the rest of Iran relative to Isfahan' economy and less dependence of it. In other word, the larger size of the region, the more transactions and intersectoral linkages is probably to be. In the next section is more talked about dependence of each region and its relationship with size of

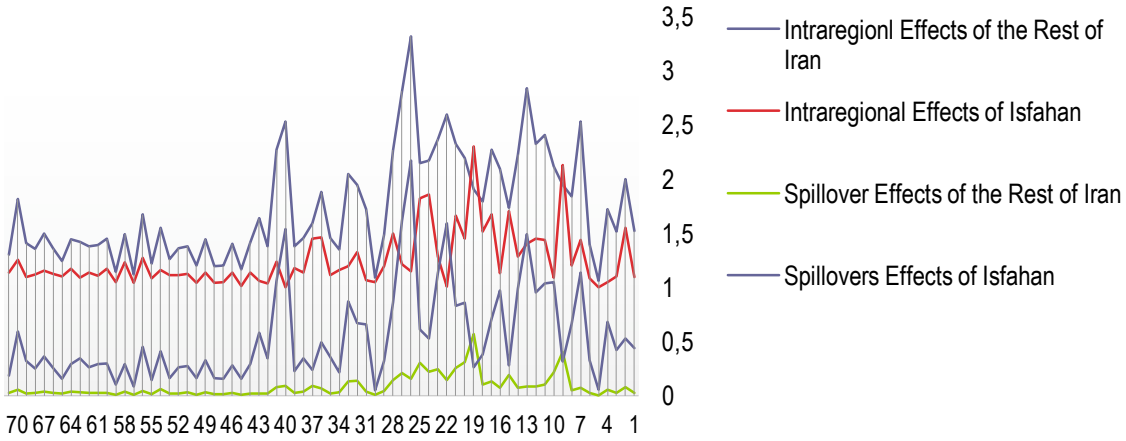
region. Results of total effects state changing in final demand of the manufacture of motor vehicles, trailers and semi-trailers creates the most total effect on Iran's output-it is observed that this sector have had the most internal effect, too.

6.3. The relationship between interregional effects and size of regions

Figure 6 shows the intraregional effects of the rest of Iran (large region) are larger than Isfahan (small region) for all sectors (except the manufacture of basic metal and the manufacture of textiles). That means intersectoral connections in larger region is stronger relative to smaller region.

In aggregate, it is expected that dependence of larger region be less or the spillover effects of larger region be smaller.

Figure 6. Comparing the results of Isfahan and rest of Iran's models



Source: results of research

Comparing the spillover effects of two regions shows that these effects resulting from sectors of Isfahan province are larger for the majority of sectors. This observation can be considered consistent with the theory of regional that is, the smaller size of the region (Isfahan province), the more dependence of regional economy to intermediate inputs of the larger region (the rest of Iran) is likely to be, in aggregate. At sectoral level, a unit changing in final demand of smaller region's sectors has a greater impact on the larger region except sectors with strong intraregional linkages (comparative advantage) in smaller region-In this case the dependency relationship can be reversed.

Internal feedback effects resulting from Isfahan in all sectors are larger from the rest of Iran, except the manufacture of basic metal and the manufacture of textiles. Also, this comparison can be stated as an overall number by dividing the sum of internal feedback effects on the sum of internal effects (third column) multiplied by 100. This is an error measure of ignoring the interregional effects (Miller 1996). This measure is obtained 3.55 percent for Isfahan and 1/54 percent for the rest of Iran. Both numbers are small but for large region is smaller. Interregional feedback effects affected by two factors:

1. the spillover effects that affect the output of the second region (initial changing occurs in the first region) so that, the more spillover effects, the more internal feedback effects are to be in the first region;
2. intraregional effects in the second region that the stronger intraregional linkage, the less internal feedback effects. If large region is considered as the first region, both fewer spillover effects are created and intraregional in small region is weaker, as a result, internal feedback effects in large region (the rest of Iran) are smaller than small region (Isfahan).

Through two sectors - the manufacture of basic metal and the manufacture of textiles, large region (the rest of Iran) leaves so much larger spillover effects thus, counteract the effects of strong intraregional connections in these sectors in small region. Hence, the internal feedback effects resulting from these sectors are greater in the larger region.

Also, external feedback effects resulting from an initial changing in final demand of Isfahan are larger than the rest of Iran except the manufacture of basic metal and the manufacture of textiles. This result is obvious because the internal feedback effects and the spillover effects -that determine the amount of external effects- in Isfahan are larger than the rest of Iran except for two mentioned.

Conclusion

In this study, in terms of theoretical and empirical ways, interregional effects are investigated. Most studies in this context have focused on internal feedback effects. Besides that, we have paid special attention to the external effects of exogenous shock and decomposed them into spillovers and external feedback effects. In this way, the impact of a variety of effects on each other effects could be explored.

For this purpose, the two-regional interregional input-output tables of Isfahan and the rest of Iran was estimated. Each region includes 71 economic sectors. Then, using Leontief inverse matrix decomposition, interregional effects were calculated when an exogenous shock occurs for each sector in each region. According to the results, it was observed that:

- intraregional linkages in larger region is stronger relative to smaller region, hence, the spillover effects of larger region are smaller and hence, the dependence of the larger region to the economy of the smaller region is less;
- for both larger and smaller regions, the internal feedback effects are small but, for the larger region is less because, spillover effects of most sectors in the larger region are less and also, intraregional connections for the most sectors in small region are weaker;
- external feedback effects due to an initial changing in final demand of smaller region are greater than larger region, because the spillover effects resulting from small region and the internal feedback effects in it are greater than larger region;
- sectors with comparative advantages and strong intraregional linkages in the smaller region leave less spillover effects and thus, have less internal and external feedback effects. Therefore, spillover effects can play a decisive role in determining the feedback effects.

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Quantification of Possible Level of Cost Reduction in Enterprise as a Result of Intensification of Production Processes

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Abstract:

The article presents a comparative model system for quantification of the level of change in total production process costs in enterprises. These are changes in the level of costs attained in connection with the application of intensification measures in a given production process or processes which are linked logistically with the production process and measures expressed in them in the production process. Intensification measures allow the attainment of higher process performance, which is expressed in a growth in the level of production. This fact has a possible echo in the possibility of reducing total process costs. The presented model allows an informationally correct quantification of the level of reduction in total process costs in the context of comparison of process variants. The article also presents an information analytical model determination of possible distortion in the level of change of total process costs in the case of a cost comparison of process variants. This information distortion of the level of savings on process costs then initiates a further distortion in potential decisions of managers, who apply these distorted information inputs to subsequent solutions of decisive situations in the enterprise. Our article has been written in order to avoid the occurrence of the input information conditions leading to the formation of such incorrectly taken decisions.

Keywords: algorithmization; information distortion; intensification measures; comparative model; process costs; production process; decision-making

JEL Classification: D24; L23; M11

1. Introduction

One of the most significant ways to attain an increase in the effectiveness of enterprises' operation is to reduce their costs (Wheeler 2010). This means that through their effective management we wish to ensure that the enterprises are low cost. However, ineffective, uncontrolled reduction in costs can even have fatal consequences, for example in the area of quality of products (goods, services) that are the output of the enterprise's production activity (Šnapka and Mikušová 2014). Therefore, it is necessary to perform an ongoing evaluation of the level of attained changes, including the cost aspect of the applied measures, focusing on reduction of costs in the enterprise. One can also say that it involves an evaluation of attained savings on corporate costs leading to an increase in the effectiveness of the given enterprise without a deterioration in the level of fulfilment of other target parameters of its operation. This involves, for example, a reduction in the level of labour productivity, the aforementioned quality of its production, introduction of necessary innovations etc.

2. Cost reduction approaches

There are many strategic ways to achieve a cost reduction of a given enterprise. The following examples can be given:

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- cost cutting, *i.e.,* essentially the application of crisis measures associated with a rapid reduction in costs (for example through redundancies, significant pressure on suppliers to reduce the prices of supplies and extend the payment deadlines for them, application of outsourcing and centralization of buying, pay cuts and profit reductions etc.);
- application of lean process, which is the result of cost management. This involves the long-term elimination of activities, which bring no added value with the application of the ideas of the enterprise's employees. But in this case it does not involve merely a reduction in costs, but in compliance with customer requirements a search for an implementation of measures leading to the attainment of maximum possible quality of the given product for the customer at a commensurate price and an increase in his satisfaction with the aim of retaining him;
- searching for and applying intensification measures in processes (first and foremost in production processes and the processes logistically linked with them) leading to an increase in their productivity (intensification, effectiveness), allowing attainment of growth of production or financial output (yield) from the implementation of production from the given production process. They also lead to a reduction in unit costs of production processes compared to the costs before the implementation of these measures. A reduction in these costs for a unit of production (production process output) then leads to savings on total process costs of the given production process following the implementation of intensification measures. However, this fact leads to the necessity of implementing an analytical evaluation (quantification) of the level of savings of total costs compared to the level of total process costs before the application of intensification measures.

It is possible to consider other approaches to the implementation of measures leading to a reduction in total costs of the implemented processes in enterprises (Rajnoha *et al.* 2016). However, in this article we will analyse the designation of the level of savings of total costs of production processes linked with the process intensification in the sense of the measures designated under letter c).

The evaluation of the level of savings (reduction) of costs resulting from intensification of processes, in particular in connection with production processes, is significant from the information aspect because there is an increase in labour productivity resulting from process intensification. This then leads to an increase in the effectiveness of the level of output of the given process. So, it does not involve an absolute reduction of linkage and consumption of process potentials (for example, production ones), *i.e.,* direct savings which could lead, inter alia, to a reduction in or stagnation of labour productivity and in the final analysis to a reduction in the required production-economic performance of the economic systems. This is also a reason why we wish to analyse in the article the possible objectification of quantification of the level of savings (reduction) in costs resulting from process intensification in connection with the application of a comparative model for quantifying the level of savings of total production process costs. This means process variants without changes of input structure of total process costs.

In the context of the comparative model, it will involve a solution to the potential information inaccuracy of quantifying the changes in total costs for implementation of production processes the output of which is the specifically required production and the process costs for its attainment associated therewith. The aim is the information precision of quantification of application of low cost management. At the same time, a reduction in process costs is not attained through a direct reduction in the costs of the inputs and operational implementation of production processes, but through an intensification of processes leading to a growth in production compared to their attained level before this intensification. Structurally, based on cost calculation, it will involve combined costs (two groups of costs): fixed and variable costs depending on the change in level of production. Variable costs will be of the type proportionate costs. The level of fixed and proportionately variable costs will be designated for the input process variant (V_I), *i.e.,* variants before application of intensification measures designated in a certain proportion. This proportion will be expressed by a ratio, *i.e.,* proportionate figure or percentage of the specified cost groups. The two-group composition of process costs will also be preserved in the next cost evaluation, *i.e.,* in the context of the comparison of changes to the level of total process costs following the application of process intensification measures, but in connection with the changed level of unit operating costs arising from the higher

use of fixed costs by a growth in production volume. The proportion is defined by calculation for unit process costs designated /$UC_I(Q_I)$/, *i.e.,* costs of the process variant (V_I), with attained production (Q_I). The process variant (V_I) will consist of the base for determining the level of total costs for the variant (V_{II}) as a result of the cost comparison of process variants (V_I) and (V_{II}). Variant (V_{II}) is linked in terms of process with the application of intensification measures. In the case of a group of proportionately variable costs, these costs per unit of production will be constant.

For the aforementioned structural composition of total process costs in connection with the change in the level (volume) of production (for example, output from given production process), we can describe the course of the change in the level of these costs using the following functional Eq. (2.1):

$$TC(Q) = FC + UCVp \,.\, Q \tag{2.1}$$

and

$$UCVp \,.\, Q = TCVp \tag{2.2}$$

where: TC(Q) – total costs of production process depending on final level of production (for example in monetary units/period, *i.e.,* for the period over which we are monitoring production and ascertaining the level of costs); FC – level of fixed costs of given production process for monitored (evaluated) period in monetary units per period (m.u./period); UCVp – level of unit variable (proportionate) costs of production process, *i.e.,* costs for unit of production, for example p.u./pcs; Q – level (volume) of production for the monitored (evaluated) period, for example in items per period (pcs/period); TCVp – total proportionately variable costs of production process in p.u./period for given production Q.

From the Eq. (2.1) we can then derive the unit costs for production /UC(Q)/, *i.e.*, costs per unit of production (output from production process). We determine the level of these unit costs from the following equation:

$$UC(Q) = \frac{TC(Q)}{Q} \tag{2.3}$$

After the insertion of Eq. (2.1) into Eq. (2.3) we arrive at the equation for quantification of the course of unit costs of a given production process in relation to the change in the level of production in the form.

$$UC(Q) = \frac{FC}{Q} + UCV_p \tag{2.4}$$

and then:

$$\frac{FC}{Q} = UC_F(Q) \tag{2.5}$$

where UC_F is the level of unit costs from the fixed structural part of the total costs of the given production process, for example in m.u./pcs.

From Eq. (2.4) it is evident that there is a change in the level of unit costs in the total, for example management defined, production interval of the change in level of production (Q). This means that there is a change in the level of unit costs /UCF(Q)/ in the direction of their reduction. The reduction occurs in connection with the level of production change up to the maximum possible production of the given process (upper limit of possible change in production level in context of production interval).

The upper limit of the possible production interval is defined on the basis of an evaluation of the criteria representing a material limit of the level of the possible production. This involves, for example, criteria specifically linked to:

- level (degree) of possible time and performance use of tangible fixed assets applied in production process, *i.e.*, use of machines, equipment complex etc.;
- limit in level (degree) of intensity and productivity of live work;

- level of faults (frequency and duration) in linked logistical processes and in the actual production process;
- limit of level of possible sale of products from given process, which indirectly via costs initiates a limit in the target level of production;
- any comparable limit with other specific content influencing the level of production in system terms.

In order to perform an evaluation of the importance and designation of weightings for the criteria we can use the method of multicriteria analysis, including Saaty's method (Saaty 1980, 1996). As a result of the linkage of several criteria influencing the decision-making about the choice of intensification measures and determination of the limits of production process limitations, it is expedient to use analytical findings associated with an increase in the effectiveness of the course of the group decision-making process (Kašík and Šnapka 2012, 2013, 2015).

As far as are concerned the content characteristics of the intensification measures applied in the processes the aim of which is an increase in production (process production efficiency), this characteristic can be given subsequently. In view of the analytically considered comparative procedure for the evaluation of change (reduction, savings) in total costs of the production processes resulting from the application of intensification measures, we will consider such measures as will not primarily initiate structural changes in the total costs of the production process, and this shall be by preserving the level of fixed costs, and the variable costs will increase commensurate to production. This means that they will not lead to an absolute reduction in the fixed component of total process costs, and a level of unit proportionate costs will be achieved that is the same as the level before the implementation of the intensification measures. In the following part of the article we will give our total methodical system (procedure) of cost comparison with quantification of changes (reduction) in level of total costs of the given production process in the context of the given variants for implementation of the production process, both before and after its intensification. This will be a part containing a description of the specific logic of the comparative cost system in the sense of the above two variants (V_I) and (V_{II}) of implementation of the given production process. With regard to the examples of intensification measures allowing a variant increase in the level of production from the given production process without their application leading to a change (in the above sense) in the structure of the fixed and proportionately variable component of the total costs of this process, it is possible to present these in the following form:

- application of measures associated with the elimination of faults with the aim of increasing the time and performance production utilization of equipment in the production process (measures based on changes to the system of organization and process management of production process in the logistics sense);
- ensuring the conditions which allow attainment of higher labour productivity of performing workers of a given production process and in processes logistically linked in terms of system with the given production process;
- application of process measures leading on the one hand to growth in the level of fixed costs in the context of certain sub-components of these costs whilst ensuring the growth in the level of production, but on the other hand in other components these costs will drop in such a way that the level of fixed costs remains preserved at the level of these costs before the application of the process measures. Or the application of intensification measures will result in growth in unit proportionately variable costs in certain sub-components, but at the same time this growth will be eliminated by the application of measures leading to their reduction in the context of other components of these costs in such a way that the level of the unit variable-proportionate costs as the level of the process variant (VI) is preserved. Everything must be performed in such a way as preserves the ratio of the level of the fixed and proportionately variable component of total costs of the given production process for production at the level (QI) which was recorded before intensification. To compile measures of this type it is possible to use analytical findings from the system for calculation (calculation item evaluation) of the product from the given production process in the context of an attempt after intensification of this process with the aim of savings of total costs for production for a given period.

3. Solution to the system of quantification of level of changes (reduction, savings) of total costs of the production process based on comparison

In the first part of the article, it was already stated that one of the significant ways to increase the effectiveness of the activities of enterprises measured, for example, via the profitability indicators, is the finding and implementation of measures leading to a reduction in total process corporate costs. These measures are associated with an absolute or relative reduction in consumption and indirectly also with the linkage of potential via which (in the context of their consumption and linkage) in the production processes and other logistically linked processes there occurs the creation of production demanded by the consumer in the sense of need. And it is precisely the level of consumption and linkage of potential as arises from the quantitative financial analyses (for example pyramidal) of effectiveness of corporate trading that are the most significant system components influencing the achieved level of effectiveness of the given enterprise's trading. For this reason, it is very important from the system aspect for targeted management of effectiveness of the enterprise's trading to manage, which means to analyse and evaluate the area of consumption and linkage of the above-considered potentials. In addition to everything else, it also initiates the necessity of an evaluation (combined with quantification) of the benefit (effect) in the form of a reduction in total process costs of an enterprise as a result of intensification of corporate processes and the processes linked logistically therewith. This is thus an evaluation of cost reduction resulting from the implementation of measures allowing the attainment of these savings in the area of process costs. In other words, this is an evaluation (quantification) of the rationality and required target benefit of implementation of the actual process for management of cost consumption of potential in the context of production processes in the enterprise.

For the evaluation (quantification) of the level of change (savings) of process costs (on the basis of intensification of processes), it is necessary to compile and apply a system of quantification on the basis of comparison of the level of total production process costs before and after the performed intensification. This system should provide objective, materially correct information about the level of changes in the area of total process costs. Without objective credibility of information about the changes in the level of process costs as a result of intensification, the system of cost management would be ineffective, with a high level of uncertainty. We subsequently give the analytical structure of the configuration of the system for quantification of the level of changes (savings) of process total costs, which should fulfil the requirements of information reliability of quantification of cost changes.

4. Configuration of comparative model for quantification of changes (savings) of total costs of production processes

The analytical foundation of the comparative model for quantification of changes (savings) of total costs of production processes in the enterprise (hereafter comparative model) will be based on practical experience from cost management in enterprises. The level of production costs is derived from the calculation of costs per production unit. From the calculation derived level of costs per production unit as unit costs we are then capable of determining the level of total costs for the designated (required) volume of production. This means, as is known from the cost calculation system, that according to consumption of process potentials (such as enterprise assets, human potential etc.) we can determine the costs per unit of production, and from the product of the level of production for which we have a designated unit cost and this unit cost we get information about the total level of costs for the projected (or attained) level of production, for more see the below Eq. (4.1).

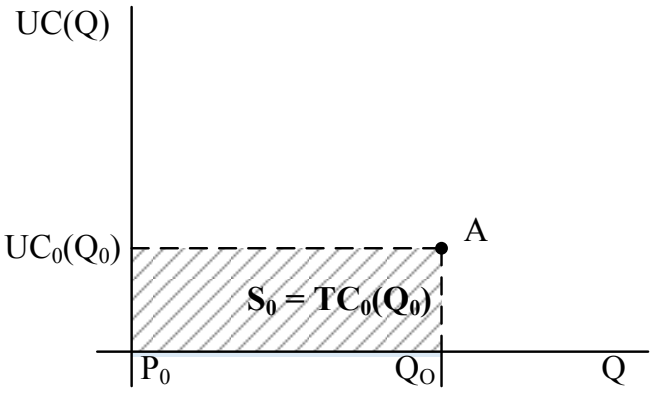
This means that in relation to the already specified Eq. (2.3) we get Eq. (4.1) in the form:

$$TC(Q) = UC(Q) \,.\, Q \tag{4.1}$$

In the context of the coordinate system, we can depict the above equation geometrically as a flat rectangle. The coordinate system contains two variables, *i.e.*: variable describing the level of unit costs of the product from the production process/symbolically designated as the variable UC(Q) and variable describing the level of production (Q) at which the level of the unit process cost UC(Q) is attained. The characterized coordinate system including depiction of surface $S_0 = TC_0(Q_0)$ for geometric interpretation of total costs of the production process for

production at the level (Q_1), *i.e.*, unit cost $UC_0(Q_0)$ is depicted in Figure 1. With the use of Eq. (4.1) then $S_0 = TC_0(Q_0) = UC_0(Q_0) \,.\, Q_0$.

Figure 1. Geometric depiction of surface S_0 presenting the level of total costs $TC_0(Q_0)$



For designating the level of total costs according to Eq. (4.1) we can in general consider the size of the surface (Si) for i = 1, 2…n, where index (i) is the index for distinguishing the level of production with possible designation (Qi). The size of change of surface (S_0) in Figure 1 in the general designation of surface (Si) for various levels of process production (Qi) will change in a linear fashion only with the change of production volume, *i.e.*, for various levels of production (Qi) under the assumption that the total process costs will be structurally composed only of proportionately variable costs, as we can see from Eq. (2.1) and Eq. (2.2). Nevertheless, for the considered comparative model we will consider mixed total costs, *i.e.*, both proportionately variable costs and fixed costs (absolutely fixed). It is the regular structural composition of total costs during a calculation of production process costs. As has already been shown in the comparative model for analysis of cost changes resulting from process intensification, we will accept this two-type composition of total costs. But we must amend the concept of fixed and proportionately variable unit costs for compilation of a comparative model analytically in relation to the system basis we are considering for the compilation of a comparative model for evaluation of the changes in the level of total costs before and after the implementation of intensification measures in the given production process. As has already been stated, the intensification process measures are focused on growth of process production, and there is no change in the cost function presented by Eq. (2.1). From Eq. (2.1) we can designate the level (course) of the unit costs of the production process via Eq. (2.4). From Eq. (2.4) it is evident that given an increase in the level of production (Q) resulting from the intensification of the production process, there is a drop in the unit costs from the fixed component of the total process costs /UCF(Q)/. The unit costs from the proportionately variable component of process costs (UCVp) are constant.

From the above analytical conclusion, it can be seen that in relation to the change in the level of unit process cost during an increase in the level of production (Q) which occurs during the intensification of the production process, the originally fixed component of total costs in the context of unit costs is expressed as a variable component (the level of this component of the unit cost also drops). In contrast, the proportionately variable component of total costs acts as a fixed component in the context of unit costs. We must then consider this fact during a quantification of the level of change (reduction) of total process production costs.

In the sense of the above facts, in the process calculation of costs for unit of production /UC(Q)/ we can for one thing designate the level of the share of these costs with fixed character in connection with the change in the volume of production (absolutely fixed component of costs for unit of production). This component arises from the proportionately variable component of total costs for the given level of production (Q). We designate the proportion of these unit costs as (f), and

$$f = \frac{UCV_{pl}}{UC_I(Q_I)} \tag{4.2}$$

with linkage to absolute level of components of unit costs of production (the information significance of the individual components has already been given). The proportion of unit costs of variable character (functionally hyperbolic drop) in relation to the change in the volume of production arises from the fixed component of total process costs for the given level of production (Q). We designate the proportion of these unit costs as (v), and

$$v = \frac{UC_{FI}(Q_I)}{UC_I(Q_I)} \tag{4.3}$$

with linkage to absolute level of components of unit costs of production (the significance of the variables has already been given). If we designate the level of proportion of the individual components (f) and (v) by proportionate number, (f) + (v) = 1. In the case of percentage designation of level of proportion, f % + v % = 100 %.

The aim of the comparison of total costs of the given production process structurally composed of fixed and proportionately variable costs is the designation of the change (reduction, savings) of these costs after the performance of process intensification (implementation of intensification measures in production process or also in processes logistically associated therewith). The comparison of total process costs constitutes the algorithmic foundation of the comparative model for determination of the level of change of these costs after the application of intensification measures allowing an increase in production from the production process to the level designated (Q_{II}) compared to the level of the process production before intensification, which was designated (Q_I). This means that $Q_{II} > Q_I$ (for example in items per designated period). In the case of production (Q_{II}) as the maximum possible production after intensification of the production process (or specifically required) process total costs will be achieved at the level designated $/TC_{II}(Q_{II})/$. Before process intensification with production (Q_I) process total costs were achieved at the level designated $/TC_I(Q_I)/$.

In the context of the comparative model, on the basis of comparison we will discover the level of change of total process costs, *i.e.*, difference between costs $TC_I(Q_{II})$ and $TC_{II}(Q_{II})$. For the purposes of comparison, we will consider the total process costs designated $TC_I(Q_{II})$ as equation costs for comparison of the total process costs which were attained before the implementation of intensification measures. These are actually relatively (notionally, by calculation) considered costs for designation of changes of the level of total costs of the production process which are based on the total process costs for production *i.e.*, production (Q_I), without process intensification, and their level is relatively transformed for production (Q_{II}), which is attainable after the implementation of process intensification. The notion of relative transformation of total process costs is applied because we must compare the change in costs from the aspect of information pertinence in relation to the same level of production, *i.e.*, (Q_{II}). But with regard to the structural composition of total process costs (as has already been shown analytically), it is evident that there will not be a leap (reduction) in total process costs $TC_I(Q_I)$ in the interval of production from (Q_I) to (Q_{II}), this being from the level of $/TC_I(Q_I)/$ to $/TC_{II}(Q_{II})/$. There will be a gradual reduction in the unit costs for the given volume of production in the production interval from (Q_I) to (Q_{II}) as a result of the structural component of the total production costs in the form of fixed costs. As can be seen from Eq. (2.4), in unit terms these costs have a falling level (hyperbolic function) given an increase in the volume of production (Q).

We perform a cost comparison (as already stated) on the basis of comparison of total process costs before the performed intensification and after the performed intensification. Algorithmically we perform this via the difference of total process costs which would be attained in the interests of the possibility of comparison in the case of increased production (Q_{II}) both under the conditions of implementation of the given production process before its intensification and under the conditions of implementation of production process after its intensification. If we wish to perform a comparison of total process costs before and after the performed intensification of the production process in the context of a level/production (Q_{II})/ which is, however, not achievable realistically in the production process without intensification, it is necessary to perform a relative amendment of the calculation of total process costs for this input variant of implementation of the production process (variant for which we perform a comparison

of the changes in the level of total costs). We will designate this variant of cost analysis as variant (V_I), but with a linkage to process production (Q_{II}).

We will designate the process variant after implementation of intensification measures as variant (V_{II}). As has already been stated in the article, we wish to compare the change in the level of total process costs of implementation of variant (V_{II}) in terms of the initial variant for implementation of the production process (V_I), but as a result of the possibility of comparison with information application of production (Q_{II}) in the context of variant (V_I). And with regard to the already specified conditions for implementation of intensification of the production process we want to maintain (not change) the analytical structure of costs (fixed and variable) in the context of both variants. But this fact means that in the case of a comparison of variants of total process costs with acceptance of production (Q_{II}),

in the context of information realism of the comparative calculation of changes to the level of the total costs we also have to reflect in notional calculation terms the fall in the level of the unit fixed costs in the case of growth in production from the level (Q_I) to the level (Q_{II}). It is necessary to realize from the analytical aspect that even if we perform a cost comparison of the variants for implementation of the production process in relation to the total costs of variant (V_I), for the designation of the total costs of this variant with production (Q_{II}), *i.e*., costs $TC_I(Q_{II})$, it is not analytically correct during the calculation of these costs with use of equation (2.3) to apply the level of unit costs $/UC_I(Q_I)/$, *i.e*., such level of unit process costs which were attained during production (Q_I) in the case of implementation of the production process without intensification.

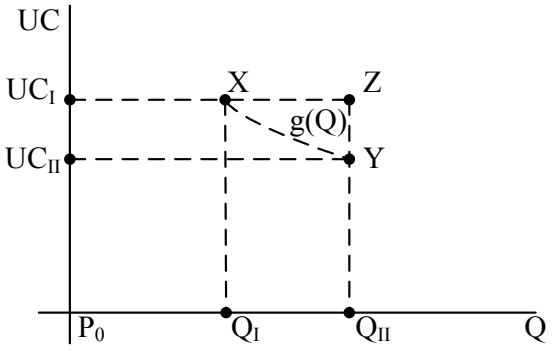
The analytically notional application of unit costs $/UC_I(Q_I)/$ would be appropriate in material information terms only if the total costs were generated only from proportionately variable costs, as can be seen from the Eq. (2.1) and Eq. (2.3). In the case of non-acceptance of this fact we commit and error during the designation of the level of change of total costs between the variants (V_I) and (V_{II}). In practice this occurs during the derivation of future costs in a strategically considered growth in production and past average unit costs without respecting of the structure of total costs.

So that we can implement correctly in terms of information a cost comparison and correctly ascertain the level of change of total process costs, we perform a designation of the level of these costs before and after implementation of intensification measures via the already illustratively given graphic interpretation of the level of these costs (see Figure 1 with linkage to the following Figure 2), which means from the unit production process costs before and after the performed intensification process and production at the level (Q_{II}) whilst respecting the above considerations associated with the determination of the level of total costs of both process variants, *i.e.* (V_I) and (V_{II}).

We display the graphic interpretation of designation of total production process costs with use of the Eq. (2.3) and Eq. (2.4), *i.e*., with linkage to the unit process costs (UC) for given production (Q) in Figure 2. The graphic interpretation is depicted by the application of the coordinate system where on the axis of dependent variable there is depicted the level of unit costs, this being for the variant (V_I) and (V_{II}) for compared production (Q_{II}) and in the case of variant (V_I) (for its sub-part) also production (Q_I) as the foundation for comparison. The designated total process costs of variant (V_I), in the context of which production (Q_I) is truly achieved form the basis of the comparison for determining the level of cost changes in comparison with the variant (V_{II}) (after intensification of the process).

In Figure 2 we can define the comparative surface for determination of the changes of total costs between variants (V_I) and (V_{II}) whilst respecting the above facts.

Figure 2. Definition of comparative surfaces



The surface which we designate as (S_1) will be defined by the level of total production process costs for variant (V_I), *i.e*., the variant without application of intensification measures. Because of the cost comparison (as shown in the article), production (Q_{II}) is being considered. In Figure 2 the surface (S_1) is defined by the points (coordinates):

$S_1 \equiv \{P_0; UC_I; X; Y; Q_{II}\}$. We would describe this sub-variant for determination of the total process costs, *i.e*., with linkage to surface (S_I) as process variant ($V_{I,1}$). From the figure it is evident that we can gain surface (S_1) by compiling surfaces (S_{11}) and (S_{12}). This means that surface $S_1 = S_{11} + S_{12}$. We can then define the sub-surface S_{11} according to Figure 2 with the points: $S_{11} \equiv \{P_0; UC_I; X; Q_I\}$ and surface (S_{12}) then points: $S_{12} \equiv \{Q_I; X; Y; Q_{II}\}$. This means that the points for definition of surfaces (S_{11}) and (S_{12}) are the coordinates in the coordinate system (UC) and (Q). From Figure 2 it is evident that the sub-surface (S_{12}) for surface (S_1) will be a surface from the aspect of geometric concept surface of rectangle or surface of square. According to the known relations for the calculation of surface of rectangle or square we gain by calculation these surfaces and the sub-surface of total process costs defined by the geometric surface (S_{11}). We get surface (S_{12}) and thus the sub-level of total process costs for variant (V_I), *i.e*., without direct application of intensification measures, *i.e*., with linkage to production (Q_I) by the product of production (Q_I) and level of unit process costs (UC_I). We obtain surface (S_{12}) and thus the further sub-level of total process costs for variant (V_I) with linkage to production in interval from (Q_I) to (Q_{II}) by integration of the function g(Q) in a range from (Q_I) to (Q_{II}). They are total costs with comparative notional production linkage to level of production (Q_{II}). The significance of this cost system arrangement has already been characterized in the article for the process variant of cost solution (V_I).

Surface (S_2) for determination of comparative total process costs for the process variant (V_{II}), *i.e*., after application of intensification process measures, is defined by points (coordinates): $S_2 \equiv \{P_0; UC_{II}; Y; Q_{II}\}$. We obtain surface ($S_2$) and thus determination of the level of total process costs after the application of intensification process measures with insertion of production (Q_{II}) by the product of production (Q_{II}) and level of unit process costs (UC_{II}). This is an implemented drop of the original total process costs reached in the context of variant (V_I) through the influence of the drop in original unit fixed costs, *i.e*., unit costs in the context of variant (V_I). This drop occurs as a result of the attainment of the real growth of the output of process production at the level (Q_{II}) by the application of intensification measures. For a comparison of the determination of level of changes of total costs of the given production process in the sense of the notional comparison of cost variants (V_I) and (V_{II}) for production (Q_{II}) it is possible according to Figure 2 to designate a notional level of total process costs of the process in relation to the surface (S_3) defined by the points: $S_3 \equiv \{P_0; UC_I; Z; Q_{II}\}$. We would describe this sub-variant for determination of the total production costs, *i.e*., with linkage to surface (S_3) as sub-process variant ($V_{I,2}$). But the total costs of the production process are not correctly designated in terms of value because in this case it does not take into account the influence of the increase in the volume of production from the level (Q_I) to (Q_{II}) in the direction of a reduction in the unit costs of production from the fixed component of total process costs. This reduction would occur if the system was capable of realistically achieving this production without the application of intensification measures.

The definition of surfaces (S_3) and determination of total costs of the process for production (Q_{II}), *i.e.*, costs /$TC_I(Q_{II})$/ would be materially correct in a situation where the total process costs would not contain the component of fixed costs and would consist only of proportionately variable costs. In the case of an incorrect value determination of the total process costs /$TC_I(Q_{II})$/, when there is a mutual comparison of the level of total costs of the given production process (V_I) and (V_{II}) we get an error, which we designate (ε). We give the determination of the level of this error in the part in which there is a presentation of algorithmization of the comparative model. This error actually leads to a distortion in the level of the possible attained savings of the total process costs during implementation of intensification process measures.

Surface (S_4) for the determination of the level of error in the savings of total costs is defined in Figure 2 by the points: $S_4 \equiv \{X; Y; Z\}$. We designate surface (S_4) for determining the level of cost error for comparison of costs, *i.e.*, error (ε), from the already determined surfaces, this being: $S_4 = S_3 - S_1$.

4.1 Algorithmization of comparative model for determination of level of changes (savings, reduction) of total process production costs.

In compliance with the already specified system analysis of the possibility of assembling a comparative model, and possibly quantification of the level of change in the level of the total costs of production processes in the enterprise on the basis of a comparison of these costs (i.e., before and after the performance of intensification changes in processes leading to the possibility of a growth in the output process production), we perform an algorithmic description *of the comparative model***.** On the basis of mathematical algorithmization of this model it will be possible to quantify the level of change of total production process costs in a comparison of these costs before and after the performed process intensification. It will involve a comparison of the cost variants in designation (V_I) and (V_{II}). Specifically, it will involve a cost comparison of variant (V_{II}) against variant (V_I). In the context of variant (V_I) we designate the total process costs depending on the level of production (Q) symbolically as costs /$TC_I(Q)$/. Should it involve sub-variant ($V_{I,1}$) in relation to the surface (S_1), it will consist of total process costs designated /$TC_{I,1}(Q)$/. Should it involve sub-variant ($V_{I,3}$) with linkage to surface (S_3), it will consist of total costs designated /$TC_{I,3}(Q)$/.

In the context of variant (V_{II}) we designate the total process costs in relation to the level of production (Q) symbolically as costs /$TC_{II}(Q)$/ with linkage to surface (S_2).

Procedure of model algorithmization

As has already been stated several times in the text, we perform the determination of level of changes to the total process costs on the basis of a comparison of these costs achieved before application of the intensification measures and after their application, which means in the context of process variants (V_I) and (V_{II}). We perform the foundation of algorithmization of comparison of total process costs on the basis of the differences of total process costs before and after the process intensification, i.e., on the basis of a comparison of costs /$TC_I(Q)$/ and /$TC_{II}(Q)$/. We designate the level of changes in total costs between variants (V_I) and (V_{II}) as (SA) and determine by use of the equation (4.4):

$$SA = TC_I(Q) - TC_{II}(Q) \quad (4.4)$$

where: SA – level of changes (savings, reduction) of total process costs between variants (V_I) and (V_{II}) in m.u./period; $TC_I(Q)$ – the level of the total process costs for variant (V_I), *i.e.*, without application of intensification measures in m.u./period. The costs and level of production for sub-variants ($V_{I,1}$) and ($V_{I,3}$) will be quantified according to the surfaces from Figure 2, *i.e.,* surfaces (S_1) and (S_3); $TC_{II}(Q)$ – the level of the total process costs for variant (V_{II}), *i.e.*, with application of intensification measures in m.u./period. The costs and level of production for determination of the costs (TC_{II}) will be quantified according to the surface from Figure 2, *i.e.*, surface marked (S_2).

From the aforementioned system analysis, it is seen that the determination of the level of changes of process total costs (SA) can be performed in relation to the determination of costs /$TC_I(Q)$/ in a suitable manner, this being: in a distorted (informationally incorrect, erroneous) form or in a form that is quantitatively correct in terms of information (apposite in terms of value). As has already been shown as part of the description of variants ($V_{I,1}$) and

($V_{I,3}$) the dual quantification of total process costs /$TC_I(Q)$/ is derived from the fact of whether in the quantification we respect or do not respect the influence of the increasing volume of production on the reduction of unit fixed costs of the production process. This means that within the context of the sub-variant ($V_{I,1}$) we can designate an appropriate (correct in terms of information) level of total process costs /$TC_I(Q)$/ for determination of the level (SA), *i.e.*, changes (savings, costs) between the process variants (V_I) and (V_{II}). And variant (V_I) will be cost quantified by the application of sub-variant ($V_{I,1}$). Or we will quantify the total costs according to variant ($V_{I,3}$), but we will have a distorted (overvalued) designated level of savings (change in costs). We derive the determination of the level of distortion from the further procedure of algorithmization of the comparative model. The determination of the level of total costs according to variant (V_I,3) with linkage to surface (S_3). Figure 2 is for example commonly applied in practice during the determination of the level of total costs from unit costs and changes to the level of production during a comparison of cost variants or during strategic considerations.

If we determine the level of change of total process costs in a comparison between these costs in the context of the sub-variant ($V_{I,1}$) and variant (V_{II}), we will designate the value-correct level of change (savings) of costs symbolically (SA_{RA}). Otherwise, during the application of the sub-variant ($V_{I,3}$) and variant (V_{II}) we will designate the level of change of costs symbolically (SA_{IR}). This means that we can determine the level of change of total process costs (SA_{RA}) and (SA_{IR}) in the context of sub-variants ($V_{I,1}$) and ($V_{I,3}$) of variant (V_I) according to the following equations (4.5) and (4.6):

$$SA_{RA} = TC_{I,1}(Q) - TC_{II}(Q) \quad (4.5)$$

and

$$SA_{IR} = TC_{I,3}(Q) - TC_{II}(Q) \quad (4.6)$$

$TC_{I,1}(Q)$ and $TC_{I,3}$ are total process costs in monetary units for the period (m.u./period) before intensification of the production process in the context of the information-considered sub-variants of determination of total costs, *i.e.*, costs /$TC_{I,1}(Q)$ and $TC_{I,3}(Q)$/ in the context of variant (V_I).

4.2 Equations for quantification of the level of total process cost of variants V_I and V_{II}

Then we specify the equations for the quantification of the level of total process costs before and after implementation of intensification measures in the given production process. This means that it will involve equations for the quantification of the level of costs in the context of the sub-variant ($V_{I,1}$), *i.e.*, for costs /$TC_{I,1}(Q)$/, and for the sub-variant ($V_{I,3}$), *i.e.*, for costs /$TC_{I,3}(Q)$/. As has already been stated, even if it entails process variant (V_I), *i.e.*, without application of intensification process measures as a result of a comparative determination of changes (savings) to the level of total process costs, for a comparison of the costs of process variants (V_I) and (V_{II}), it is necessary to comparatively consider the determination of process costs of variant (V_I) given the level of production (Q_{II}). Although we will no longer emphasize this fact in the text, the information process variant for cost comparison is understood as such.

We also give the equation for quantification of the level of total process costs for variant (V_{II}), *i.e.*, for costs /$TC_{II}(Q)$/. The derivation of these relations allows us to quantify the changes (reduction, savings) of total production process costs in the context of their comparison before and after a performed intensification of processes allowing an increase in output production from the given production process. The relations for the quantification of total process costs will be compiled with the use of already presented considerations from the systems analysis of the relevant matter. The change in the level of total process costs will thus be compared on the basis of a structure of initial total unit process costs. And the level of total process costs will be determined (as has already been stated) in relation to the defined variant surfaces (Figure 2), which geometrically in the coordinate system display the level of total process costs of the variants. This is an equation variable in the form of unit process costs /$UC(Q)$/ and variable in the form of output process production (Q).

Algorithmization of determination of total process costs of process variant V_I

Subsequently we will give equations for the quantification of total process costs of sub-variants /$V_{I,1}$(Q)/ and /$V_{I,3}$(Q)/ for a comparative model of the determination of the level of change of total process costs.

a) In the context of the sub-variant ($V_{I,1}$) it will entail costs /$TC_{I,1}$(Q)/, which will be determined (according to Figure 2) in relation to the surface (S_1) comprising of two sub-surfaces, these being (S_{11}) and (S_{12}). And the resultant total process costs of variant ($V_{I,1}$) in relation to the defined surface will be designated $S_1 = S_{11} + S_{12}$.

We can quantify the sub total process costs designated /$TC_{I,11}$(Q)/ of variant ($V_{I,1}$) linked to surface (S_{11}) with the Eq. (4.7)

$$TC_{I,11}(Q_I) = UC_I(Q_I) \,.\, Q_I \tag{4.7}$$

where: $TC_{I,11}(Q_I)$ are the sub total process costs of variant ($V_{I,1}$) in m.u./period.

We can quantify the sub total process costs /$TC_{I,12}$(Q)/ of process variant ($V_{I,1}$) linked to surface (S_{12}) with the Eq. (4.8) We designate these costs with linkage to Figure 2 and already specified analytical information for the determination of these costs by integration of the surface under the function g(Q) in the interval from g(Q_I) to (Q_{II}). For integration determination of the designated surface (S_{12}) and thus the sub total process costs ($TC_{I,12}$) it is necessary to determine the shape of the function g(Q).

We determine the course of the function g(Q) from the already specified analytical consideration for the compilation of the comparative model, and do so in such a way that the course of the function g(Q) will reflect the course of the change of the unit process costs in the case of a change in the level of production (Q). The change of production will be registered from the level of production (Q_I) to the level (Q_{II}). This means from the level of production before the application of intensification measures up to the attainable production after the application of intensification measures. During the formation of the compensation model we also proceed from the already presented consideration that there remains preserved the structure of total process costs with share of fixed and proportionately variable component of costs, before and after application of intensification measures. This means that, as already stated, in the context of function g(Q) the proportion of the fixed component of costs at the level (f) and the variably proportionate component at the level (v) is maintained. During a comparison of the total process costs we proceed from the total costs, and in their context designated unit costs of the initial process variant, which is variant (V_I). This means that the initial unit costs for designation of the function g(Q) will be unit costs of this variant designated in terms of information (UC_I). The level of these unit costs is attained in the context of process production (Q_I), *i.e.*, without application of intensification process measures. In unit process costs (UC_I) the proportion in unit costs of the fixed component is then at the level (f) according to Eq. (4.2), which is, as already shown, derived from the component of proportionately variable total process costs.

As we know, in the context of costs (UC_I) there is also the proportion of the second component, this being the variable component marked (v). Its determination has already been given in the text /see equation (4.3)/. This component of unit process costs is formed in relation to the component of fixed costs of total process costs. In view of the aforementioned structural condition for the level of unit process costs and Eq. (2.4) we can give the function g(Q) modelling the course of the change of unit process costs in the form (4.8)

$$g(Q) = f \cdot UC_I(Q_I) + v \cdot \frac{UC_I(Q_I)}{Q} \tag{4.8}$$

where: g (Q) – level of change in unit process costs /UC_1(Q)/ in relation to growth in production from level (Q_I) to level (Q_{II}), *i.e.*, Q ϵ <Q_I; Q_{II}>, for example in pcs/period. For the cost comparison the initial level of unit costs is at the level of unit costs of variant (V_I), *i.e.*, costs /$UC_I(Q_I)$/; Q – level of process production, for example in pcs/period with possibility of change from level (Q_I) to (Q_{II}), *i.e.*, in range of changes attainable after application of intensification measures; $UC_I(Q_I)$ – unit process costs of variant (V_I) for level of production (Q_I), for example in pcs/period; f, v – proportions of fixed and variable component of unit process costs of process variant (V_I), for example as share number.

The levels of the proportions are designated by Eq. (4.2) and Eq. (4.3). We determine sub total process costs /$TC_{I,12}(Q)$/ with linkage to surface (S_{12}) according to Figure 2 (as has been specified) by integration of the function g(Q) in limits from (Q_I) to (Q_{II}). We arrive at the sub total process costs /$TC_{I,12}(Q)$/ of variant (V_I) according to Eq. (4.9) as follows:

$$TC_{I,12}(Q) = \int_{Q_I}^{Q_{II}} g(Q)dQ \tag{4.9}$$

After insertion of Eq. (4.8) into Eq. (4.9) and performance of integration we get:

$$TC_{I,12}(Q) = \int_{Q_I}^{Q_{II}} \left\{ f \cdot UC_I(Q_I) + +v\frac{UC_I(Q_I)}{Q} \right\} dQ \tag{4.9a}$$

After performing integration, we gain the Eq. (4.10):

$$TC_{I,12}(Q_{II} - Q_I) = UC_I(Q_I) \cdot Q_I \left[f\left(\frac{Q_{II}}{Q_I} - 1 \right) + v \cdot \ln \frac{Q_{II}}{Q_I} \right] \tag{4.10}$$

If we insert from Eq. (4.10) $\frac{Q_{II}}{Q_I} = p$ (4.10a) – change of production performance of process, we get the Eq. (4.10b) for determination of the sub total process costs /$TC_{I,12}(Q_{II} – Q_I)$ for process variant (V_I) in the form (4.10b)

$$TC_{I,12}(Q_{II} – Q_I) = UC_I(Q_I) \,.\, Q_I [f\,(p – 1) + v \,.\, \ln p] \tag{4.10b}$$

By merging the level of sub total process costs of variant ($V_{I,1}$) we get the level of costs in the form (4.11). From the specified equations, it is evident that:

$$TC_{I,1}(Q) = TC_{I,11}(Q_I) + TC_{I,12}(Q_{II} – Q_I) \tag{4.11}$$

After inserting into the Eq. (4.11) instead of /$TC_{I,11}(Q)$/ and /$TC_{I,12}(Q_{II} – Q_I)$/ Eq. (4.7) and Eq. (4.10) we get the Eq. (4.11a) for determining /$TC_{I,1}(Q)$/ in the form

$$TC_{I,1}(Q) = UC_I(Q_I) \,.\, Q_I + UC_I(Q_I) \,.\, Q_I [f\,(p – 1) + v \,.\, \ln p] \tag{4.11a}$$

The significance of the individual variables has already been shown.

b) In the context of sub-variant ($V_{I,3}$) it will entail total process costs /$TC_{I,3}(Q)$/, which will be determined according to Figure 2 in relation to surface (S_3). In this case it will entail a sub-variant of total process costs which quantify the materially incorrect level of these costs for determination of the level of change of costs in comparison with process variants (V_I) and (V_{II}). Application of the level of total process costs at the level /$TC_{I,3}(Q)$/ for designation of the level of cost savings leads to the determination of an information distorted level of savings in relation to Eq. (4.6). It would be possible to consider this determination of the level of total cost via unit process costs and for comparison of process variants of the information-considered level of process production at the level (Q_{II}) as being relevant in information terms in a specific costs situation. This situation would occur if the structural process costs consisted only of proportionately variable costs with unit constant costs even in the case of a change in the level of production. As has already been stated, in practice during various evaluations the existence of a varying internal structure of process costs is overlooked, and thus in the context of the application of unit costs to the calculation of the total costs the level of these total costs is distorted. The specific influence of changes to unit costs from the fixed component of process costs is not considered. We give the cost variant /$TC_{I,3}(Q)$/ so that in the context of the comparative model of process total costs we can quantify the distortion (error) during the comparison of process costs of process variants (V_I) and (V_{II}). We specify the model-equation quantification of this error later in this article.

We can designate the total process costs /$TC_{I,3}(Q)$, in the context of the level of the aforementioned system considerations and in relation to the delimitation of the surface (S_3) in Figure 2 according to the Eq. (4.12) as follows:

$$TC_{I,3}(Q_{II}) = UC_I(Q_I) \,.\, Q_{II} \tag{4.12}$$

The significance of the individual variables has already been given in the text.

Algorithmization of determination of total process costs of process variant (V_{II})

In the context of process variant (V_{II}) it will entail total process costs /$TC_{II}(Q)$/. These costs will be determined (according to Figure 2) in relation to surface (S_2). We calculate surface (S_2) and thus also the level of total process costs /$TC_{II}(Q_{II})$/ in relation to unit process costs /$UC_{II}(Q_{II})$/ and output process production (Q_{II}) in the context of the process variant (V_{II}) by applying Eq. (4.13) as follows:

$$TC_{II}(Q_{II}) = UC_{II}(Q_{II}) \,.\, Q_{II} \tag{4.13}$$

The significance of the individual variables is given in the text. The units of individual variables (factors) of the Eq. (4.13) are comparable to those for equivalent variables for the process variant (V_I). We ascertain the level of the unit process costs for production at the level (Q_{II}) with symbolic designation /$UC_{II}(Q_{II})$/ in the following manner with linkage to the comparative process variant (V_I). On the basis of the process cost calculation, the unit process costs, *i.e.*, costs (UC_{FI}) from the fixed components of these costs for the variant (V_I). and also the unit process costs from the variable proportionate component of total process costs, *i.e.*, the costs (UC_{VpI}), are known. For the determination of the unit costs /$UC_{II}(Q_{II})$/ we use the following equation (4.13a) for determining these unit costs:

$$UC_{II}(Q_{II}) = \frac{UC_{FI}(Q_I) \cdot Q_I}{Q_{II}} \tag{4.13a}$$

From the course of the fixed component of total process costs during a change in the level of production with regard to the character of fixed costs, it is evident that the level of this component of costs remains the same for both process variants. There is only a drop in the level of the unit process costs from the fixed cost components in relation to a change (increase) in production. The level of the proportionately variable component of unit costs remains constant even when there is a change in the level of process production. It is possible to give a comparative algorithmic model for determination of the level of changes (savings) of total process costs between the process variants (V_I) and (V_{II}) on the basis of equations (4.11), (4.12) and (4.13) in two variants. This is actually a cost comparison of the process variant (V_{II}) with linkage to process variant (V_I) via the output process production at the level (Q_{II}). This would be attainable, for example, as the maximum or wanted after the implementation of intensification of process measures. In the case of process variant (V_I), it entails only the information level of production for quantification of comparison. In the case of process variant (V_{II}), this entails realistically attainable process production, for example in items for the given period. We can designate the level of change (relative savings, relative reduction) of total costs on the basis of a model comparison of total costs of process variants (V_I) and (V_{II}) according to Eq. (4.5) and Eq. (4.6).

A) We achieve a materially and informationally correct comparison for the determination of the level change of total process costs with symbolic designation (SA_{RA}) by Eq. (4.15) (depicted as model) by the application of Eq. (4.5) after the insertion of inputs into this equation. This means that

$$SA_{RA} = UC_I(Q_I) \,.\, Q_I + UC_I(Q_I) \,.\, Q_I \,[f\,(p - 1) + v \,.\, \ln p] - UC_{II}(Q_{II}) \,.\, Q_{II} \tag{4.14}$$

By adjusting the equation (4.14) we get the equation (4.15):

$$SA_{RA} = UC_I(Q_I) \cdot Q_I \left\{1 - \frac{UC_{II}(Q_{II}) \cdot Q_{II}}{UC_I(Q_I) \cdot Q_I}\right\} + f(p-1) + v \cdot \ln p \tag{4.15}$$

From Eq. (4.15) for the determination of the level of change (savings, reduction) of total costs of the given production process (costs of production from this process for the given period) it is evident which factors (variable) influence its level of attained degree of change of the specified costs after the application of process intensification measures. From the specified Eq. (4.15) it is also possible to derive the necessary level of, for example, output factors (variables) in such a way that the required level of cost savings (reduction) of process costs is attained.

As an example we can give the derivation of the level of unit process costs after implementation of process intensification measures, *i.e.*, unit costs /$UC_{II}(Q_{II})$/. This entails unit costs for the designated level of possible

production (Q_{II}) after the application of intensification process measures with the aim of attaining the required level of change (reduction) of total process costs at the level (SA_{RA}) with the use of Eq. (4.15). For the derivation of Eq. (4.16) on the basis of which we designate the level of process unit costs /$UC_{II}(Q_{II})$/ from the Eq. (4.15), we adjust this using the following substitution:

- within Eq. (4.15) we insert:

$UC_I(Q_I) \,.\, Q_I = D \qquad \frac{Q_{II}}{D} = E \qquad F\,(p-1) + v.\ln p = G$

- with the use of the aforementioned substitutions a) to c) we can adjust Eq. (4.15) to the equation (4.15a) in the form:

$$SA_{RA} = D\,[1 - E.\,UC_{II}(Q_{II}) + G] \tag{4.15a}$$

From the Eq. (4.15a) we derive the Eq. (4.16) for determination of the level of unit process costs/$UC_{II}(Q_{II})$/, this being in the form:

$$UC_{II}(Q_{II}) = \left(1 - \frac{SA_{RA}}{D} + G\right) \cdot \frac{1}{E} \tag{4.16}$$

From Eq. (4.16) we reach the conclusion that if we wish to achieve targeted cost savings at the level (SR_{RA}) for the given period of time after the application of process intensification measures, it is necessary to ensure the insertion of unit process costs after the intensification of the given production process at the level /$UC_{II}(Q_{II})$/ designated on the basis of Eq. (4.16).

B) We gain a materially and informationally incorrect comparison (for determination of the level of change of total process costs) with symbolic designation (SA_{IR}) depicted by the Eq. (4.18) as a model through the application of Eq. (4.6) after inserting the inputs in this equation. This means that

$$SA_{IR} = UC_I(Q_I) - UC_{II}(Q_{II}) \,.\, Q_{II} \tag{4.17}$$

and $UC_I(Q_{II}) = UC_I(Q_I)$, because there is no information consideration of the influence of the change (reduction) of unit process costs from the fixed components of total costs as a result of production growth. By adjusting Eq. (4.17) we achieve the below comparative Eq. (4.18):

$$SA_{IR} = \{UC_I(Q_I) - UC_{II}(Q_{II})\} \,.\, Q_{II} \tag{4.18}$$

Determination of the size of possible error for quantification of level of change (reduction, savings) of total process costs on the basis of comparison of information procedure (SA_{IR}) and (SA_{RA})

We perform a determination of the level of error (ε) in the case of the incorrect application of the system information procedure by determination of level of change (savings) of total process costs on the basis of a model comparison of process variants (V_I) and (V_{II}) on the basis of the difference in the determination of cost changes according to the equation for (SA_{IR}) and (SA_{RA}). This means that we determine the level of error (ε) in m.u for the monitored period for the evaluated volume of production on the basis of the relationship (4.19) as follows:

$$\varepsilon = SA_{IR} - S_{RA} \tag{4.19}$$

In connection with Figure 2 it entails a graphical depiction of the scope of the cost error (ε) via surface (S_4), (S_3) and (S_1). This means that $S_4 = S_3 - S_1$. After insertion of the Eq. (4.7), Eq. (4.9) and Eq. (4.12) into Eq. (4.19) we obtain for quantification of the error (ε) Eq. (4.20) in the form

$$\varepsilon = UC_I(Q_I)\left[Q_{II} - Q_I\right] - \int_{Q_I}^{Q_{II}} g(Q)\,dQ \tag{4.20}$$

We could further adjust Eq. (4.20) by inserting Eq. (4.10) into Eq. (4.20) for quantification of error (ε). The level of the cost error (ε), as has been shown, means the level of distortion (overvaluation) of the level of savings (reduction) of total process costs in a comparison of these costs between the process variants (V_{II}) and (V_{II}). This

means that the ascertained level of possible cost savings by the application of a comparative model of procedure leading to the ascertaining of change of total costs at the level (SA_{IR}) must be reduced by this error. And in many cases in practice a comparative calculation (based on determination of change in the level of SA_{IR}) is used to evaluate the benefits of process intensification changes. But this fact then leads to a distortion of the result of the implemented subsequent evaluations with linkage to the distorted comparative evaluation of cost changes. This may entail, for example, an inadequate evaluation of the financial economic effects of various projects focusing on the intensification of corporate processes, evaluation and selection of project variants, stimulation overvalued rewarding of employees for proposed intensification process measures, allowing of tolerance increase in costs in other areas of corporate activities with linkage to distorted reporting of process savings etc. In view of equation (3.20) it is evident that the higher the level of the error (ε) is in the comparative evaluation of variants in the composition (V_I) and (V_{II}), the higher will be the level of unit process costs /$UC_I(Q)$/, *i.e*., the process variants (V_I) and the higher the difference of the possible attainable production during the application of intensification process measures, *i.e*., difference ($Q_{II} – Q_I$) and the lower will be the value of the integral from the function g(Q) in the integration limits from production (Q_I) to production (Q_{II}). The lower value of this integral means that a significant influence of the growth in production on the reduction in unit process costs from the fixed component of total process costs is applied between the variants (V_I) and (V_{II}).

Conclusion

In the conclusion to the contribution on the quantification of the possible level of change (savings) of total process costs arising from the intensification of the production processes we introduce the basic system steps that have to be applied for the level of this change to be designated correctly, and also for it to be possible to use the gained information further to resolve corporate decision-making situations.

We can state the basic system steps for the solution to the relevant matter as follows:

- To ascertain by analysis, for example on the basis of calculation of costs, the structure and level of unit process costs in the sense of their level and structural proportion of the fixed and variable component of these costs. In our case of analytical considerations in the context of the variable component of total costs it entailed a proportionately variable component of the production process costs, this being the initial production variant (V_I). Then during the application of the cost calculation it entailed the determination of unit process costs which are considered for the determination of total process costs for the given input level of production from the production process before its intensification. These costs are also considered in the context of the cost comparison of process variants (V_I) and (V_{II}) for production which is comparatively considered at the level of production attainable after process intensification /*i.e*., production (Q_{II})/.
- To determine the possible intensification measures and derive the possible (attainable or desired) level of process production, *i.e*., production (Q_{II}) following application of intensification measures with final focus on intensification of evaluated production process.
- To determine according to the derived equations, the level of total costs for the cost comparison of process variants (V_I) and (V_{II}), *i.e*., costs /$TC_{I,1}(Q)$/ and /$TC_{II}(Q_{II})$/.
- Determination of value-correct level of changes to total process costs with information designation (SA_{RA}) according to equation (4.7).

If necessary, the possibility of quantification of the level of deviation (ε) in the evaluation of changes to the level of total process costs in a comparison of variant (V_{II}) with variant (V_I) using the equation (4.12).

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Innovation Capacity of the Regions of Siberian Federal District: Status and Dynamics

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Abstract:

Considerable changes in the income flows and in the structure of the expenses for mobilization of resources in the system of the economy generate the demand for innovations. The differences between the approaches to the regional innovation status estimation predetermine the differences in the tools for the implementation of the state innovation policy. The possibility to establish the interrelations between the specific features of regional economies and the quality of their innovation capacity serves as an indicator of the opportunity for regulatory intervention into innovation practices. Institutional analysis and the application of the ranking approach to the array of the public domain data on the contents, resources and the results of regional innovation systems in Siberian Federal District made it possible to suggest the methodology of indicative estimation of innovation capacity of the territorial subjects of the Russian Federation and to establish the interrelations between the rating change and the nature of innovations. The rating of the regions of Siberian Federal District is a result of the monitoring of innovation capacity of the regions and of the determination of the values of the indicators. Classification of the regions based on the initial level and on the innovation capacity rating change is represented by the matrix of the diverse tools for the regulation of the innovation systems that possess different quality of innovation capacity. The results of the undertaken investigation provide the foundations for the state regulatory authorities to formulate the effective approach to the implementation of the innovation policy taking into account the maturity of the innovation system in the region.

Keywords: innovation capacity of the region; innovation capacity rating of the region; subjects of siberian federal district

JEL Classification: O32; R11; R12

1. Introduction

The current urge to ensure competitive sustainability of national and territorial economies under the conditions of the constrained resource coverage exacerbated by the conditions of an open economy predetermines the fact that now there are no alternatives to the innovative development of national economy. Thereat, the innovation dynamics of the regions of the Russian Federation is insufficient for ensuring the economic security: statistical indicators of innovation activities reflect the low level of technological transfer at both national and regional levels (National report

2015). In modern economic and political environment, the identification of the opportunities to stimulate and support economic transformation based on the innovative practices comes to the front line of corporate and governmental managerial and regulatory efforts. The issue of the formation of the analytical basis and tools to duly identify the trends and problems of the implementation of the innovation processes across the country and at the level of the subjects is of paramount importance (Vladimirova and Malakhovskaya 2016).

Innovation capacity plays an important role in ensuring the appropriate rate of economic transformation of the sectors of the economy. *Innovation Capacity of the Region* is the availability and the capability of the economic agents and of the executive authorities of the region to create, to develop and to implement the innovation processes as component elements of the innovation policy taking into account the existing conditions and available resources within the framework of the clearly determined and transparently exercised regional and national development strategies of the innovation policy (Vladimirova 2011).

2. Methods

The fact that the notion of innovation capacity is rarely used in scientific journalism (Klowden and Wolfe 2013, Patel and Pavitt 1995, Hollanders *et al.* 2009) shows that the issue of selecting the strategy and tactics of regulatory intervention into innovation practices still represents an open question in international practices.

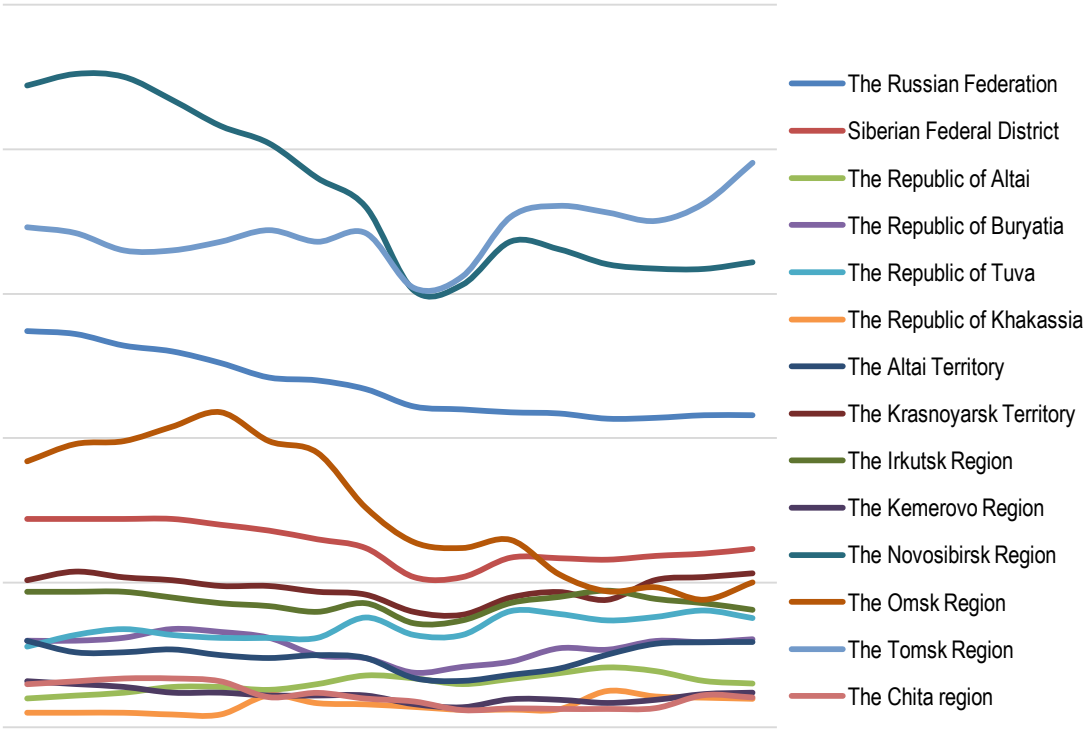
The world scientific literature deals with the questions of the impact of innovations on the regional development and entrepreneurship (Anokhin, Wincent and Ylinenpää 2016), the relationship of innovations and knowledge (Capello and Lenzi 2014) on the development of institutions in the regions (Moodysson, Zukauskaite 2014). The authors proposed to introducethe concept "the innovative susceptibility of the region" into the scientific circulation (Vladimirov 2011, Vladimirova *et al.* 2015) and the method of assessing the level of innovation susceptibility of the regions (Vladimirova 2010, 2011) was developed. This article provides the empirical research of the ranking of the Siberian Federal District, which confirms the possibility of its use by the management authorities to select the instruments of the innovation policy regulation.

Institutional justification and methodological support of the approach to the assessment of innovation capacity of the region (Vladimirova 2011) have been verified in the course of the empirical tests (calculations based on the public domain official statistical data on years 2000-2013 (Vladimirova 2013) and based on the data of the website “Science and innovations in the region” (Science and innovations 2016) applied to the innovation systems of the regions of Siberian Federal District (SFD). The developed analytical functional model of innovation capacity includes the indicators of resource-based, financial, demographical, institutional and resulting components that describe not only the scale but also the intensity of innovation activity. The multifaceted account of the specific features of the territorial innovation systems makes it possible to understand the method of selecting the efficient tools to regulate regional innovation practices.

The factor approach to the analysis of innovativeness as of economic activity requires that the conditions of human and physical capitals of innovation flow should be determined (Malakhovskaya and Skrylnikova 2009): here not only the number but also the tightness of the relations in the activities of the innovators is important (Koshland 2007). The fundamental (basic) element of ensuring the proper flow of innovation activity is represented by the availability of the experts who implement innovative projects (who offer and implement innovative products, technologies of production and management). A considerable array of the initial data for the analysis becomes represented by the dynamics of the share of those who are employed by the sector of Research and Development (R&D), insofar as it reflects the change in the incentives for being engaged into innovative activity (as percentage to the total number of the workforce it is shown in Figure 1). Statistical and calculated values testify of the continuing negative trend of the decreasing share of R&D employees affecting the quality of innovative environment. While across the Russian Federation in general the share of the people employed by R&D sector is in the range of 1.080-1.37, in SFD this figure is almost two times lower. The accumulation of the number of scientific workers is observed in the Novosibirsk and Tomsk Regions over the whole period of the investigation. The outsiders are represented by the subjects specialized in “livestock and crop farming” (the Republic of Altai, the Republic of Khakassia, the Republic of Buryatia). In the Krasnoyarsk Territory the share of this indicator remains to be lower than the average value across RF and SFD.

The fluctuating nature of the dynamics of those employed by R&D sector confirms that the participants of these activities understand the uncertainty of the results of innovative practices. This fact makes for poor incentives in terms of the anticipated benefits for the "newcomers", for the participants who would never gain any big success. The demotivation is exacerbated still as the participants' end in an innovative fiasco and "drop out of race" within this period.

Figure 1. Dynamics of the share of the people employed in the sector of Research and Development in the Russian Federation and in SFD in the total workforce over 2000-2015



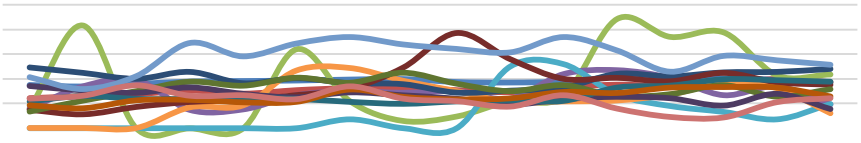
The indirect indicator of concentration (closeness) of the relations between the innovators can be represented by the number of economic organizations who position their practices as innovations. The dynamics of the indicator of the share of innovatively active organizations in the total amount is illustrated in Figure 2.

The vector of the specific weight of innovative organizations does not possess any clear direction; it is characterized by fluctuations over the period of 2000-2015 within the range of 8.8-10.48% on average across Russia and within the range of 6.1-9.1% across SFD. Statistical data show that 4 subjects continuously exceed Russia average level. However, compared to the results of the earlier investigations, no growth of innovation activities has been observed despite the introduced incentives.

Functional concentration of the innovators can lead to their vertical integration (that would, according to the cut-through method, become "a link that drives the whole chain" of territorial economy). The prerequisites of innovation clustering are predetermined by the development of the sufficient structures (industrial aspect of vertical integration and clustering) and by the sufficiency of the innovation infrastructure that predetermines the quality and culture of innovative practices.

The issue of creating the infrastructure of the sphere of innovations is of special importance in studying the problems of innovation development of the regions (Lebrais 2010). Table 1 provides the information on the institutional composition and on the qualitative parameters of innovation infrastructure across SFD in 2015.

Figure 2. Dynamics of the share of innovatively active organizations in their total amount in the Russian Federation and in SFD over 2000-2015



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
The Russian Federation	8,8	8,5	9	9,5	9,6	9,7	9,9	10	9,4	9,3	9,5	10,4	10,3	10,1	9,9	9,3
Siberian Federal District	6,1	6,5	6,9	7,6	7	7,7	8,1	8,1	7,7	7,3	8,2	8,8	8,5	9,1	9,9	9,3
The Republic of Altai	3,9	20,8	0	0	0	16	5,5	1,5	2,4	5,5	6,5	22,1	18,5	19,4	10,7	10,9
The Republic of Buryatia	4	8,5	9,8	3,7	3,8	6,7	7,5	7,2	7,5	6	11	11,8	10,2	6,7	8,5	4,8
The Republic of Tuva	0	0	0	0	0	0	1,8	0	0	12,5	13	6,8	4,5	3,3	1,8	4,9
The Republic of Khakassia	0	0	0	4,2	4,6	11,7	12,2	9,6	7,5	5,3	5,4	5,6	6,8	9,1	8,1	3
The Altai Territory	12,3	11,2	10	11,4	9,1	10,1	9,1	8,9	7,2	7,6	8,2	11	10,5	11,3	11,4	12
The Krasnoyarsk Territory	3,7	2,8	4,3	5,3	5,7	6,7	8	12,3	19,3	14	10	10,2	9,5	11,2	9,3	8,8
The Irkutsk Region	3,4	5,6	7,5	9,4	8,6	10,2	9,2	11,2	9	7,5	8,7	6,5	6,9	8,7	6,4	7,9
The Kemerovo Region	8,6	7,7	7,2	8,3	7	6,3	7,3	6,7	6	4,8	5,9	6,4	6,1	4,6	7	3,9
The Novosibirsk Region	5,4	6,5	5,9	5,9	6,1	5,9	5,3	4,9	5,4	5,6	5,5	8,2	8,6	9,9	9,7	9,4
The Omsk Region	4,6	4	5,6	5,7	5,2	5,3	7,8	6,3	5,8	6	7,3	7,1	8,2	8,3	8,2	6,4
The Tomsk Region	10,3	7,9	10,5	17,2	14,5	17,1	18,4	16,9	16	15,3	18,4	15,7	11,4	14,6	13,7	12,8
The Chita Region	6	6,6	8,7	6,6	6,7	5,9	8,5	6	5,5	4,4	6,7	4	2,3	2,2	5,3	6,1

Based on the analysis of the presented statistical data, the irreducible minimum of innovation infrastructure can be understood as the combination of the factors as follows: Business incubators, Shared knowledge centres, Scientific and technical information centres, Higher education institutions, Techno parks, Technology transfer centres, Innovation activity development centres, Small sized business support centres, Funds for Support of Microentrepreneurship, Scientific centres of Siberian Branch of the Russian Academy of Sciences. Undoubtedly, the issue of the quality of the relations between the elements of this “irreducible minimum” is very important: the types of the functions they perform within the local innovation system, the quality of their integration into the national innovation system. The confirmation of the data on the established relations within the innovation cluster will make it possible to identify the innovation capacity in three forms as follow: “efficient” – “inefficient” – “fictitious” (Table 6).

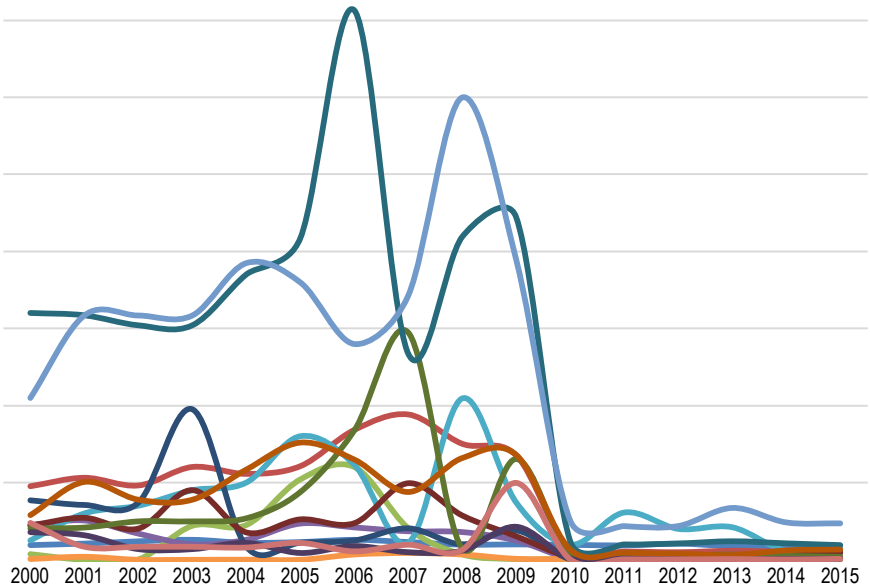
Efficient innovation activity is only possible when it is supported by modern equipment and technologies. The dynamics of the share of the acquired capital stock in R&D sector in the total costs is shown in Figure 3.

The obtained calculated data show that there is no single trend of change in this share across Russia on average, even given the fact that the general level of the indicator was estimated as low (0.0177–0.026). In SFD the dynamics of the indicator is characterized by the stepwise amplitude. The leading positions are held by the Novosibirsk, Tomsk and Omsk Regions. Among the regions of SFD only the Kemerovo Region and The Chita region acquire less capital stock than the average figure across Russia.

The disturbing trend of trying to save money on the stocks that would help implement innovations is increased under the effects of the factor of considerable deterioration (both physical ware and obsolescence) of the fixed assets. Deterioration of fixed assets across the Russian Federation in 2014 amounted to 47.9%, and across SFD it was 41.8%. Among the subjects of SFD the highest level of deterioration was observed in the Tomsk Region (53.1%), in the Kemerovo Region (43.4%); in the Altai Territory, in the Novosibirsk and Omsk Regions it made circa 42%. The severity of the situation is testified by the range of the relevant values across SFD that made

27.2 - 53.1% (Regions of Russia 2016). Moreover, the situation goes from bad to worse: in 2015 in Russia the deterioration already amounts to 48.8 %, and across SFD it makes 44.3% and the range of values is 32.9-55.3%. The analysis of the change in the statistical data shows that there is a correlation between the growth of the investments in capital stock and the change of the degree of deterioration which is perfectly illustrated by the indicators of 2010-2015. The observed dynamics of the "drop" in capital-labor ratio affects all groups of innovations: technological, organizational, marketing, environmental, social, and information-related; and thus it becomes the factor that hampers the innovative transformation of economic activity.

Figure 3. Dynamics of the share of the acquired capital stock in Research and Development sector in the Russian Federation and in SFD in total expenses



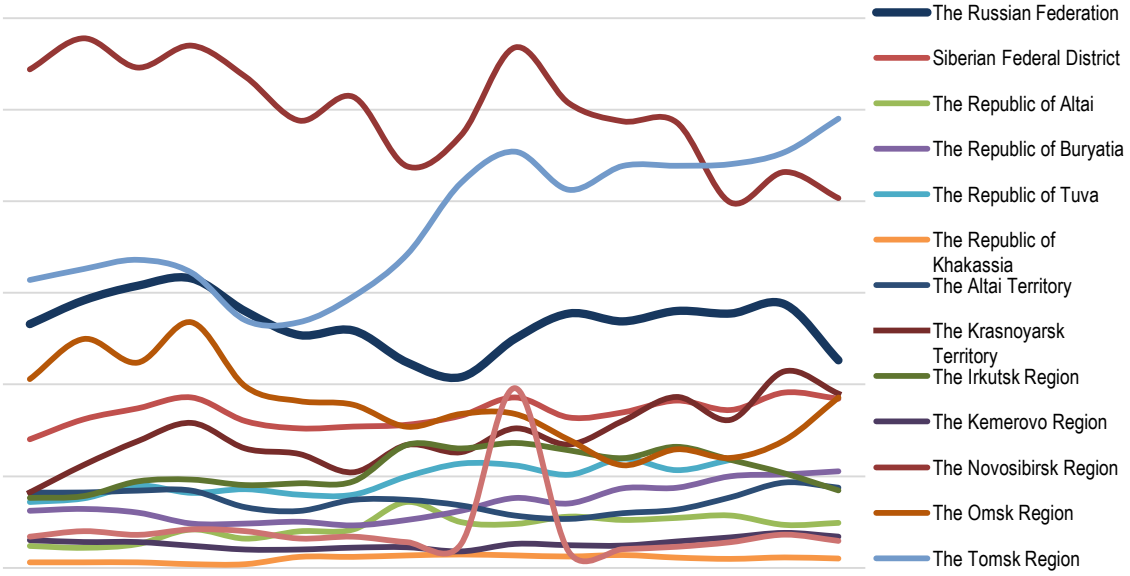
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
The Russian Federation	0,019	0,021	0,024	0,026	0,022	0,023	0,026	0,023	0,020	0,020	0,019	0,019	0,021	0,018	0,018	0,018
Siberian Federal District	0,095	0,106	0,096	0,120	0,111	0,121	0,168	0,188	0,150	0,135	0,010	0,010	0,010	0,011	0,010	0,010
The Republic of Altai	0,007	0,000	0,001	0,044	0,045	0,104	0,120	0,041	0,007	0,001	0,001	0,002	0,002	0,001	0,001	0,005
The Republic of Buryatia	0,045	0,051	0,034	0,020	0,026	0,047	0,042	0,037	0,036	0,025	0,002	0,001	0,004	0,004	0,003	0,009
The Republic of Tuva	0,025	0,060	0,070	0,090	0,100	0,160	0,123	0,022	0,209	0,074	0,019	0,061	0,040	0,042	0,012	0,015
The Republic of Khakassia	0,001	0,004	0,000	0,000	0,000	0,000	0,007	0,009	0,007	0,001	0,001	0,001	0,000	0,000	0,001	0,000
The Altai Territory	0,077	0,071	0,074	0,195	0,017	0,022	0,025	0,041	0,020	0,038	0,001	0,002	0,004	0,004	0,006	0,002
The Krasnoyarsk Territory	0,044	0,054	0,040	0,090	0,035	0,052	0,047	0,099	0,057	0,030	0,004	0,007	0,004	0,004	0,006	0,009
The Irkutsk Region	0,041	0,042	0,050	0,050	0,054	0,088	0,168	0,295	0,015	0,131	0,007	0,009	0,006	0,007	0,005	0,004
The Kemerovo Region	0,036	0,032	0,014	0,014	0,022	0,009	0,018	0,010	0,012	0,043	0,002	0,002	0,001	0,001	0,001	0,001
The Novosibirsk Region	0,320	0,317	0,304	0,304	0,370	0,417	0,713	0,267	0,419	0,444	0,023	0,020	0,021	0,024	0,021	0,019
The Omsk Region	0,058	0,101	0,078	0,078	0,117	0,152	0,130	0,088	0,132	0,136	0,014	0,009	0,008	0,006	0,012	0,013
The Tomsk Region	0,210	0,317	0,317	0,317	0,385	0,360	0,280	0,343	0,600	0,389	0,051	0,044	0,044	0,067	0,049	0,047
The Chita region	0,048	0,017	0,017	0,017	0,016	0,022	0,011	0,020	0,013	0,100	0,001	0,001	0,001	0,001	0,001	0,001

The amount of internal spending for research and development calculated relative to Gross Regional Product is of considerable importance for innovation development (Figure 4).

Over the period under investigation the indicator does not reveal any single dynamic trend. Thus, in the Russian Federation over the period of 2006-08 there was a decrease and in 2009-2012 there was growth. For SFD in general since 2005 there is a positive trend. Crisis phenomena of 2008-2009 did not affect the growing share in such regions as the Republic of Buryatia, the Republic of Tuva, the Krasnoyarsk Territory, the Irkutsk, Novosibirsk

and Tomsk Regions. Thereat, the stepwise fluctuations of the indicators have to be highlighted. As compared to the results of the earlier investigations, there is still a considerable gap between the values as follows: minimal value in the Republic Khakassia (0.14), maximal value in the Tomsk Region (2.45). Preserved multidirectional vectors and the increased gap between the values prove the consistency of the approach to the development of the target program aimed at supporting research and development in practically all regions of SFD. Obviously, the foundations of the multidirectional dynamics can be explained by the fact that in the non-innovation (in terms of the purpose of activity) economic organizations R&D expenses are interpreted as transactional expenses and thus are subject to immediate sequestration, should there appear the threats of worsening market situation. In this regard, only the internal spending for innovation in the innovative organizations proper cannot be cut, insofar as here they are considered to be the interaction expenses that ensure the performance of the principal production tasks.

Figure 4. Dynamics of the share of internal spending for Research and Development in GRP (GDP) in the Russian Federation and in SFD over 2000-2015

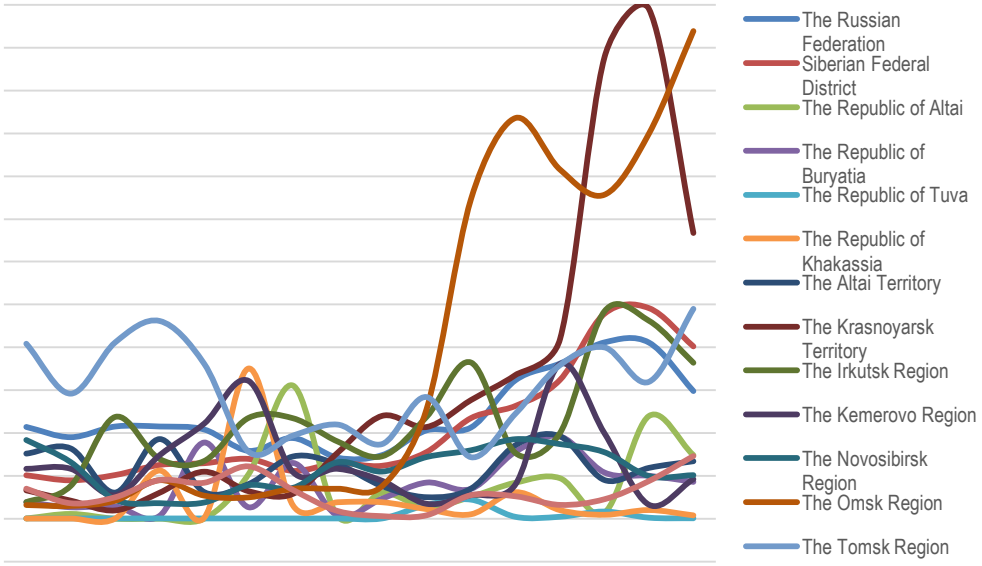


Note: * The forecasting value, the official statistics

The indicator of technological innovation spending calculated according to the relevant methodology makes it possible to determine the level of technological upgrades. The specific weight of the expenses relative to GRP enables the assessment of the technological effectiveness of the regional product (Figure 5).

The calculated values show that the regions of SFD come closer to the average Russian indicators which since 2009 have been demonstrating sustainable growth. These dynamics that testifies of the increased number and the improved quality of technological process stages can be explained by the trajectories of import substitution and by the enhanced export potential of regional economies. Among the subjects of the territory the leading positions are occupied by the Tomsk Region, the Irkutsk Region, the Krasnoyarsk Territory and The Chita region which indicators exceed the average indicators of Russia. The group of the outsiders includes the Republic of Tuva and the Republic of Khakassia. In all, the dynamics of change of this indicator is still of multidirectional nature in all subjects of this territory.

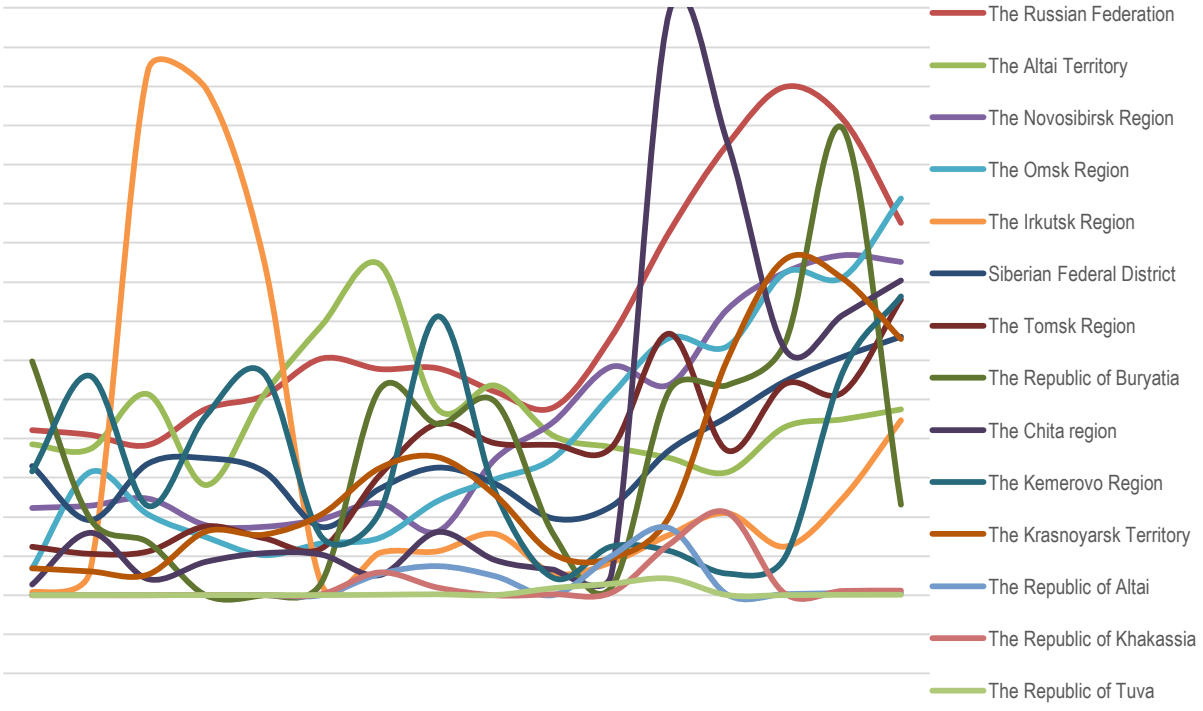
Figure 5. Dynamics of the share of spending on technological innovations in GRP (GDP) in the Russian Federation and in SFD over 2000-2015



Note: * The forecasting value, the official statistics

The indicator of the share of innovative goods, works and services in GDP (GRP) (Figure 6) reflects the performance of the existing innovation organizations.

Figure 6. Dynamics of the share of innovative goods, works and services in GDP (GRP) in the Russian Federation and in SFD over 2000-2015



Note: *The forecasting value, the official statistics

Taking this indicator as one of the constituent components the authors of this study assumed that the scale of innovative activity does not necessarily predetermine its efficiency. The calculated values show the positive dynamics of the specific weight of innovative products up to 6.4-4.5% in Russia on average. In SFD this share does not exceed the threshold value of 3.3%. At the same time, in some separate subjects (the Krasnoyarsk Territory and The Chita region, the Novosibirsk and Omsk Regions) the indicators are getting closer to Russian average. Several regions show quite low levels, *i.e.* the Republic of Tuva and the Republic of Khakassia, the Republic of Altai do not practically produce any innovative products. Thus, the intensity and efficiency of innovative activity across the region in general are not sufficient to position its subjects as competitive in the world market.

Demographical situation that is characterized by the continuous drop of the level of births (which is largely predetermined by social and economic conditions and by the surrogate moral and ethical norms in the society), by the growing rate of deaths, by the increased specific weight of pensioners and by active migration processes is still an important factor that affects innovation capacity. Innovation capacity of the territory is particularly predetermined by the willingness to introduce innovations into consumer and production practices that is undermined by the outflow of the young and qualified cohort of potential workers (innovations of production) and of potential consumers (supporting innovations).

Figure 7 reflects the dynamics of the share of economically active people in the total number of the population.

Figure 7. Dynamics of the share of economically active population in the total number of population in the Russian Federation and in SFD over 2000-2015

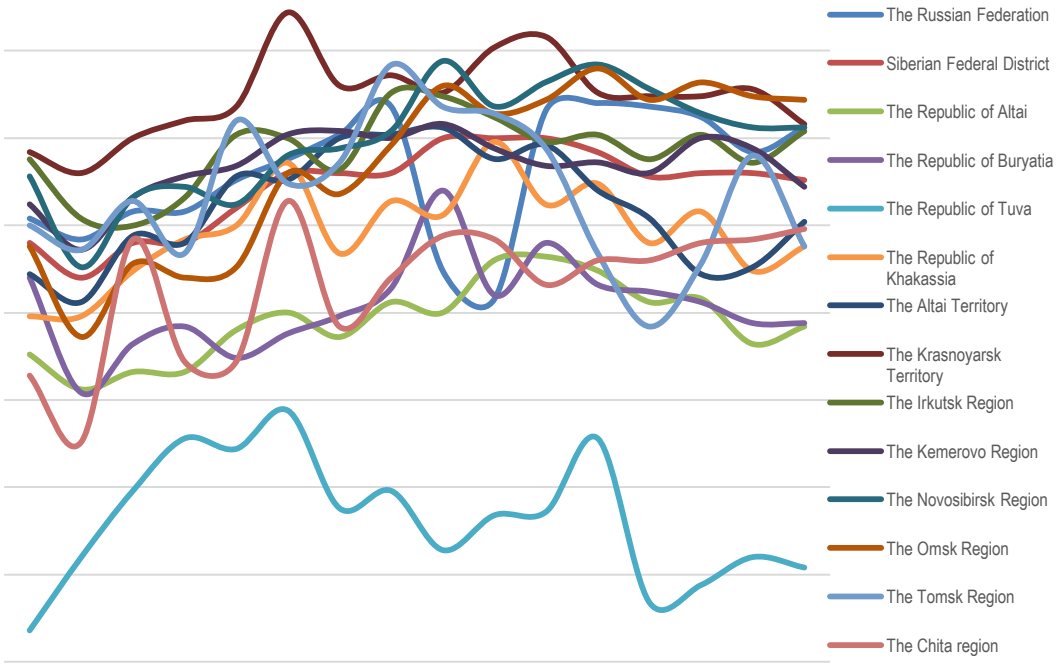


Table 1. Organizations of innovation infrastructure in Siberian Federal District (01.01.2016)

Region	Business incubators	Business parks	Shared knowledge centers	Science and innovation campuses	Scientific and technical information center	Technopolises	Higher education institutions	Techno parks, including science and technology parks	Innovation and technology parks	Engineering and technology centers	Technology transfer centers	Innovation centers	International consulting centers	Innovation activity development centers	Scientific and research institutions	Coaching centers	Funds for Support of Microentrepreneurship	Venture funds	Scientific centers of Siberian Branch of the Russian Academy of Sciences	Other	TOTAL
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
The Russian Federation	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Siberian Federal District	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
The Republic of Altai	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
The Republic of Buryatia	2	-	1	-	1	-	1	-	-	-	-	1	-	-	-	-	1	-	1	-	8
The Republic of Tuva	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3
The Republic of Khakassia	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
The Altai Territory	2	-	2	-	1	1	2	2	-	1	3	1	-	-	-	-	2	-	-	4	21
The Chita region	2	-	-	-	1	-	2	1	-	-	-	-	-	-	-	-	1	-	-		7
The Krasnoyarsk Territory	6	-	3		1	-	1	1		1	1		-	-	-	-	-	1	1	5	21
The Irkutsk Region	2		2	-	1	-	1	2	-	1	1	1	-	-	-	1	-	-	1	1	14
The Kemerovo Region	2	-	-	1	1	-	-	1	-	-	1	-	-	-	-	-	1				7
The Novosibirsk Region	5	-	-	-	1	-	4	3	-	7	1	1	1	-	-	1	4	1	1	29	59
The Omsk Region	3	-	-	-	1	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	7
The Tomsk Region	7	-	1		1		2	2	-	3	4	-	-	-	-	-	2	1	1	7	31
TOTAL	32	-	9	2	9	1	18	13	-	13	11	4	1	-	-	2	11	3	5	46	180

Source: Compiled based on (Science and innovations 2016)

While trying to improve the efficiency of innovative activity with the tools of the "triple helix" it was discovered that the environment for innovative economic practices should be institutionally constructed (Malakhovskaya and Skrylnikova 2009). Over the period of 2008-2015, the intensive lawmaking activities have been observed in the sphere of innovations. Table 2 provides the review of the innovation-related legislation in the subjects of SFD.

Table 2. Innovation-related legislation in the Russian Federation and in the subjects of Siberian Federal District as of 01.01.2016

Region	Legislation in the sphere of social and economic development		The law that regulates the sphere of innovations	Delegated legislation that regulates the sphere of innovations		
	Strategy	Program	Law	Concept	Program	Strategy
The Russian Federation	+	+	-	+	+	+
Siberian Federal District	+	-	-	-	-	-
The Republic of Altai	+	+	-	-	-	-
The Republic of Buryatia	+	+	+	+	+	-
The Republic of Tuva	+	+	+	+	+	+
The Republic of Khakassia	+	+	+	+	+	-
The AltaiTerritory	+	+	+	-	-	+
The Chita region	+	+	+	-	+	-
The KrasnoyarskTerritory	+	+	+	-	+	+
The Irkutsk Region	+	+	+	+	-	-
The Kemerovo Region	+	+	+	+	+	-
The Novosibirsk Region	+	+	+	+	+	-
The Omsk Region	+	+	+	+	-	-
The Tomsk Region	+	+	+	+	+	+

According to the methodology of determining the innovation capacity of the region, the progress of the normative innovation support has been regarded as a part of the complex package of norms and legislation that includes the laws in the sphere of social and economic development, specialized legislation that regulates the sphere of innovations and the delegated supplementary legislation.

Here the leader is represented by the Tomsk Region where the quality of institutional support of innovations is developed intensively: the current principal norms and regulations have been revised for several times; the activities are also underway in the Altai Territory, in the Kemerovo and Omsk Regions and in the Republic of Tuva. In the Republic of Altai and in the Republic of Khakassia the attention paid to these issues is still insufficient.

3. Results and discussion

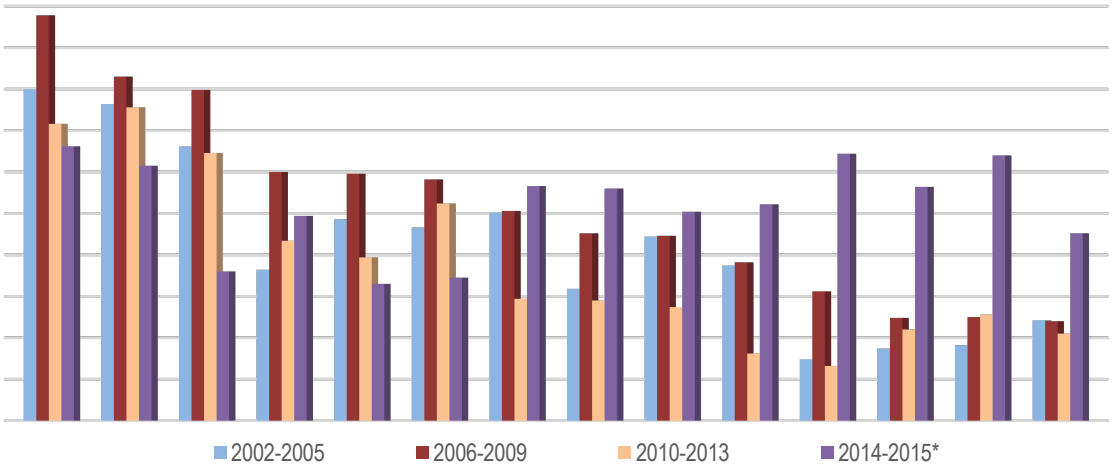
The resulting picture of the long-term incentives for implementing the innovative methods of economic activity (Table 3) gives the general idea about the comparative intensity of the processes in national economy, in the economies of SFD and its regions confirming the existence of considerable differences in the territorial innovation systems.

Table 3. Dynamics of changing Innovation Capacity Indices in the regions of SFD over 2015

Region	Legislation in the sphere of social and economic development		The law that regulates the sphere of innovations	Delegated legislation that regulates the sphere of innovations		
	Strategy	Program	Law	Concept	Program	Strategy
The Russian Federation	+	+	-	-	+	+
Siberian Federal District	+	+	-	-	-	-
The Republic of Altai	+	+	-	-	-	-
The Republic of Buryatia	+	+	+	-	+	-
The Republic of Tuva	+	+	+	+	+	+
The Republic of Khakassia	+	+	+	+	+	-
The Altai Territory	+	+	+	-	-	+
The Chita region	+	+	+	-	+	-
The Krasnoyarsk Territory	+	+	+	-	+	+
The Irkutsk Region	+	+	+	+	-	-
The Kemerovo Region	+	+	+	+	+	-
The Novosibirsk Region	+	+	+	+	+	-
The Omsk Region	+	+	+	+	-	-
The Tomsk Region	+	+	+	+	+	+

The fluctuating dynamics of the rating is characteristic even for the sustainably innovative territories (the Tomsk Region), and it is not only vividly demonstrated by the dynamic series, but is also reflected in the indices averaged over the period of four years (Figure 8) which confirm the uncertainty of innovations as investment type processes.

Figure 8. Dynamics of resulting Innovation capacity rating in the regions of SFD and in the Russian



Note: * The forecasting value, the official statistics

Considerable differences in the incentives for innovative modernization of economic processes prove that the specifics of the already established elements of innovative activity should be taken into account in the course of the implementation of regional innovation policy. However, the very possibility of ranking the regions by the indicators of innovation capacity reveals the opportunity for some type of classification of the tools and for the stage by stage stimulation of innovative processes in the regional economy. An important factor for improving the incentives becomes to be represented by the very differences in the levels of development of the innovation systems of the regions: this fact makes it possible to apply "follow the leader" approach at the level of SFD in the course of customizing the well-proven efficient methods and instruments of innovative policy. The reference section includes the interval data that help aggregate the existing trends of innovation capacity.

Analyzing the results of ranking in terms of the level of the rating and in terms of its change in dynamics it becomes possible, applying the methodology of normalization, to formalize the numerical values of the indicators and to represent them as a table that would reflect the quality of the difference in innovation capacities; thereat, the methodology of ranking implies the development of the matrix of the distribution of the regions of SFD based on the levels and on the intensity of innovation capacity rating changes (Table 4). The comparative dynamics of innovation capacity is visualized by representing the data of 2009-2013 rating together with the relevant positions occupied by the regions within the interval of 2006-2009 (in italics).

Table 4. Innovation Capacity Matrix of the regions of SFD

Rating change	RATING LEVEL											
	High			Middle			Satisfactory			Low		
	2006-2009	2009-2013	2014-2015*	*2006-2009*	2009-2013	2014-2015*	2006-2009	2009-2013	2014-2015*	2006-2009	2009-2013	2014-2015*
Of high capacity	*Tomsk Region*	Tomsk Region	-	*Krasnoyarsk Territory, Novosibirsk Region, Omsk Region*	–	-	Republic of Buryatia, Chita region	Krasnoyarsk Territory, Irkutsk Region	-	*Republic of Tuva, Republic of Altai, Republic of Khakassia*	Republic of Tuva, Republic of Altai, Republic of Khakassia	Republic of Tuva, Republic of Altai, Republic of Khakassia, Republic of Buryatia, Chita region, Omsk Region
Quadrant number	*1*	1	1	*5*	5	5	9	9	9	*13*	13	13
Of middle capacity	–	–	-	–	Altai Territory, The Omsk Region	-	–	Republic of Buryatia, Chita region	-	–	–	-
Quadrant number	2	2	2	*6*	6	6	10	10	10	*14*	14	14
Possessing capacity	–	Novosibirsk Region	-	–	–		Altai Territory, Kemerovo Region	–	-	–	–	-
Quadrant number	*3*	3	3	*7*	7	7	11	11	11	*15*	15	15
Of low capacity	–	–	-	–	–	-	Irkutsk Region	Kemerovo Region	Tomsk Region, Novosibirsk Region	–	–	Altai Territory, Kemerovo Region, Krasnoyarsk Territory,Irkutsk Region
Quadrant number	*4*	4	4	*8*	8	8	12	12	12	*16*	16	16

Note: * The preliminary data

Based on the combination of two rating assessment indicators, according to the methodology suggested elsewhere (Vladimirova 2011), 5 groups of the regions of SFD can be distinguished (Table 5).

Table 5. Comparative typology of innovation capacity in the regions of SFD

Groups of regions		Leaders	Potential leaders	In progress	Unstable	Falling behind
Aggregates of the territories formed based on the interpretation of the properties of their innovation systems	Quantitative consistency of indicators subject/level	1, 2, 3, 4	5, 6	9, 10	7, 8, 11,12	13,14, 15,16
	Analytical consistency of the properties	1, 2, 5, 6	3, 4, 7, 8	9, 13	10,11, 14,15	12,16

The methodology of determining the gross domestic product in the official Russian statistics causes the preliminary rating of 2014-2015, so the ratinginter pretation is commented by the data of 2009-2013.

The "Leaders" that include the Tomsk Region, are characterized by high absolute values of the rating and by sustainable growth rates which, if preserved, will keep the subject within this group. Compared to the results of the previous rating, the region in this group managed to maintain its standing.

The group called "Potential leaders" is distinguished by the middle level of rating and by the rating change greater than 10 % which makes it possible for the members of this group to shift to "Leaders", provided that the rate of the development is preserved. They include the Novosibirsk and Omsk Regions and the Krasnoyarsk Territory. Thereat, compared to 2006-2009, there were some positive changes in this croup; namely, all subjects have strengthened their standings.

"In progress" is a group that consists of the Chita region and the Republic of Buryatia which shifted to the quadrant of high capacity in terms of their rating change. The subjects of this group are described by the highly intensive rating growth at relatively low level of its absolute value. They can well transit into the group of "Potential leaders", provided that innovation activities are intensified and boosted by all the participants.

The fourth group of "Unstable" is represented by the Altai Territory and the Kemerovo and Irkutsk Regions which ratings go down while the values themselves are rather good. The members of this group can be described by multidimensional vectors of change: the Altai Territory and the Irkutsk Region showed slower rating growth, and, correspondingly, shifted to the quadrants of those that possess capacity or of those of low capacity. The Kemerovo Region shifted from the quadrant of low capacity into that of possessing capacity.

The fifth group of those "Falling behind" is represented by the subjects where the high levels of innovation capacity prevail, but the rating growth is very low. The members of this group in the dynamics of the period under investigation remained the same; namely, they are the Republic of Tuva, the Republic of Altai and the Republic of Khakassia.

Conclusion

The formation of the regulation tools cannot help being founded on similar features of the objects of management. The effort to aggregate the innovation attributes applying the indicators of the rates and levels of innovation capacity reveals their contradictory nature at the levels of "high" and "middle" at the rates of "Of high capacity" and "Of low capacity"; the qualitative features of regional innovation systems found in these quadrants can be characterized by the high degree of uncertainty: it is most likely that the barriers for leadership can be represented either by industrial limitations of innovation process (even under the conditions when the cut-through innovation process has been implemented), or by the limitations of the relevant stage (only product-related, only technological or only organizational innovations, etc.), or by the excessive territorial focus of the implemented transformations (the lack of scalability which is required to initiate the cluster mechanisms of innovative development).

The interpretative attitude chosen by the regulator in the course of selecting the strategy and tactics is not neutral, and it affects the composition of the tools and the nature of the consistent regulations of the incentives for innovations. Placing a priority on such attribute as "qualitative consistency of the indicators of 'rate/level of innovation capacity'" in the process of establishing the typological groups the authors of this study assume that there is some certain level of synchrony of the changes in the area of innovations that is required for the efficiency

of the multilevel regulatory effects focused on the development of resource and product results of the economy (Table 6).

Table 6. Interrelations between the rating change and innovation capacity

Observed manifested motivation for innovations	Nature of innovation capacity		
	Efficient	Inefficient	Fictitious
Capacity rating group, dimension of rate/level	"Leaders", "Potential leaders"	"In progress"	"Unstable", "Falling behind"

These empirical data confirmthe possibility of the use of the author's technique of rating innovation susceptibility of the region to select the instruments of state management in the context of separate indicators and a common index. Thus, the monitoring of innovation capacity of the regions of SFD enables a statement that greater attention is now paid to some certain components of innovation activity (in particular, there are positive phenomena in the sphere of legislative regulations). At the same time, there are negative trends in other areas which predetermine rather low general level of innovation capacity.

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Applications of Input-Output Analysis in Economy of Central North-Eastern Thailand

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Abstract

The aim of this study was to applications of input-output analysis in economy of central north-eastern in Thailand, particularly the agricultural fields in the central north-eastern. This study shows the impact of economic activity on the basis of output in each province in central north-eastern in order to know the forward and backward links as well as impact on economic of the regions, ability to add value and the income distribution in each field of production in the central north-eastern. The results of study found that the production and agricultural field are rarely ability to add value and income distribution. Moreover, the production in the central region is inadequate to meet the demand in the area. Therefore, production is needed to be imported from outside the north-eastern region. The potential event forward linkage in the central of Northeast is the production of appliances and electrical equipment, Iron and steel industry, other manufacturing, Printing and Manufacture of chemicals and chemical products.

Keywords: linkage; input-output analysis; economic structure; production sector

JEL Classification: E23; O18; P40; Q10

Introduction

There are many foods and agricultural products of Thailand were exported to abroad. The most products exported to both in Asia and Europe. In addition, products produced in Thailand are high quality for neighbouring countries such as Laos Vietnam Cambodia (Office of the National Economic and Social Development Board 2015). Areas of three countries were border of north-eastern Thailand. There are several million baht trade occurred in the north-eastern border with three countries. This is the reason that the trading, investment and industry development in north-eastern region need to be focused. In this region, it is an advantage location as the central of the GMS and the numbers of workers in the sector are many as this region has 23.7 millions for population which is counted as 34.6 percent of overall population for the whole country. Although the agricultural sector is an important sector of the country, the farmers still have problems with poverty, and economic inequality in the population, especially in the central north-eastern region, and it is accounted for 13.4 percent of the poor than any other region in the country (Office of the National Economic and Social Development Board 2015).

There are many labours evacuate from agriculture to industry, which showed that the income from agriculture is insufficient to sustain their lives. Therefore, this research study about production potential of the central area of north-eastern and the linkage on the production field in such areas is necessary in order to reflect

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the income distribution in each field of production in central of north-eastern region particularly in the field of agriculture by apply Input –Output table (IO).

1 Literature review and related theories

In the past study, it is found that IO can examine the linkage of production fields and capability to add more value in each field (Leontief 1936, Lenzen 2003). Mostly, the study will take place only between the industries (San Cristóbal and Biezma 2006, Kwak, Yoo and Chang 2005, Raa and Rueda-Cantuche 2007, Xing, Ye and Kui 2011) but there is not study the economic integration group in regional sector. Therefore, this study is to study on the occurred linkage in each field of provincial cluster and to know the income distribution as well as the value added of production fields in the central North-eastern. Income distribution is considered in the nature of the distribution of the population in various levels of income. If the distribution of income has high level of equal, it means that the differences of the income of individuals in the society are very less (Pasinetti 1962). On the other hand, if the income distribution is highly unequal, it means that the differences of income of individuals in society are great. The characteristic of income distribution can be divided into 2 types which are absolute distribution, and relative distribution

Concepts, and theories of table inputs as well as output and concept of (Leontief 1936) is an important one to study on the relations of output in production field in economic way by using inputs and output tables in order to present the demand for inputs from the field of competitors to raw materials or intermediate inputs, and basic materials or primary material as well as wages and the profits such as profits, land rent, interest, and depreciation, etc. The analysis of the factors of production, and productivity are the main objectives to calculate the level of each unit produced or production fields which will be produced to meet production unit and the final demand.

The main mechanism is another type of linkage between the field of industry, as it is both forward and Backward Linkages. In this case, both linkages presented the levels of impacts on main industry to other related industries. Growth pole theory is a theory that has the most influence on the planning in the international region and Thailand's region. This theory is very popular both in academic and practical section. It is said that it keeps growing and it almost becomes the General Theory of the sector development after Perru proposed such concept in 1950. After that, other analysts developed such ideas and then they blossom it, especially on the issues relating to the consolidation of the industry in the geographic area. It can be said that during the period from the mid 1960s until the mid-1970s was the golden age of growth pole theory because it has a lot of academic research, and it is applied to be used in the regional development plan in many countries both developed and developing countries, especially in Latin America (Conroy 1973). The concept of economic development on Unbalanced Growth Theory (Hirschman 1958) is pointing out that the rapid development of the national economy to grow up needs to dedicate resources and capital money of the country to all fields of productions to make it grow up simultaneously.

2. Methodology

In this analysis, the researchers applied analysis techniques using the input and output model. The advisory board brought the input output factor's table and outputs from 58 production fields from Bureau of National Accounts, Economic Development Board, and the National Society 2014, and then adjusted as well as managed the production fields in order to match it with the gross domestic product's production within the provincial clusters. In this case, there are 47 fields of products from provincial clusters as well as input output factor's table. Then, the forward and backward linkages will be analyzed for each production field. After that, the impact on the economic in income fields and employment will be analyzed by using the input output factor's table and outputs from 16 production fields from Bureau of National Accounts, Economic Development Board, and the National Society in order to match with the data base for employment from the Provincial Bureau of Statistics, and database investments from the Board of Investment.

In the second stage, the manufacturing group from input output table and 180 activities of Thailand's production are needed to be set up as the input output table. And, the 16 activities of Thailand’s production, the Integration of production activities will be managed in order to make from 180 activities into 16 activities.

The IO model consisting of N production sectors can be expressed as:

$$X_1 = \sum_{j=1}^{N} X_{ij} + F_i = \sum_{j=i}^{N} a_{ij}X_j + F_i$$

or

$$X_1 = \sum_{j=1}^{N} X_{ij} + V_j = \sum_{j=i}^{N} r_{ij}X_j + V_j$$

where: X_i is the total gross output in sector *i* 1 . . . N; a_{ij} are direct input or technical coefficients which divide X_{ij} the inter-industry purchases of producing sector *i* from supply sector *j* by X_j total gross output in sector *j*; r_{ij} are direct output coefficients which divide X_{ij} the inter-industry purchases of producing sector *i* from supply sector *j* by X*i* total gross input in sector *i*; and F_i the final demand for products in sector *i*, and V_j final value added by sector *j*. Thus, Eq. (1) describes the demand-driven model as viewing I–O tables vertically, while Eq. (2) expresses the supply-driven model as horizontally.

3. Finding

By analyzing of forward linkage and backward between one production field., it is found after considering the linkage by backward linkage of one production field that it can tell the importance of that production field by using middle stage of production factor from other upstream productions; whereas, the forward linkage of one production field will tell the importance of such production fields which is the one who input the products in the middle stage factor. In this case, such linkage, no matter it is forward or backward, will have higher influence on production fields where there is low linkage level between other fields. The analysis can be presented as follows:

Table 1. Forward linkage and backward linkage indexes of each field of production in Central Northeastern of Thailand

No.	Sector	Linkage	Type I multi
001	The farming	FL	0.9278
002	Corn cultivation	BL	1.1228
003	Cassava farm	FL	0.7220
004	Dilichos Biforuss farm	BL	0.8156
005	Vegetable and orchard farm	BL	0.8643
006	Sugarcane farming	FL	0.7249
007	Rubber plantation	FL	0.9444
008	Other crops	FL	1.0447
009	Livestock	BL	0.8160
010	Forestry	FL	0.8248
011	Fishery	FL	0.7586
012	Coal mining, natural gas and petroleum.	FL	0.9908
013	The iron ore mining	BL	0.6958
014	Non-ferrous mining	FL	0.8284
015	Food and Drink	BL	0.9436
016	Manufacture of tobacco products	BL	0.7950
017	Manufacture of textiles	FL	0.9308
018	Paper pulp production	FL	2.0304
019	Printing	BL	1.6010
020	Manufacture of chemicals and chemical products	FL	2.7949
021	Petroleum Refinery	BL	0.6958

No.	Sector	Linkage	Type I multi
022	Rubber products and plastic products	BL	1.3884
023	Metal products	BL	0.8816
024	Iron and steel industry	BL	2.0481
025	Production of non-iron products	FL	1.4346
026	Metal products	BL	1.1339
027	Machinery Industry	FL	1.6508
028	Production of appliances and electrical equipment.	BL	2.2851
029	Automotive manufacturing and repair.	BL	1.1484
030	Other Vehicles	BL	1.3804
031	Leather products	BL	1.1778
032	Sawmills and Wood Products	BL	1.0598
033	Other manufacturing	BL	1.6314
034	Electricity and natural gas	FL	1.4657
035	Water supply	BL	0.8316
036	The housing construction	BL	0.7639
037	Construction of public service	BL	0.7384
038	Wholesale and retail trade	BL	0.8149
039	Hotels and restaurants	BL	1.0086
040	Transportation	BL	0.8563
041	Communication	FL	0.9045
042	Finance and Insurance	FL	1.4750
043	Property	FL	0.7797
044	Business services	BL	1.1555
045	Public Service	BL	0.7631
046	Other services	FL	1.0964
047	Indistinguishable activities	FL	0.8189

Note: BL= Backward Linkage, FL = Forward Linkage

From the study, it is found that in group of central field of production that mostly have backward linkage is counted as 27 fields, and field of production which has index of the forward linkage are counted as 20 production fields from totally 47 fields. After considering the linkage index of production, it is found that field of production which has the most backward linkage are field of Production of appliances and electrical equipment (028) with the value of 2.2851, followed by field of Steel and stainless steel industry (024) field of other productions (033) field of printing (019) , and field of rubber production, and plastic production (022) where the index value of backward linkage equal to 2.0481 1.6314 1.6010, and 1.3884, respectively field of production which has the most forward linkage are field of chemical production, and chemical products (020) with the index value of the forward linkage equal to 2.7949, followed by field of paper and pulp production (018) field of machinery for industries (027) financial and insurance (042), and field of Electricity and natural gas (034) where the index value of the forward linkage equal to 2.0304, 1.6508, 1.4750, and 1.4657, respectively.

When considering only the field of agricultural production, it is found that the rice farming and rubber farming are the forward linkage. It means that the central northeast have field of rice farming (001), rubber farming (007), which can add value on the fields, and they can distribute income to other fields. Moreover, the fields that are needed to be focused and needed to find guideline to add more values are corn farming (002), Dilichos Biforus farming (004), and livestock (009) as these groups are only backward linkage without any added values, so the

income distribution is very less. The less income distribution has impact on the growth of economic in the North-eastern region as well.

Table 2. Presented the production output multiplier type I, direct and indirect impacts of each field of production in the central Northeast of Thailand's economic system

No	Type of business	Type I multi
1	Production of appliances and electrical equipment	3.284
2	Iron and steel industry	2.943
3	Other manufacturing	2.344
4	Printing	2.300
5	Manufacture of chemicals and chemical products	2.180

By analyzing output multiplier type I in production field, it can be seen that the fields that affect the economics of each provincial groups the most in the central northeast, production fields that affect the economic in the provincial group the most are field of Production of appliances and electrical equipment which has type I multiple equals to 3.2840, followed by steel and stainless steel industry, and other productions.

Hence, from the multiplier from the above table, it can be interpreted that if final demand affecting productivity is increased for 1 unit, it affects overall production output in the economic system of the provincial group, and it depends on the output multiplier type 1 whether the effect will be more or less. For the indirect impacts of the sector when the consumption in the production field is increased, the fields that have the most indirect impacts are consisted with the impact multiplier type I. From the above information, it can be seen that the provincial groups that have the same ability in the production field that have the most effect on the indirect impact and it affect the economics of the provincial groups are production of appliances and electrical equipment, except lower provinces groups 2 which have steel and stainless steel industry that affect the economics of the provincial groups the most.

Table 3. Direct and indirect impact of agricultural products

Ranking	Code	Type of business	Type I multi	Indirect
1	002	Corn cultivation	1.613	0.6135
2	005	Vegetable and orchard farm	1.242	0.2420
3	009	Livestock	1.172	0.1727
4	004	Dilichos Biforuss farm	1.172	0.1721
5	007	Rubber plantation	1.144	0.1447
6	010	Forestry	1.141	0.1415
7	008	Other crops	1.084	0.0848
8	003	Cassava farm	1.030	0.0308
9	001	The farming	1.019	0.0197
10	006	Sugarcane farming	1.010	0.0105

From the analysis of the output multiplier type 1 in agricultural field, it is seen that the field which affects the economy the most in central northeast are corn cultivation (002) with the type I multiple equals to 1.613 followed by vegetables and orchards farming (005) with the type I multiple equals to 1.242 and livestock field (009) with the type I multiple equals to 1.172. Hence, from the multiplier from the above table, it can be interpreted that if final demand affecting productivity is increased for 1 unit, it affects overall production output in the economic system of the provincial group, and it depends on the output multiplier type 1 whether the effect will be more or less. For the indirect impacts of the sector when the consumption in the production field is increased, the fields that have the most indirect impacts are consisted with the impact multiplier type I.

Conclusion and discussion

The results of study found that the production and agricultural field are rarely ability to add value and income distribution. Moreover, the production in the central region is inadequate to meet the demand in the area. Therefore,

production is needed to be imported from outside the North-eastern region. The potential event forward linkage in the central of Northeast is the production of appliances and electrical equipment, Iron and steel industry, other manufacturing, Printing and Manufacture of chemicals and chemical products.

This result of study according with Pasinetti, (1962) that distribution of income depend on growth of economics. The potential event in the Northeast is the field of electrical appliances and electrical equipment as well as Iron and Steel Industry. Most of the production fields in the provincial group are the manufacturing that supports the upstream inputs such as the field of electrical appliances and electrical equipment, the field of metal products, industry, iron and steel, and the field of printing, etc.

The ability to linked of the field of agriculture are fields of rice farming and rubber farming as these fields can deploy products to other products such as rice into flour, candy, etc., and the rubber can be processed into plastic bags, tires, etc. In addition, the fields that more attention is needed are corn farming, soybean farming, and livestock as these groups are just to pull the inputs from upstream production without adding value to the balance. As a result, the distributions of income in these fields are lesser, and it affects to the economic growth in North-eastern area. In this case, these fields shall be developed and linked forward with other fields in order to create added value and income distribution as well as reducing the income problem of farmer. The result is that the farmers will be able to generate more revenue from their own agricultural products and do not evacuate to other residents.

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Empirical Reassessment of Bank - based Financial Development and Economic Growth in Hong Kong

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Abstract:

This paper reassesses the nexus between bank-based financial development and economic growth in Hong Kong during the period 1990 – 2014. That is, it tests whether Hong Kong follows a supply-leading or a demand-following hypothesis. Empirically, economists have generally disagreed on the nexus between bank-based financial development and economic growth. Hong Kong is a typical economy which has experienced both bank-based financial expansion and economic expansion in the last three decades. It therefore serves as a quintessence for testing this overarching debate. Using the Toda-Yamamoto test for causality and two indicators of bank-based financial development – in order to report robust results – the paper finds Hong Kong to follow the supply-leading hypothesis. This implies that the banking sector is vital in driving economic growth in Hong Kong during the study period. Policymakers in this economy will only enhance economic growth further by targeting and ensuring efficient performance of bank-based financial institutions.

Keywords: bank-based financial development; economic growth; causality; Hong Kong

JEL Classification: C32; E44; G21

1. Introduction

Do banking systems drive economic growth? Or does economic growth drive banking systems? These questions have been prominent at least since the nineteenth century. Among the earliest economists to assess the relationship between financial systems and economies is Schumpeter (1912). In his paper, he emphasises the importance of the banking sector in aiding technological innovation and productive investment, which eventually drives growth. In contrast to Schumpeter (1912), Robinson (1952) asserts that financial development has no influence on growth. She argues, instead, that growth influences the development of financial markets. Robinson (1952) argues that as economies grow the need for financial services arises, thereby stimulating the growth of financial systems.

Since the above seminal works, various studies have analysed, extensively, the linkages between financial development and growth. In characteristic fashion, the empirical results remain divergent. In this paper, instead of focusing on the broad concept of financial development – which can be classified into bank-based and market-based financial development – we concentrate on bank-based financial development. In general, the findings in the literature can at best be classified into four broad categories. The first is the so-called finance-led growth hypothesis, whereby bank-based financial development acts as a precursor to growth. Several empirical studies are consistent with this view. See among others, Bittencourt (2012), Chaiechi (2012), Lee (2012), and Colombage (2009). The second is the so-called growth-led finance hypothesis, whereby growth acts as a precursor to bank-based financial development. This view has been supported by studies such as Hassan *et al.* (2011), Colombage (2009), Chakraborty (2008), and Zang and Kim (2007). The third category finds bidirectional causality between bank-based financial development and growth. This has been corroborated by studies such as Bangake and Eggoh (2011),

Hassan *et al.* (2011), Wolde-Rufael (2009), Abu-Bader and Abu-Qarn (2008), and Hondroyiannis *et al.* (2005). The fourth category finds no causality between bank-based financial development and growth. Studies such as Ibrahim (2007), Chang (2002), and Shan *et al.* (2001) find support for this view.

Most of these studies are either based on bivariate frameworks, cross-sectional approaches, or on frameworks that suffer from small sample properties. This paper attempts to re-assess the causal linkage between bank-based financial development and growth in Hong Kong, using a testing technique that overcomes the afore-mentioned shortcomings. We achieve this aim by extracting indicators of bank-based financial development and growth, and by building an augmented vector autoregression (VAR) model which caters for variable omission by introducing inflation. Then, by applying the Toda-Yamamoto test, we find Hong Kong to follow the supply-leading hypothesis, implying that the banking sector is an important source of growth in Hong Kong during the study period. Based on this conclusion, we argue that policymakers in this economy will only enhance growth further by targeting and ensuring efficient performance of bank-based financial institutions.

The rest of the paper is organised as follows. In the next section, we discuss the trends in banking development and growth in Hong Kong. Section 3 gives the theoretical and empirical underpinning of the finance-growth nexus. Section 4 outlines the empirical methodology and the data. Section 5 analyses the empirical results. Section 6 provides the conclusion.

2. Banking sector development and growth in Hong Kong

At the beginning of the twentieth century, Hong Kong was merely a barren land. Today, the economy of Hong Kong is one of the most advanced in the world. In 1842, when Britain took over, Hong Kong was the central trading port for South China and the Chinese community overseas. Although industrialisation in Hong Kong had started before the Pacific War, the government mainly focused on trade, with only limited attention to domestic manufacturing activities (Tsang 2004). However, the civil war, which broke out in mainland China during this period leading to the victory of the Communist Party in 1949, triggered massive inflow of labour, capital, and entrepreneurial skills from Shanghai to Hong Kong. These incidents led to the fundamental changes in Hong Kong. As a result, the economy of Hong Kong transformed from its long-established position as China's main entrepôt to a highly-industrialised city (Krause 1988, Tsang 2004). The post-war era witnessed the establishment of large export-dependent local manufacturing sectors in Hong Kong. From the 1980s onwards, the economy shifted gradually from manufacturing into banking and financial services (see Young 1992). Over the course of three decades, Hong Kong has transitioned from a manufacturing base to become one of the leading global financial centres (see Taylor 2005, Meyer 2015). Overall, Hong Kong has attained tremendous economic expansion during the past three decades. Today, Hong Kong together with Singapore, South Korea, and Taiwan, are known as the four Asian tigers. Hong Kong is also part of the so-called new industrialised countries of the East.

The economy of Hong Kong boasts of an advanced banking sector, which has created a wide range of financial products and services. The concentration of banking institutions in Hong Kong is one of the highest in the world. More than 70 of the world's largest 100 banks have operations in Hong Kong [Hong Kong Monetary Authority (HKMA), 2016]. Hong Kong now has a three-tier banking system, which is made up of deposit-taking companies, restricted licensed banks, and licensed banks. The chief regulator of the banking system in Hong Kong is the Hong Kong Monetary Authority (HKMA 2016). Altogether, there are 199 authorised institutions (*i.e.* the official name of depository institutions under the three-tier system), and 64 local representative offices in Hong Kong. The authorised institutions consist of 157 licensed banks, 24 restricted licensed banks and 18 deposit-taking companies (see HKMA 2015).

Various structural reforms, events, banking consolidation, and policy initiatives have helped transformed Hong Kong's banking system in the past three decades. The first significant reform entails shifting from a monolithic system to a three-tier banking system in 1981. A further enhancement occurred in 1990 (see Jao 2003). Under this system, the first, second and third tiers comprise, respectively, licensed banks, restricted licensed banks and deposit-taking companies. The nature of prudential supervision varies directly with the scope of the banking activity. The strictly regulated banks (*i.e.* the licensed banks) are allowed to accept all types of deposits. In the case of the second and third tiers, regulation is less-strict, and deposits are confined to time deposits (see Jao 2003).

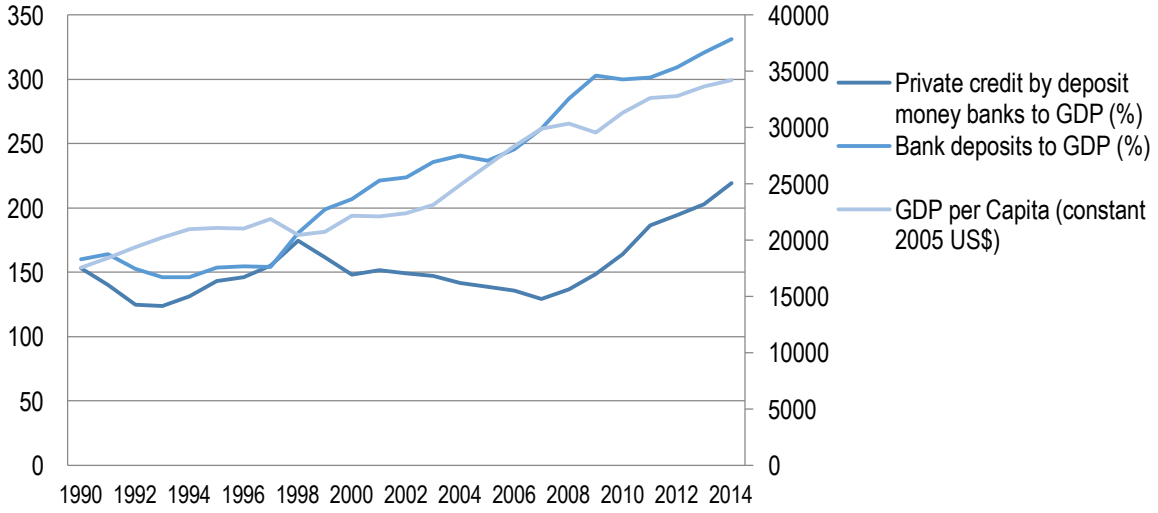
The Hong Kong Monetary Authority was created through the merger of the Exchange Fund and the Commissioner of Banking Offices in 1993 and charged with the responsibility of ensuring banking and currency stability. In fact, it was to become the central bank of Hong Kong (see Kwan 2003). Until the 1990's, the domestic banking sector was a closely regulated and largely protected sector. For example, the overseas-incorporated banks licensed in and after 1978 and the overseas-incorporated restricted licensed banks authorized in and after 1990 were restricted to operate in one branch, to prevent over-crowding in the retail banking market. As such, locally incorporated banks were relatively protected from foreign competition (Hua and Randhawa 2006). In addition, the Hong Kong Association of Banks (HKAB), under HKAB ordinance, used a set of interest rate rules to regulate interest rates on bank deposits since 1964 (Kwan 2003).

In the 1990s, authorities in Hong Kong implemented various initiatives to stimulate competition in the banking system. Among them were the deregulation of interest rates, the relaxation of one branch policy for foreign banks, and the relaxation of the market-entry criteria. The set of interest rate rules that were used to regulate the interest rates on bank deposits were eventually relaxed in 1994. This was achieved through the removal of the ceiling on interest rates put on certain types of time deposits (Kwan 2003). The monetary authority outlined steps to remove the interest rate rules entirely after the Asian financial crisis in order to promote competition. The Hong Kong Monetary Authority completed its extensive deregulation of interest rates in 2001 (Kwan 2003). In a bid to ensure equal chance for all participants (local and foreign), the monetary authority partially relaxed its one-branch restriction for foreign banks and introduced a three-branch condition in 1999 (see Jiang *et al.* 2003). In 2001, the monetary authority successfully removed all limitations on the number of branches and offices for foreign banks. In addition to this, the market-entry criteria were relaxed in 2002, permitting foreigners to invest in the local banking system (Jiang *et al.* 2003). As part of these market-entry initiatives, the asset-size requirement for foreign banks was reduced. The requirements for the domestically incorporated restricted licensed banks and deposit-taking companies to upgrade to licensed-bank status was also relaxed (Jiang *et al.* 2003). The aim of these initiatives was that by gradually eliminating market-entry barriers, the market can determine the optimal number of institutions in the banking sector (see Hua and Randhawa 2006).

The extensive financial liberalisation initiatives, a steady technological progress, costs cutting initiatives and a steady growth of revenue led to huge bank consolidation in Hong Kong. During the 2000s, a host of mergers and acquisitions took place in the banking system. As a consequence, the number of licensed banks dropped from 31 in 2000 to 23 in 2007 (see HKMA 2001; 2007). In 2001, the ten member banks of the Bank of China Group consolidated into the Bank of China (Hong Kong); and in July 2002, the bank got listed on the Hong Kong stock exchange (Jiang *et al.* 2004). Foreign banks have undertaken deals with smaller banks in Hong Kong in order to gain access to the mainland China market (see Jiang *et al.* 2004). In addition, the number of authorised institutions has declined by 45% (*i.e.* from 361 to 199 during the period 1997 to 2015) (HKMA 1997; 2015), following the restructuring of foreign parent banks and the consolidation of overseas banks during the Asian financial crisis.

Generally, the banking system in Hong Kong has developed considerably during the past three decades. To make this point clear, let us take a look at two proxies of banking sector development, namely: Private Credit by Deposit Money Banks as a percentage of GDP (PC/GDP) and Bank Deposits as a percentage of GDP (BD/GDP). Figure 1 shows that PC/GDP first fell from 153% in 1990 to 124% in 1993, and then increased gradually to 175% in 1998. There was a downward adjustment in the PC/GDP, following the Asian financial crisis, the burst in the technology bubble, the terrorist attack in the United States, and the effect of epidemic virus; that is, the PC/GDP dropped to 142% in 2004. After the slow recovery of the recent global financial crisis, there was a marked improvement in the banking sector development during the period of 2010 to 2014, with the highest PC/GDP value (*i.e.* 219%) being recorded in 2014 (Global Financial Development Database 2016). In addition, if the banking sector development is proxy by Bank Deposits as a percentage of GDP (BD/GDP), the development of the banking system in Hong Kong looks even more impressive (see Figure 1). The BD/GDP shows a general upward trend from 160% to 331% during the period of 1990 to 2014 (Global Financial Development Database 2016).

Figure 1. Bank-based financial development indicators and real GDP per capita during the period 1990 – 2014



Source: Global Financial Development Database (2016).

The banking sector expansion was associated with the expansion of the real sector. As Figure 1 shows, real GDP per capita has experienced nearly twofold increment over the past two decades (i.e. from US$ 17566 in 1990 to US$ 34,222 in 2014). On the average, real GDP per capita growth was around 2.3% in the 1990s, and around 3.5% in the 2000s. However, the growth slowed down to 2.2% in the first half of 2010s (Global Financial Development Database 2016).

3. Literature review

The causal nexus between financial development and economic growth has remained a topical issue for several years. By and large, the theoretical and empirical literature has been divisive as to whether financial development precedes growth or growth is a precursor to financial development. According to Schumpeter (1912), financial development fosters technological innovations and growth through the mobilization of funds, risks management, evaluation and selection of projects, facilitation of transactions, and the monitoring of entrepreneurs. Goldsmith (1969) attributes the positive association between finance and growth to efficient capital stock usage. McKinnon and Shaw (1973) note that financial development enhances growth by enhancing the productivity of capital. To them, a well-developed financial system is necessary for the attainment of growth.

In contrast, other economists remain unconvinced by the role played by financial development in growth. Robinson (1952), for instance, notes that financial development cannot influence growth. To her, financial development is a by-product of growth. In her view, growth breeds the need for financial products and services. This in turn necessitates the development of financial institutions and intermediaries. Lucas (1988) agrees with this notion by asserting that the role played by the financial sector in growth has been overstated. He argues that the financial sector develops in response to growth.

Patrick (1966) attempts at reconciling these views by contending that at the early stage of economic development, financial development promotes growth, while at the latter stage of economic development, growth tends to promote further financial development. In other words, he argues that there exists bidirectional causality between financial development and growth. In contrast, Graff (1999) argues that financial development and growth are not causally related. To him, what appears to be a link between the two variables is nothing but a result of a historical anomaly.

On the empirical front, the findings in the literature can at best be classified into four broad categories. The first is the so-called finance-led growth hypothesis, whereby bank-based financial development causes growth. Several empirical studies are consistent with this view. See among others, Sehrawat and Giri (2015), Menyah *et*

al. (2014), Hsueh *et al.* (2013), Bittencourt (2012), Chaiechi (2012), Lee (2012), Colombage (2009), Habibullah and Eng (2006), Chang and Caudill (2005), Calderón and Liu (2003), Agbetsiafa (2003), Rousseau and Wachtel (2000), Choe and Moosa (1999), Darrat (1999), Ahmed and Ansari (1998), and Jung (1986). The second is the so-called growth-led hypothesis, whereby growth causes bank-based financial development. This view has been supported in studies such as Menyah *et al.* (2014), Hassan *et al.* (2011), Colombage (2009), Chakraborty (2008), Zang and Kim (2007), Ang and McKibbin (2006), Liang and Teng (2006), Thangavelu *et al.* (2004), Waqabaca (2004), Agbetsiafa (2003), Shan *et al.* (2001), Demetriades and Hussein (1996), and Jung (1986), among others. The third argues for bidirectional causality between bank-based financial development and growth. This has been corroborated by studies such as Pradhan *et al.* (2014), Bangake and Eggoh (2011), Hassan *et al.* (2011), Wolde-Rufael (2009), Abu-Bader and Abu-Qarn (2008), Hondroyiannis *et al.* (2005), Calderón and Liu (2003), Shan *et al.* (2001), and Demetriades and Hussein (1996). The fourth argues for no causality between bank-based financial development and growth. This view has been supported by studies such as Menyah *et al.* (2014), Ibrahim (2007), Chang (2002), Shan *et al.* (2001). In Table 1, we provide a detailed breakdown of the empirical studies. It is clear from Table 1 that the literature is inconclusive. The inconclusive nature of the literature necessitates our paper.

Table 1. The empirical studies on the finance-growth linkages

Finance-led growth		
Author(s)	Country/Countries	Methodology
Sehrawat and Giri (2015)	India from 1982 to 2012	Autoregressive distributed lag approach
Menyah *et al.* (2014)	21 African countries from 1965 to 2008	Trivariate bootstrapped panel; Causality analysis
Hsueh *et al.* (2013)	10 Asian countries from 1980 to 2007	Bootstrapped panel; Granger causality analysis
Bittencourt (2012)	Argentina, Bolivia, Brazil and Peru from 1980 to 2007	Panel time-series analysis
Chaiechi (2012)	South Korea, Hong Kong, UK from 1990 to 2006	Structural VAR
Lee (2012)	The US, the UK, Germany, France, Japan and Korea	Time-series analyses; Granger causality analysis
Colombage (2009)	Canada, Japan, Switzerland, the UK and the US from 1995 to 2006	Vector error-correction model
Habibullah and Eng (2006)	13 Asian developing countries from 1990 to 1998	Dynamic panel Generalized Method of-Moment
Chang and Caudill (2005)	Taiwan from 1962 to 1998	Vector autoregressive model
Calderón and Liu (2003)	109 developing and industrial countries from 1960 to 1994	Geweke decomposition test on pooled data
Agbetsiafa (2003)	Eight Sub-Saharan African countries	Granger causality analysis
Rousseau and Wachtel (2000)	The UK, the US, Canada, Norway and Sweden from 1870 to 1929	Granger causality tests
Choe and Moosa (1999)	Korea from 1970 to 1992	Causality and non-nested model selection tests
Darrat (1999)	Saudi Arabia, Turkey and the United Arab Emirates from 1964 to 1993	Multivariate Granger-causality tests
Ahmed and Ansari (1998)	India, Pakistan and Sri Lanka from 1973 to 1991	Granger causality tests
Jung (1986)	56 countries both developed and developing	Vector autoregressive model

Growth-led finance		
Author(s)	Country/Countries	Methodology
Menyah *et al.* (2014)	21 African countries from 1965 to 2008	Trivariate bootstrapped panel causality analysis
Hassan *et al.* (2011)	168 countries from 1980 to 2007	Panel estimations and multivariate time-series models
Colombage (2009)	Canada, Japan, Switzerland, the UK and USA from 1995 to 2006	Vector error-correction models
Chakraborty (2008)	India from 1996:3 to 2005:1	Time series analysis
Zang and Kim (2007)	Same panel data set used by Levine *et al.* 2000	Sims-Geweke causality tests
Ang and McKibbin (2006)	Malaysia from 1960 to 2001	Cointegration and causality tests
Liang and Teng (2006)	China from 1952 to 2001	Multivariate vector autoregressive model
Thangavelu *et al.* (2004)	Australia from 1960 to 1999	Vector autoregressive model and Granger causality test
Waqabaca (2004)	Fiji from 1970 to 2000	Vector autoregressive model
Agbetsiafa (2003)	Eight Sub-Saharan African countries	Error-correction model
Shan *et al.* (2001)	Nine OECD countries and China	Granger causality procedure
Demetriades and Hussein (1996)	Sixteen countries	Time series techniques
Jung (1986)	56 countries both developed and developing	Vector autoregressive approach
Bi-directional		
Country/Countries	Country/Countries	Country/Countries
Pradhan *et al.* (2014)	35 Asian countries from 1960 to 2011	Panel data estimation methods
Bangake and Eggoh (2011)	71 industrial and developing countries from 1960 to 2004	Panel vector error-correction models
Hassan *et al.* (2011)	168 countries from 1980 to 2007	Panel estimations and multivariate time-series models
Wolde-Rufael (2009)	Kenya from 1966 to 2005	Granger causality test
Abu-Bader and Abu-Qarn (2008)	Egypt from 1960 to 2001	Trivariate vector autoregressive framework
Hondroyiannis *et al.* (2005)	Greece from 1986 to1999	Vector autoregressive framework
Calderón and Liu 2003	109 developing and industrial countries from 1960 to 1994	Geweke decomposition test on pooled data
Shan *et al.* (2001)	Nine OECD countries and China	Granger causality procedure
Demetriades and Hussein (1996)	Sixteen countries	Time series techniques
Pradhan *et al.* (2014)	35 Asian countries from 1960 to 2011	Panel data estimation methods

No relationship		
Country/Countries	Country/Countries	Country/Countries
Menyah *et al.* (2014)	21 African countries from 1965 to 2008	Trivariate bootstrapped panel causality analysis
Ibrahim (2007)	Malaysia from 1985 to 2003	Time series analysis
Chang (2002)	Mainland China from 1987:1 to 1999:4	Multivariate vector autoregressive models
Shan *et al.* (2001)	Nine OECD countries and China	Granger causality procedure

Source: Compiled by authors from the Empirical Literature

4. Methodology and data

In this section, we present the data, the econometric techniques, and the empirical models utilised to investigate the causal linkages between bank-based financial development and growth in Hong Kong. To examine the stationary properties of the indicators of bank-based financial development and growth, we use the Augmented Dickey-Fuller (ADF), and the Dickey-Fuller generalised least squares (DF-GLS) tests. We then test whether bank-based financial development and growth are causally related by employing the Toda-Yamamoto test.

4.1 Testing for stationarity

Our first step in the empirical analysis is to assess the stationary properties of the variables. For this purpose, we utilize the ADF and DF-GLS tests. We employ the DF-GLS test as a robust alternative to the ADF test, which is known to over-reject the hypothesis of no stationarity (see Schwert 1986, Caner and Killian 2001). According to Elliot *et al.* (1996), the DF-GLS test has substantially higher power even in situations where the root of the series is nearly one. The choice of lags is crucial in stationarity testing. In this paper, we use the Modified Akaike Information Criterion (MAIC) to choose the optimal lags to be included in the auxiliary regressions. The auxiliary regressions as well as the test statistics under the ADF and DF-GLS tests are well documented in the literature. We do not focus on them in this paper.

4.2 Granger causality testing using the Toda-Yamamoto test

The traditional approach for causality testing as proposed by Granger (1969) entails that we establish the integration properties of the variables under consideration. If the variables are integrated, we must examine the possibilities of cointegrating relationships, before we can carry out the test for causality. This becomes problematic because majority of the diagnostic tests for non-stationarity and cointegration are known to have low power against the alternative hypotheses of stationarity and cointegration (see Ho and Iyke 2016, for similar explanation). In fact, Toda and Yamamoto (1995) have emphasized that the conventional approach to testing for causality – which requires one to test for stationarity and cointegration – is vulnerable to pretesting bias. In support of this view, He and Maekawa (1999), explain that if causality is tested in situations whereby one or both time series are non-stationary, the results would be spurious.

According to Toda and Yamamoto (1995), the problems associated with the conventional test for causality may be obviated by fitting an augmented VAR model, whereby the highest order of integration of the variables is added to the optimal lag of the VAR model. The associated test statistic for the causality test, following this VAR model would have a standard asymptotic distribution (Toda and Yamamoto 1995). Following Yamada (1998), and Ho and Iyke (2016), a modified vector autoregressive model, $VAR(m + d_{max})$, for testing Granger causality using the Toda-Yamamoto technique will be of the form

$$\gamma_t = \gamma_0 + \sum_{i=1}^{m} \gamma_{1i} y_{t-i} + \sum_{i=m+1}^{m+d_{max}} \gamma_{2i} y_{t-i} + \sum_{i=1}^{m} \varphi_{1i} x_{t-i} + \sum_{i=m+1}^{m+d_{max}} \varphi_{2i} x_{t-i} + u_{1t} \qquad (1)$$

$$x_t = \Theta_0 + \sum_{i=1}^{m} \Theta_{1i} x_{t-i} + \sum_{i=m+1}^{m+d_{max}} \Theta_{2i} x_{t-i} + \sum_{i=1}^{m} \delta_{1i} y_{t-i} + \sum_{i=m+1}^{m+d_{max}} \delta_{2i} y_{t-i} + u_{2t} \quad (2)$$

where: y_t and x_t denote the variables; δ, γ, Θ and φ denote the coefficients; u_1 and u_2 denote the iid error terms. d_{max} denotes the highest order of integration of the variables.

From Eq. (1), x_t causes y_t if $\varphi_{1i} \neq 0, \forall\, i = 1, 2, \dots, m$. In a similar vein, in Eq. (2), y_t causes x_t if $\delta_{1i} \neq 0, \forall\, i = 1, 2, \dots, m$. The associated test statistic of these hypotheses is chi-squared distributed. Suppose that $\delta_{1i} = 0, \forall\, i = 1, 2, \dots, m$, and let $\delta = vec(\delta_1, \delta_2, \dots, \delta_m)$ denote a vector of m VAR coefficients. According to Toda and Yamamoto (1995), for a suitably selected Z, the modified Wald-statistic for this hypothesis takes the form

$$W = T(\hat{\delta}' Z' (Z \hat{\Sigma}_u' Z')^{-1} Z \hat{\delta}) \quad (3)$$

where: $\hat{\delta}$ is the OLS estimate of δ; $\hat{\Sigma}_u$ denotes a consistent estimate of the variance-covariance matrix of $\sqrt{T}(\hat{\delta} - \delta)$; T denotes the sample size. W, which is the test statistic, is chi-squared distributed with m degrees of freedom.

4.3 Data

The period covered in this paper is from 1990 to 2014. The data are obtained from the World Bank's Global Financial Development Database (2016) and World Development Indicators (2016). These databases are preferred because they are very reliable and have been used by previous studies. The variables employed in this paper are: (i) economic growth, measured by the annual percentage change in real GDP per capita (constant 2005 US$); (ii) bank-based financial development, measured by two proxies, namely: private credit by deposit money banks as a percentage of GDP (PC/GDP), and bank deposits as a percentage of GDP (BD/GDP), and (iii) inflation, measured by annual percentage change in consumer prices.

5. Empirical results

5.1 Results of stationarity tests

Before assessing the causal nexus between bank-based financial development and growth in Hong Kong, we first establish the stationarity properties of the variables. This step is necessary in order to establish the additional lag(s) (*i.e.* d_{max}) to be included in the augmented VAR model – which will be used to test for causality following Toda and Yamamoto (1995). In this paper, we utilise the ADF and DF-GLS tests and then we undertake the stationarity analysis by taking into account the no trend and trend options. Table 2 shows the results of the stationarity tests of the variables in their levels and first differences. The variables are stationary after first difference at the conventional levels of significance (see Table 2). Hence the additional lag to be included in the augmented VAR model is 1 (*i.e.* $d_{max} = 1$).

Table 2. Stationarity tests of variables in levels and first differences

Variable	No Trend	Trend
Levels – ADF Test		
lnGDP	-0.383	-1.594
INF	-1.666	-1.158
lnPC/GDP	-1.029	-2.038
lnBD/GDP	0.313	-3.683**
Levels – DF-GLS Test		
lnGDP	0.418	-1.668
INF	-1.346	-1.253
lnPC/GDP	-1.416	-2.346
lnBD/GDP	-0.108	-2.165
First Difference – ADF Test		
ΔlnGDP	-4.096***	-4.006**

Variable	No Trend	Trend
ΔINF	-4.367***	-4.769***
ΔlnPC/GDP	-2.812*	-2.903*
ΔlnBD/GDP	-4.689***	-4.661***
First Difference – DF-GLS Test		
ΔlnGDP	-4.116***	-4.153***
ΔINF	-4.325***	-4.810***
ΔlnPC/GDP	-2.534**	-2.965*
ΔlnBD/GDP	-3.281***	-3.378***

Notes: 1) *, ** and *** denote, respectively, 10%, 5% and 1% significance levels; 2) The critical values for the Dickey-Fuller GLS test are based on Table 1 of Elliot *et al.* (1996); 3) Δ denotes first difference operator; 4) lnGDP = natural log of real GDP per capita, lnPC/GDP = natural log of private credit by deposit money banks as a percentage of GDP, lnBD/GDP = natural log of bank deposits as a percentage of GDP, and INF = inflation.

5.2 Lag selection, model diagnostics, and the results for causality testing

It is important to select the appropriate lag length when performing the Toda-Yamamoto test. Here, our selection of the optimal lag length is based on the Akaike Information Criterion (AIC), the Hannan-Quinn Criterion (HQC), the Schwartz Information Criterion (SIC), and the Final Prediction Error (FPE). The optimal lag selected in our analysis is 3 (see Tables 3 and 4). Hence, we specify the two VAR models based on 3 lags. Apart from selecting the optimal lags, the best models should be free of serial correlation and be structurally stable (see Ho and Iyke 2016). We therefore test for structural stability and serial correlation. These results are presented in Tables 3 and 4. The inverses of the roots of the characteristic equations are above one in all the cases (see Tables 3 and 4), indicating that the models are structurally stable. This is supported by Figures A.1, and A.2, which show the cumulative sum of recursive residual plots. The models are also free of serial correlation. This evidence is shown, respectively, by the chi-squared statistic of 89.739 with a p-value of 0.971 for the lnGDP, INF and lnPC/GDP model; and 91.110 and 0.963 for the lnGDP, INF and lnBD/GDP model.

Table 3. Results for the Causality Test – Model with lnPC/GDP

	Wald-statistic [p-value]		Inverse Roots
Main Results			
	lnGDP	lnPC/GDP	
lnGDP	NA	5.800[0.120]	1.064
lnPC/GDP	10.000[0.019]	NA	1.064
INF	13.500[0.004]	4.700[0.190]	1.155
Lag Selection	AIC = 3 HQC = 3 SBC = 2 FPE = 3		
Serial Correlation	Chi-squared 89.739	[0.971]	

Note: NA denotes non-applicable.

Table 4. Results for the Causality Test – Model with lnPC/GDP

	Wald-statistic [p-value]		Inverse Roots
Main Results			
	lnGDP	lnBD/GDP	
lnGDP	NA	3.600[0.300]	1.146
lnBD/GDP	10.700[0.013]	NA	1.146
INF	9.200[0.020]	3.000[0.390]	1.169
Lag Selection	AIC = 3 HQC = 3 SBC = 3 FPE = 3		
Serial Correlation	Chi-squared 91.110	[0.963]	

Note: NA denotes non-applicable.

Having satisfied all the requirements underlying the Toda-Yamamoto test, we estimate a $VAR(4)$ for each of the two models (*i.e.* $m = 3$ and $d_{max} = 1$). Table 3 shows the causality tests between lnGDP and lnPC/GDP.

From Table 3, it is evident that there is a unidirectional causal flow running from lnPC/GDP to lnGDP at 5% level of significance, as indicated by the chi-squared statistic of 10.000, with corresponding p-value of 0.019, for the lnGDP equation. Similarly, there is a unidirectional causal flow running from lnBD/GDP to lnGDP at 5% level of significance, as indicated by the chi-squared statistic of 10.700, with corresponding p-value of 0.013, for the lnGDP equation (see Table 4). From these results, bank-based financial development is a precursor to growth in Hong Kong. In other words, Hong Kong tends to follow the supply-leading hypothesis. This finding is consistent with the existing findings such as those of Sehrawat and Giri (2015), Menyah *et al.* (2014), Hsueh *et al.* (2013), and Bittencourt (2012). The finding implies that policymakers in Hong Kong are able to drive growth using bank-based financial development as a tool. Hence, one way Hong Kong can continue to sustain its tremendous advancement is to ensure that its banking system is functioning efficiently. Robust stabilizers should be built to make the banking system insusceptible to systemic and external shocks.

Conclusion

This paper assessed the causal nexus between bank-based financial development and growth in Hong Kong. It answered the following question: Does Hong Kong follows a supply-leading or a demand-following hypothesis? Hong Kong is a typical economy which has experienced both bank-based financial expansion and economic expansion in the last three decades. It therefore serves as a quintessence for testing this overarching debate. Many deficiencies exist in the majority of the previous studies, including the use of limited data for methods that are inefficient in small samples, and problems of variable omission bias. This paper avoided those problems by using the Toda-Yamamoto test for causality, and by introducing inflation as a conduit between bank-based financial development and growth. The paper is also among a few to assess the above-mentioned question in the case of Hong Kong. Using a dataset that covered the period 1990 – 2014, and two indicators of bank-based financial development, the paper found Hong Kong to follow the supply-leading hypothesis. This implied that the banking sector has been an important driver of growth in Hong Kong during the study period. Policymakers in this economy will only enhance growth further by targeting and ensuring efficient performance of bank-based financial institutions.

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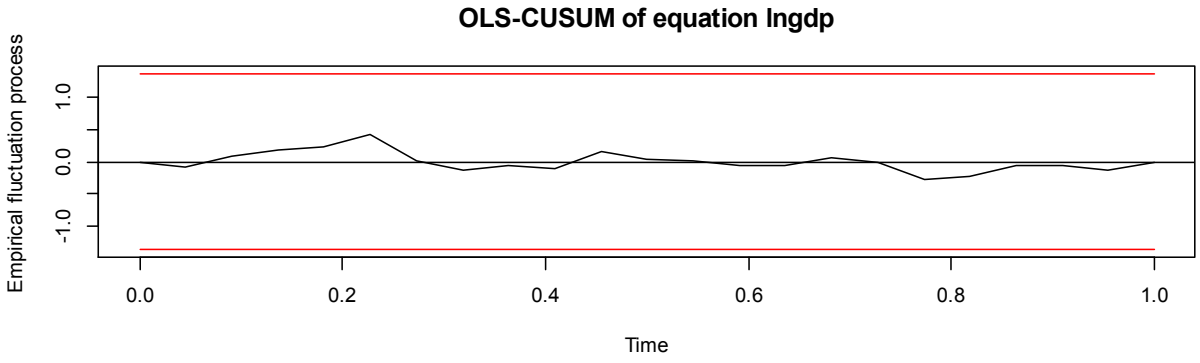
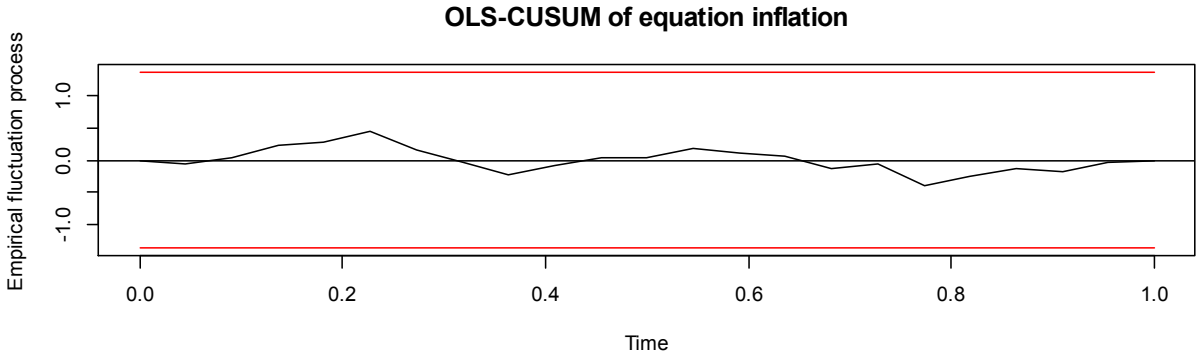
APPENDIX

Figure A.1 - The cumulative sum of recursive residual plots of lnGDP, INF and lnPC/GDP





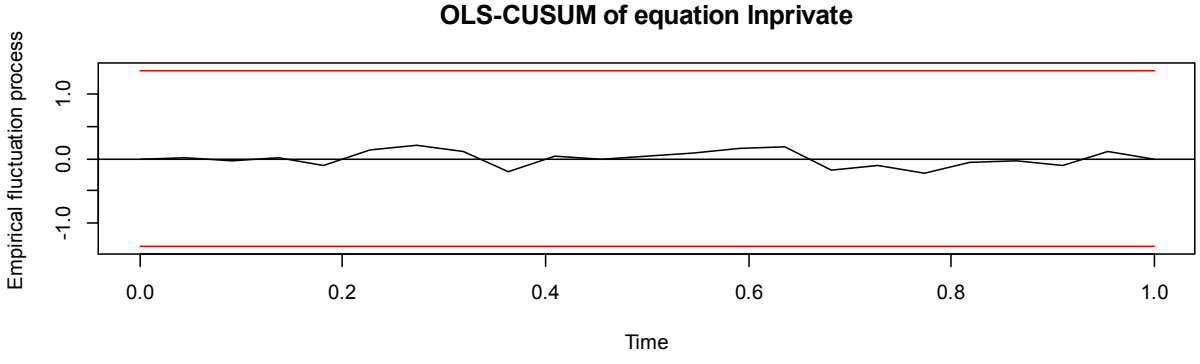
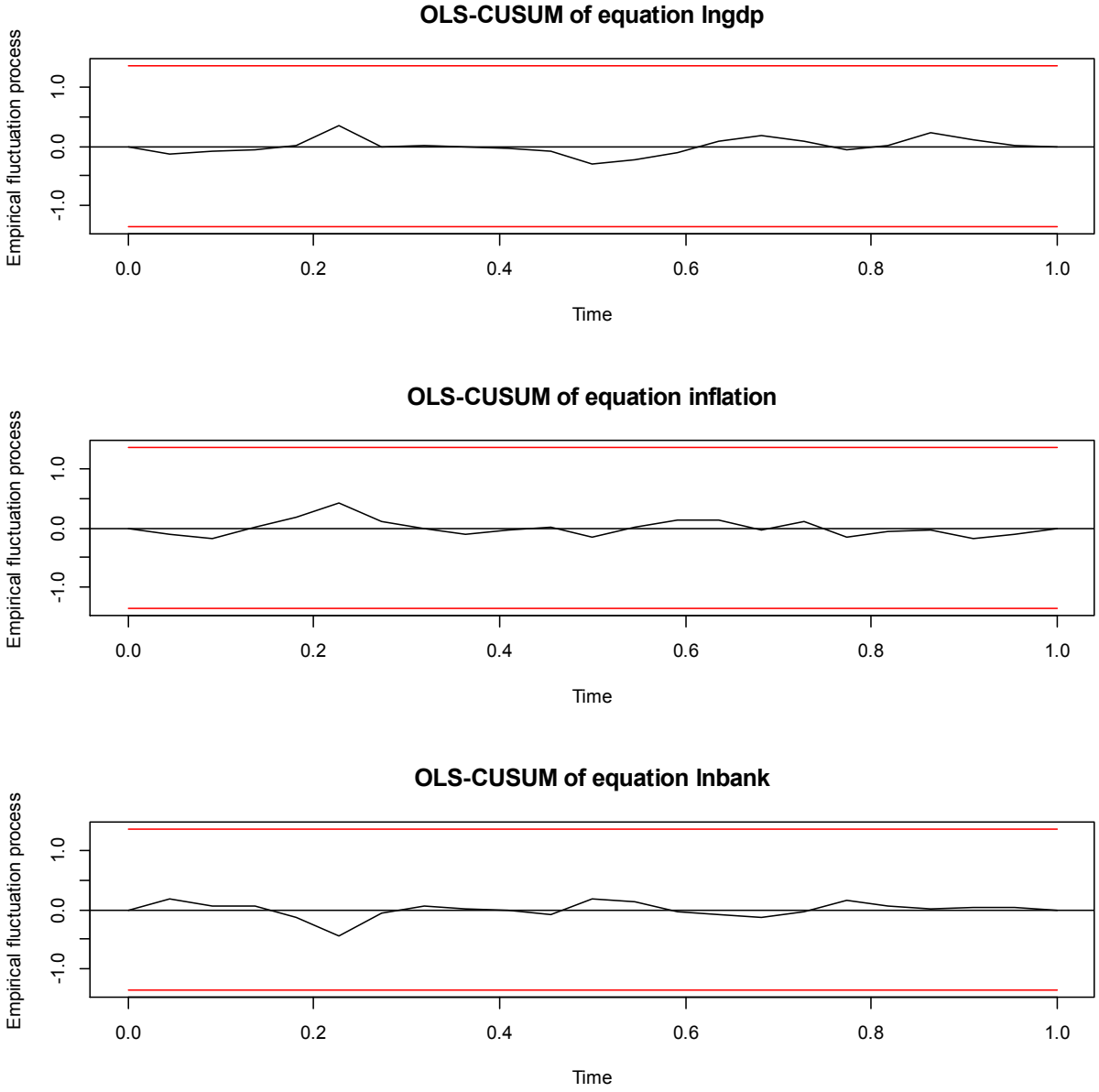


Figure A.2 - The cumulative sum of recursive residual plots of lnGDP, INF and lnBD/GDP



The Entrepreneur's Network as a Cooperation Form of Entrepreneurship: Case of Slovakia

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Abstract:

The subject of the paper is the analysis of the current situation of entrepreneur's network and smaller foreign company's developmental opportunities in terms of innovations. Entrepreneurial networks can help entrepreneurs to achieve their goals and may provide special assistance to entrepreneurs in small and medium-sized enterprises (SMEs) in particular as they usually have limited resources relative to larger businesses. A survey is carried out in order to get to know the respective company's innovation activities more thoroughly. The goal of entrepreneurial networks is usually to combine a broad selection of talents, professionals and resources in order to complement each other's endeavours. We become acquainted with some innovative models, strategies and possibilities. In the chapter dedicated to the practical part we look into the scope of activities of the company. Through interviews we examine the kind of role the innovation plays in its life. As the result of the examination, we evaluate the obtained results.

Keywords: innovation; innovation activities; entrepreneur's network; entrepreneurship; small and medium enterprises

JEL Classification: L26; O10; M21

1. Introduction

The current situation and development of the global economy, oriented primarily to the continuous creation of market and non-market goods to meet the production and final consumption, reveal problems that threaten the fundamental workings of the economic system on its each level. Shortcomings in the functioning of national economies are growing and have an impact on the global economic system, which is based on the principle of market mechanism. The phenomenon of globalization is increasingly familiar to people, and it reveals the interdependence of political, social, cultural, safety, environmental and special economic areas. Economic theory has had a long development (Chikán 2010), during which researchers have formed a number of economic concepts that have predetermined the behaviour of those responsible for managing the economy. (Ivanička 2014, Doležal, Šnajdr, Belás and Vincúrová 2015) Innovative activities (Keresztes 2012) are currently the most effective answers

to a modern company operating internationally, to create business opportunities in the global economy. It is necessary to emphasize the understanding of innovation. It is not only the development of science and technology in that specific field, but it is also a complex business phenomenon (Pitra 2004).

In 1910, Schumpeter was the first who used the concept of innovation in his study of economic growth. Current players of the economy can be characterized by a paradigm shift in their expectations. Promising professional cultures have emerged. The rapid ´´prototyping´´, genetics, nanotechnology and other innovative discoveries are the tools of the change of the future determining technology. It is an inducement of development of innovative sectors. (Poór *et al.* 2012)

There are four types of innovation. The first type is product innovation. The aim is to survive, to increase the prestige, profits and market share, to create new jobs and to increase the number of loyal customers. The second type is process innovation – an innovation during the financial and controlling processes (Michalski 2014) of product development. Its aims are to reduce costs (Mihóková, Andrejovská, and Buleca 2016), increase productivity, material and energy savings, introduction of automation, protection against accidents and environmental protection. The third type is social innovation, which includes the innovations in the elements of human sphere and in the control system. The aim is to develop training schemes, to improve social conditions and the ability of an organization to retain its employees, to increase social benefits, to boost internal mobility and to use the new organizational form. The fourth type is structural innovation – innovations taking place in distribution systems, in the buying and selling markets.

2. Theoretical framework

In economic development of some countries we distinguish certain features that are gradually merging into business conditions (Sobeková Majková 2016, Buleca and Tóth 2016). Branches with a high proportion of knowledge, innovation and skilled labor come to the front. There is a decrease of mass production, and production growth will vary depending on the specific requirements of customers. There is an observable shift from the material factors of prosperity for the benefit of knowledge, ingenuity and the ability to innovate and manage effectively.

“Humanity has become more mature through continuous innovations, technical and intellectual inventions. Development - with some interruptions – can be considered continuous, which is characterized by distinct stages. This constant renewal activity is called innovation. The word innovation comes from the Latin verb innovare, innovatum (renovate), and it consists of the prefix in- and the word novus (new)". (A határ menti régió..., Team of authors, Sopron 2013, 7-10)

Innovation has always been present and it will certainly be in the future. Mankind has undergone great developments, and it has invented countless articles for personal use. It is obvious that as time passed by the world has increasingly developed, reinforced by innovations, the industrial revolution and social trends. (Cross, 2012) "Marketing and innovation are the features that express the essence of a business the most. The aim is to meet the needs of consumers profitably. The former one means turning to the market, and the latter one refers to adaptation to changing consumer demands."(Chikan 2010, 134)

On the basis of what has been said above, we can define that innovation is to meet consumer needs at a new and higher quality level. The concept of research and development (R&D) is closely related to innovation, which is understood as the operation of production of a novelty. This perspective attracts attention to the view that innovation is always a new knowledge: with its realization we can meet consumer needs in a way that was impossible before. Consumer needs, of course, can never be fully met. The constant change of consumer needs and the lack of resources limit the possibilities to satisfy consumer demands. The main goal of various industries and companies is to satisfy customer needs. These objectives have a twofold impact. On the one hand, as demands are growing, and all this is taking place under competitive requirements, companies must find better and better solutions to meet these needs. On the other hand, innovation is one of the conditions to survive, and it significantly contributes to the dynamism of the economy.

Based on the above observations, two essential qualities of innovation are obvious: customer orientation and innovation. There also exists an inevitable feature of innovation. Uncertainty is in a close connection with the

previous ones. Companies need to invest money if they tend to realize their planned innovation. Return on this investment is doubtful, since its result becomes apparent later, whether innovation has the desired effect.

If a customer appreciates innovation, its effect and its better and higher-level solutions, then the company can perhaps gain additional benefits as well. The company may become a monopoly for a while, depending on the uniqueness of the novelty, and thereby it may obtain substantial profits. Thus competitive advantage obtainable by innovation seriously depends on the degree of sustainability. However, if a customer does not really appreciate innovation, then return on investment can happen much later than the scheduled time or it will not happen at all. Joseph Alois Schumpeter (1883-1950), an Austrian-born American economist, is regarded as one of the greatest economists who developed the theoretical framework of innovation. He identifies the importance of innovation in the new pairing of production factors. These efforts are related to the entrepreneur, and not to the inventor or the owner of the invented device. His perception of innovation became the base of the theories and hypotheses dealing with innovation. Basically, the Schumpeterian concept applies to production based companies, but of course it could be extended to other types of companies as well (Chikan 2010).

Schumpeter distinguished five basic types of innovation:

- the introduction of a new good – that is one with which consumers are not yet familiar – or of a new quality of a good;
- the introduction of a new method of production that is one not yet tested by experience in the branch of manufacture concerned;
- the opening of a new market that is a market into which the particular branch of manufacture of the country of question has not previously entered;
- the conquest of a new source of supply of raw materials of half manufactured goods;
- the carrying out of the new organization, or its liquidation (Schumpeter 1939).

To gain and maintain market positions companies today must look for ways to gain a competitive edge. Globalization and internationalization of businesses encourage businesses to have new and closer forms of cooperation (Tuzová, Toulová, and Veselá 2016), allowing them to become successful in the market. In this context it is necessary to focus on such key terms as business networks and business clusters (Kordos, Krajnakova, and Karbach 2016).

We look at the forms of businesses from the perspective of their inclusion to the network. In the next section we develop terminology in a specific area of SMEs, such as business networking. Entrepreneurial activity is the driving force of the economy, in which new tangible or intangible goods appear trying to meet the needs of various players of society. Entrepreneurship should be considered as an ongoing process, it is not the result. It is a systematic operation involving activities aimed at analyzing market opportunities, creating new ideas, formulating a business vision, a business strategy, eliminating business risks and it also involves the implementation of a business plan.

The issue of business has gained much attention in the EU recently, because the business sector is an option for the reinvigoration of the economy in recession. Small and medium-sized enterprises form the bulk of the corporate sector (Súbertová 2015). Almost two thirds of all jobs are these businesses and can be considered as the most important elements of economic growth. According to the European Union (2014), entrepreneurships have particular importance, because they have economic functions, they ensure business activities, social and political functions. Business helps to increase the competitiveness and the innovation of the economy. Expanding of the business promotes the initiative and interest of the various subjects to ensure the adequate implementation and profitability. Large companies would not exist without collaboration with SMEs. The various size categories are not only appropriate to supplement in the field of supply, but together they also form certain business networks.

Renowned teams of experts Belás, Vojtovič, and Ključnikov (2016) and Ubrežiová, Wach and Horváthová (2008) define business networks as the interconnection of complementary business entities in which the participating companies are jointly involved in the development of products, respectively services. Their business network is based on cooperation in the field of research and development, creating business networks and distribution options. A business network is a complex network of companies, working together to accomplish certain

goals and utilizing shared resources to cooperate on joint activities. In Central Europe and Slovakia business network can be characterized as a young type of business, in which participating businesses together act in different areas, respectively in spheres of business activities. Business network is an option to achieve higher competitiveness of enterprises and subsequently of the regions. Cooperation in a business network has various forms, such as mergers and acquisitions or business clusters.

Business network can ensure the further development of the sector of SMEs, which is characterized by mutual cooperation, support and a partner type of mutual business relations.

The impulse to create a business network is to intensify interaction, cooperation and to have a mutual goal of setting long-term objectives in a harsh challenging competition. Innovative businesses and the evaluation of the innovation potential of business networks are reflected in more intense ties, and it enables the participants to strengthen their current market position and also to improve their competitive advantage in the market.

With creating a network of cooperation and forming a network of companies a business network is created. When defining business networks, we can rely on various sources. The characteristics of international organizations and experts are relevant for us. According to Mares (2007), business network is a type of business, in which businesses can keep their sovereignty when linking businesses into larger structures. Network is a community of companies using the combined resources of the joint business project. Business network is a group of companies with similar characteristics, which means that they have similar needs for support.

Organization for Economic Co-operation and Development (OECD 2005) defines business networks as a group of businesses that use the combined resources to collaborate on joint projects. Business networks may consist of small, medium and large enterprises that have their manufacturing program in this group or they join other areas such as commercial policy, marketing activities, information and communication technology, legal and other services, and on the basis of this close cooperation they form their common business strategy. The business network is the result of compromise and consensus of the participating companies. It has no fixed hierarchy, but some members have a partial impact on its core activities.

There are two types of business networks. In the first type there is a leading company, whereas the second is based on equality. The first has an advantage in terms of easier functioning, respectively operation, while the other offers much more dynamics. Their common feature is that they are useful only for such businesses, which in their own businesses complement each other or have a common intersection. The basic idea is that networking is useful only if they have common characteristics.

3. Material and methods

The aim of this paper is to outline the issue of evaluation of business networks and their development. This paper is a partial outcome of the research projects VEGA 1/0381/13 and KEGA 001UCM-4/2016. When analysing the problem, it was necessary to focus on factual materials from primary and secondary literature sources. Our research results were the primary resources, and the secondary sources consisted of the works of domestic and foreign experts. In the processing of the data, we used descriptive statistics and a graphical system.

When preparing the research sample, the following steps were applied: the database of enterprises was obtained from website www.zoznam.sk, the obtained data was used confidently, solely for research purpose. In this research 5208 SMEs were addressed, 454 questionnaires were returned and the collected data was analyzed. This represents 8,7% return.

Questions related to innovation potential of entrepreneurial network led us to formulate questions as the following: characteristics of small and medium enterprises, characteristics of membership in the entrepreneurial network and its influence on the researched enterprise, characteristics of innovation activities of the company. Based on the study of relevant scientific background, we will examine whether it is possible to recognize a relationship between various factors affecting innovation.

Result and Discussion

According to Korab and Koudelova (2016), business networks are advanced methods in business. In most cases they occur as a defensive reaction to intensified, multinational companies. Exchange of information, better

recognition of a business opportunity and the concept of sustainable development serve as a support for cooperation between enterprises through their networking.

There exist business typology and typology of business networks. In the first table the basic forms of business networks are being shown. Innovative businesses and evaluation of the innovation potential of business networks. The author explains the advantages and disadvantages of clustering businesses in different types of networks:

- Horizontal homogeneous network is an association of enterprises with the same or similar line of business and with the same size. Economic advantages are the main benefits when purchasing raw materials;
- Vertical heterogeneous networks are business networks with a different line of business, together they create a new product or service, and they introduce supply chains. The result of their collaboration is a joint contract;
- Combined networks are formed by combining a large company with several small ones that have a subcontracting relationship;
- Regional industrial clusters.

In order to be able to assess the advantages and disadvantages of companies involved and not involved in networking, it is necessary to compare them in terms of the partial lines of the business such as production, customers, marketing, and management and so on. Findings can be seen in Table 1.

Table 1. Results of the survey – comparison of the companies involved and not involved in a network

Area	Business network	Not involved in a network
Production	▪ broader product portfolio, respectively services, diversification of the product range	▪ narrow range of manufactured products, respectively provided services
Economic efficiency	▪ application of economic laws - "economies of scale" and its boosting with accepting new businesses to the network	▪ The company may achieve economic efficiency with cheaper inputs. The cost of the economic sustainability of the business may not be shared.
Marketing	▪ Marketing is focused on the presentation of a broad portfolio of products and services. It highlights the complexity of the offer.	▪ Marketing is focused on the presentation of activities and products of the company, respectively services. It emphasizes the individual approach.
Customers	▪ A wide range of customers. Some companies in the network often have mutual customers. The wide range of customers makes it easier to attract new customers	▪ individual customers without interaction
Management	▪ Complex organizational structures. The network is divided into divisions, plants, departments	▪ Simpler organizational structure which allows a flexible model for management.

Source: *Own processing*

According to Štofková (2014), business networks are necessary not only in the development of modern information and communication technologies but also in the market environment, which is characterized by knowledge and creative economy.

According to the authors, knowledge, skills and creativity are the base of the development of network cooperation between businesses. Knowledge economy - its active elements are networked businesses - creates added value (Andrejovská and Martinková 2016, Grancay, Grancay and Dudas 2015) which increases the importance of knowledge utilization, scientific knowledge and economic success of businesses. It is based on the effective utilization of skills and knowledge, which are the key sources of the competitive advantage.

How important is business networking for the participants? The most significant reasons are the following: increased economic efficiency, cost savings, the possibility of obtaining economies of scale, intensification of

innovation and developing innovative businesses, increasing competitiveness, adequate partner to multinational companies, a consequence of globalization tendencies.

Network cooperation is becoming even more important in business development, as the future of enterprises assumes that one-owner companies will be less and less. Harsh competition pushes the managers and owners of businesses to seek opportunities to maintain and ensure their sustainable growth (Šúbertová 2015). Activities of business co-operations, respectively strategic partnerships assume the control of the specifics of this business segment and development of companies (Šimo and Mura 2015). The economic theory and practice have new demands (Merkevičius, Davidavičienė, Raudeliūnienė and Buleca 2015). Acquirement of advanced techniques and techniques in company management require a thorough study of the issue, as well as the necessary practice from economically developed countries. Expressions referring to partnerships are:

- Business Networks – business networking, business network;
- Strategic Coalitions – strategic partnerships, strategic alliances;
- Multiple Partners – multiple partnerships.

Cooperative business, where clusters are included as well, has a longer history than the very concept of the cluster. Enterprises, however, tried to move their cooperation to a qualitatively higher level. The principle of clustering began to develop in the nineties of the last century. The association of small and medium business networks and cooperation networks are a very similar concept as the cluster is.

Integration of businesses in strategic partnerships in the form of cluster initiatives has been one of the critical success factors in the business on the market today. The initiative of businesses to join together is based on mutual interest in research and development, on joint actions in the implementation of products and services (commercial activity), logistics solutions and so on. The phenomenon of globalization creates new forms of cooperation, which in the period of super competition can become a starting point for the solution of the individual situation of businesses. Motives of businesses for joining are highly differentiated. Usually it is an effort to face high competitive pressure from large and multinational companies. Involvement of businesses in the corporate strategic partnership is purely voluntary and it is motivated individually. Such options are business networks and clusters. In these cases, companies in the partnership fully keep their legal and economic independence and they do not disappear or become part of another business. It means the preservation of its own management of the company. The task of creating a partnership is to achieve common goals based on shared interests.

Factors affecting the development the company

Respondents of primary research evaluated 17 pre-defined factors affecting the development of the company. Respondents could evaluate the degree of influence of factors on the development of the business using the Likert scale.

After the evaluation of each factor, on the basis of their arithmetic mean, we think that the examined companies consider quality and continuous improvement of sales extremely important. We can declare the fact that by respondents all defined factors affecting the development of the company were evaluated as rather important. It can be concluded that respondents with regard to the individual factors expressed a single approach. Based on the analysis above, regarding research question 2, we can say that, yes, respondents expressed a single approach regarding the factors affecting the development of the company.

After examining the mean and the standard deviation of individual factors, we made a correlation analysis of factors that we started with excluding the extremes.

After excluding the extremes, we analyzed the opinion of 365 businesses concerned in the survey. We have confirmed the correlation with rate of 1% of significance. Correlation analysis was necessary for the realization of factor analysis, since 17 of the listed factors we tried to combine with factor variables. After data reduction, we chose the principal component analysis so that we could define initial variables. We investigated whether our data could be used for factor analysis. We used the SPSS software to create a correlation matrix. We examined the value of MSA anti-image correlation matrix, Bartlett's test values and the value of KMO.

After the formation of the correlation matrix, 78 of the 136 correlation values showed significance (57%), the highest value of correlation was 0.517 in assessing the importance of logistics and information management. On the basis of the correlation values it can be stated that the variables are suitable for factor analysis. Values of MSA anti-image matrix ranged from 0.649 to 0.890. Bartlett's test showed the significance ($\chi 2 = 993{,}434$, df = 136, p = 0.000), *i.e.* based on Bartlett's test variables are suitable for factor analysis, as they correlate. KMO value reached 0.821, *i.e.* variables are particularly suitable for factor analysis. Based on the above indicators, we can unambiguously say that the variables are suitable for factor analysis.

Table 2. Results of factor analysis

Factors	Variables	Factor weight	Mean
Running the business 0,807 Mean: 3,57	Information management	0,78	3,44
	Logistics	0,68	3,72
	Technical development	0,60	3,85
	Human resource management	0,57	3,44
	Payroll accounting	0,53	3,19
	Leadership	0,52	3,85
	Development organization	0,47	3,47
Finance 0,704 Mean: 3,58	Accounting	0,78	3,51
	Controlling	0,71	3,43
	Strategic planning	0,59	3,51
	Finance	0,56	3,85
Organization 0,632 Mean: 4,10	Selling	0,80	4,24
	Quality	0,70	4,40
	Production	0,50	3,80
	Selling/marketing	0,48	3,87
Materials 0,714 Mean: 3,49	Inventory management	0,81	3,38
	Cost management	0,75	3,60

Source: *Own processing*

To determine the number of the main components, we first examined the variables on the basis of Kaiser´s criterion by which we can define four main factors. Four major factors explain 57% of the total variance, which, on one hand, does not reach the desirable minimum value (60%), on the other hand, we have lost almost half of the information. Therefore, in order to meet the minimum criteria of 60% variance, we would have to create at least five factors. Based on the previous analysis, we finally decided to define four main factors. Values of Cronbach´s alpha of individual factors, the individual variables with factor weights and means are being summarized below in Table 3.

Based on factor analysis, we therefore identified four main factors that influence the development of the company: running the business, finance, organization and material. Cronbach´s alpha value for each of the identified factors exceeds the value of 0.5, which is a basic condition for a good analysis. After carrying out factor analysis we found that the groups of factors influence business development as follows: running the business - 33%, finance - 8.6%, organization of sales - 8.3% and material - 7.2%. Regarding the means of the main factors, we think that the organization (4.1) is the most important factor of development, *i.e.* if the company wants to develop in the future, it is necessary to devote much time to meet the needs of the customers. It is necessary to deal significantly with the sale and development of appropriate marketing. Organizational units, ensuring the financial stability of the company, such as controlling, accounting, corporate finance and strategic planning, play an important role in the development of the company. Units responsible for running the business (3.57) and material (3.49) are also above-average values. Based on the results, it can be said that regarding business development most of the companies consider each factor rather important.

In the final question of the primary questionnaire survey we examined, which factors are considered necessary to maintain competitiveness. The Likert scale was used for the evaluation of the factors.

Table 3. Factors maintaining competitiveness

Order	Factors maintaining competitiveness	Mean	Standard deviation
1	Quality of the product/service provided	4,32	0,910
2	Punctuality of order fulfilment	4,15	1,005
3	Order processing time	3,93	0,995
4	Customer service	3,89	1,045
5	Productivity	3,85	0,919
6	Turnover inventory	3,82	0,999
7	Product development	3,82	0,977
8	Capacity utilization	3,73	0,979
9	Cost of guarantees	3,70	1,175
10	Claims turnaround time	3,69	1,078
11	Continuous production time	3,67	1,069
12	Number of product types	3,59	1,135
13	Unit costs of production	3,52	1,062
14	Age of the technology	3,46	1,114

Source: *Own processing*

Among factors to maintain competitiveness those ones were considered particularly important that are connected with consumers, i.e. quality of the product, respectively the provided service, punctuality of order fulfillment, order processing time and customer service. Factors regarding the production and technology are considered less important, but we must add that respondents found factors maintaining competitiveness rather important because none of the factors´ average value falls under three. Value of the standard deviation is close to 1, which means that the views of respondents are mostly the same.

Conclusion

Globalization involves the integration of different companies into joint partnerships, through which they can effectively face the pressure of competing businesses. Gavláková (2012) states that globalization highlights the role of clusters (clusters, common initiatives), thanks to which businesses participating in this cluster are much more competitive. Competitive advantages are based on the internal and external resources that are available in national and local business environment. According to the author, clusters are potential tools for improving regional values because they use the combination of knowledge, skills and abilities of different subjects. They enable the participants to create value for customers while reducing transaction costs and increasing economic benefits. Businesses in clusters through an innovative approach improve their competitive position and the situation of the region. The current business environment is facing very dynamic changes, forcing businesses to increase their competitiveness.

Small and medium-sized enterprises (micro-enterprises, small businesses, medium-sized enterprises) react to changes in the business environment in the most susceptible way, and therefore they require special attention. Linking the SMEs to the national economy is constantly growing. Adversaries of globalization note that globalization and integration of international economic space goes together with its fragmentation, and globalization is essentially a process in which developed countries consolidate to oppose the rest of the world (Kolmykova, Lukianykhina, Baistriuchenko, and Lykianykhin 2015). This business segment contributes significantly to the creation of new jobs, to the introduction of innovations into practice, to the new technological resources and to the formation of a competitive environment.

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The Impact of Selected Research & Development Indicators on Companies´ Growth in Individual Industries in V4 Countries

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Abstract:

The aim of this paper is to evaluate the influence of research and development on companies´ growth in individual industries in V4 countries from 2003 to 2014. Using generalized method of moments (GMM) will be tested the influence variables such as for example the firm growth rate, capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability, growth rate of R&D employees in individual industries in V4 countries. It is expected the positive influence for companies´ net sales growth of their investment in R&D and of tax policies that benefit the individual companies. It is expecting also a positive effect of R&D intensity in companies´ growth. On the basis of the article we can find information about importance of R&D investment and R&D tax credits and their consequent impact on companies´ growth.

Keywords: companies´ growth; profitability; R&D intensity; R&D investment; tax incentives

JEL Classification: H20; H30; O32

1. Introduction

The aim of this paper is to evaluate the influence of research and development on companies´ growth in individual industries in V4 countries from 2003 to 2014. Another target of this paper is to identify which selected factors affecting companies´ growth. Using generalized method of moments (GMM) will be tested the influence variables such as the firm growth rate, capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability, growth rate of R&D employees on companies´ growth in individual industries in V4 countries. The first chapter includes an introduction and literature review. The second part of this paper includes a methodology. using date and purpose of the generalized method of moments (GMM). This chapter includes an overview of variables and characteristics of the data used. The third part of the paper is focused on the results of estimating generalized method of moments (GMM) and their comments. This chapter is focused on the selected factors affecting the companies´ growth in individual industries in V4 countries from 2003 to 2014.

The EU Industrial R&D Scoreboard defines research as original and planned investigation undertaken with the prospect of gaining new scientific or technical knowledge and understanding. Expenditure on research is recognised as an expense when it is incurred. Development is the application of research findings or other knowledge to a plan or design for the production of new or substantially improved materials, devices, products, processes, systems or services before the start of commercial production or use. Development costs are capitalised when they meet certain criteria and when it can be demonstrated that the asset will generate probable future economic benefits. Where part or all of R&D costs have been capitalised, the additions to the appropriate intangible assets are included to calculate the cash investment and any amortisation eliminated.

Theoretical and empirical literatures show that research and development (R&D) and R&D investments are crucial for economic growth. Innovation is the engine of a knowledge economy. Research and development (R&D) is the key ingredient of the innovation process. Research and development ensures the generation of new knowledge and technologies. Institutions that perform research and development stay abreast of leading-edge

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technologies, make more informed decisions, and nurture a valuable knowledge base and absorptive capacity in their skilled personnel. New technologies resulting from R&D increase productivity.

We can say that growth in productivity leads to economic growth. Economic research has long linked R&D expenditure with economic growth, showing that about 30-50% of economic growth in society comes from the introduction of new technologies. A competitive and stable tax policy has the potential to be an effective tool for promoting R&D and innovation in the country or region. Government has a major supporting role in this area by providing a favourable business environment, including appropriate and competitive incentive programs for R&D (Warda 2005).

Companies improve their production technology through a variety of means, many of which are unobservable to the outside world. This is, in particular, true for a very significant proportion of innovations and other production efficiency gains that arise through learning, internal research and development (R&D), and accumulation of organizational capital. As many of these gains are not patentable, firms prefer to retain privacy of information about their actual cost and technology structure. More interestingly, it is difficult for existing rivals, potential competitors, and other stakeholders in the industry to readily acquire information about efforts and inputs expended in the R&D process of a firm. In competitive markets, the absence of observability of R&D investment or efforts undertaken by other firms is likely to influence the strategic incentive to invest, the extent of actual technological improvements, and the eventual market outcomes. This leads to an important question about the effect of privacy of such information on technological change and social welfare. If such secrecy is not socially desirable, then there would be a case for public policy to discourage secrecy and promote sharing and disclosure of information about R&D investments made by the firms (Sengupta 2016).

2. Literature review

Del Monte and Papagni (2003) have engaged R&D and market performance of firms. They used data on a sample of 500 firms from Italy with time series in the range 1989–1997. Using panel regression analysis, it was found that the results obtained support the existence of a positive relation between R&D and growth performance of firms. They tested variables such as firm size, growth rates, productivity, productivity growth rate, profitability and R&D intensity. The results of analysis confirm the existence of a positive relation between R&D intensity (measured by the R&D/sales ratio) and the growth rate of firms. As far as the size level is concerned, it appears that on average it has no systematic effect on the growth of firms.

Lian *et al.* (2011) have provided evidence at the firm level regarding the relationship between R&D investment and firm growth, with respect to the influence of financial constraints, government support, and involvement of financial intermediaries and insurers. The data was derived from the survey of 609 high tech firms in China in the period 2007-2009. The results show that R&D expenditure can significantly enhance firm growth. There were used following variables: firm growth rate (measured as difference between current year and previous year). R&D intensity (measured as R&D expenditure divided by sales), firm size (measured as total assets), firm age (measured as difference between last analysed year and established year) and profit (measured as net income divided by total assets). Results show the positive effect of R&D intensity and profit on the growth of the firms. Firm age and firm size have a negative effect on the growth of the firms.

García-Manjón and Romero-Merino (2012) have presented a model of endogenous firm growth with R&D investment as one of the main mechanisms of growth. This study evidences a positive effect of R&D intensity on the sales growth by using OLS, quantile regressions, and GMM system estimators for a sample of 754 European firms for the 2003-2007. They also found this association is more intense in high-growth firms and in especially significant when referring to high-technology sectors. Independent variables included variables such as size previous year (measured by the nominal value of the firm net sales). R&D previous year (measured as R&D firm expenditure of the previous year divided by net sales of the previous year) and growth previous year (measured as the log-difference of the previous year firms´ net sales). Depend variable is calculated as the differences of logs of net sales. Results show that the effect of R&D on the growth of the firms is significantly positive in all cases. According to this result, an increase in the R&D investment positively influences the growth of a firm´s net sales. It was found a positive relation between growth and its lag.

Soares Tiago *et al.* (2012) examined the effects of factors affecting firm´s growth using panel regression analysis for 21 countries from 2003 to 2012. The model was estimated by using Ordinary Least Squares (OLS) with dated panel and fixed effects. Authors used variables including R&D intensity, firm size, firm sales, tax incentives, profitability and capital intensity. The results confirm the positive effect of R&D intensity, firm sales and R&D tax credits in companies´ growth. The results also confirm the negative effect of firm size in companies´ growth.

Triguero-Cano *et al.* (2012) analysed the role of innovation output persistence on employment growth. Using a GMM system estimator they showed that process innovation has a positive effect on employment while the effect of product innovation is positive but insignificant. They also found the compensation effect of process innovation to increase over time.

Wang (2013) examined the effect of publicly-supported research and development (R&D) subsidies on companies´ growth in Taiwan. The empirical models were estimated using firm-level balanced panel data for the years 1991-1999 for a sample of 67 firms in Taiwan. He used variables such as: the ratio of accumulated innovation patents to total accumulated patents, the ratio of the firm's R&D expenditure to its total sales, the ratio of R&D employees to total employees. The results indicated that a higher ratio of publicly-supported R&D subsidies to total project expenditures would contribute to the companies´ growth of both sales and employment. Contrary to what one might expect, it also results in a decrease in the growth rate of employment in R&D.

Deschryvere (2014) analysed how the relationship between R&D and firm growth varies between continuous and occasional innovators for a sample of Finnish firms between 1998 and 2008. He found that only continuous product and process innovators show positive associations between R&D growth and sales growth. Also the links between sales growth and subsequent R&D growth were stronger for continuous innovators than for occasional innovators, but only for product innovators.

Triguero and Córcoles (2014) considered the effect of the persistence of innovation on employment in Spanish manufacturing firms during the period 1990–2008. They use a GMM-system estimation to study the importance of persistence of product and process innovation on employment growth. The empirical results indicate that process innovation measures show a positive effect on employment while the effect of product innovation is positive but not significant.

Segarra and Teruel (2014) analysed the impact of internal and external R&D on firm growth for a group of high-growth firms. Their results show that investing in R&D increases the likelihood of becoming a high-growth firm. Furthermore, internal and external R&D investments show varying impacts according to the firm growth distribution. Internal R&D shows a positive impact among high-growth firms, while external R&D has a significant positive impact for firms with median growth rates.

Capasso *et al.* (2015) analysed the effect of R&D expenditure on firm employment growth in the medium term, using six cross-sectional waves of an innovation survey conducted in the Netherlands in all sectors. The analysis was focused on firms having positive R&D expenditure and investigates whether higher investments in R&D (in proportion to firm turnover) translate into higher medium-term growth rates. Quantile regression techniques indicated that a higher R&D has a positive effect on high growers and allows a higher number of firms to be high growers. They used the data from the Community Innovation Survey (CIS) that refer to the Netherlands, and from the Business Register (Algemeen Bedrijven Register—ABR) provided by the Dutch statistical office (Statistics Netherland—CBS). They considered the six waves of the innovation survey conducted between 1996 and 2006 and match them with yearly data from the Business Register from 1996 to 2011. With the linear regression model they estimated the average firm growth given the firm's R&D intensity.

3. Data and methodology

The aim of this paper is to evaluate the influence of research and development on companies´ growth in individual industries in V4 countries from 2003 to 2014. The empirical analysis is performed for companies in V4 countries, namely Czech Republic, Poland, Slovakia and Hungary. The analysis uses data were taken from OECD database and the EU Industrial R&D Investment Scoreboard that has been published within the context of the Industrial

Research Monitoring and Analysis activities. The analysis uses data on annual basis. The generalized method of moments (GMM) will be used to identify factors affecting companies´ growth.

The generalized method of moments (GMM) is used in econometrics and statistics. The generalized method of moments (GMM) is a generic method for estimating parameters in statistical models. It is applied in the context of semiparametric models, where the parameter of interest is finite-dimensional, whereas the full shape of the distribution function of the data may not be known, and therefore maximum likelihood estimation is not applicable. The method requires that a certain number of moment conditions were specified for the model. These moment conditions are functions of the model parameters and the data, such that their expectation is zero at the true values of the parameters. The GMM method then minimizes a certain norm of the sample averages of the moment conditions. The GMM estimators are known to be consistent, asymptotically normal, and efficient in the class of all estimators that do not use any extra information aside from that contained in the moment conditions (Hansen 1982).

To identify factors affecting companies´ growth will be estimated following:

$$G_{it} = \alpha_1 + \beta_1 * \Delta G_{it-1} + \beta_2 * X_{1it} + \beta_3 * X_{2it} + \cdots \ldots + \beta_n * X_{nit} + \varepsilon_{it} \ . \quad (3.1)$$

where G_{it} is the companies´ growth of companies conducting companies in selected countries i at time t; α_1 and ε_{it} are constant model and the residual component in the model GMM; G_{it-1} is delayed value of companies´ growth in the previous period; X_{nit} is a vector of explanatory variables for the companies´ growth. The vector of explanatory variables will be including variables such as: firm growth rate, capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees.

Table 1. Description of various industrial groups

Industrial groups	Industrial sector
Low-tech firms	Oil and gas producers; Industrial metals; Construction and materials; Food and drug retailers; Transportation; Mining; Tobacco; Multi-utilities
Medium-tech firms	Food producers; Beverages; Travel and leisure; Media; Oil equipment; Electricity; Fixed line telecommunications; Electronics and electrical equipment; Automobiles and parts; Industrial engineering; Chemicals; Personal goods; Household goods; General industrials; Support services
High-tech firms	Pharmaceuticals and biotechnology; Health care equipment and services; Technology hardware and equipment; Software and computer services; Aerospace and defence; Leisure Goods

Source: author´s processing

The EU Industrial R&D Scoreboard divides firms operating in each sector into three main groups according their technological and knowledge-intensity dimensions: high-tech firms, medium-tech firms and low-tech firms. A description of the various industrial groups is presented in table 1. Table 2 presents a description of used variables.

Table 2. Description of used variables

Variable	Definition	Measure of Variables	Expected sign
G	Firm growth rate (%)	Difference between logarithm to sales in present period and logarithm to sales in previous period	
CE	Capital R&D expenditure (%)	Ratio of capital R&D expenditure to sales	+
RDI	R&D intensity (%)	Ratio of R&D expenditure to sales	+
BI	R&D tax incentive generosity	1-B-index	+
P	Profitability (%)	Ratio of profit to sales	+ / -
E	Growth rate of R&D employees (%)	Difference between logarithm to employees in present period and logarithm to employees in previous period	+

Source: author´s processing

The B-index model measures the relative attractiveness of R&D tax treatment in the country or region. The model is based on the marginal effective tax rate approach. The marginal model is designed specifically to look at the tax burden on income generated by an “additional dollar” invested in R&D. and to construct an overall measure

of the corporate tax burden on marginal R&D investments in different countries. The marginal model provides a useful summary of the main features of business taxation and is effective in making international comparisons (Warda 2009). Formula for B-index is following:

$$B = \frac{1-A}{1-t} \tag{3.2}$$

where: A is the net present discounted value of depreciation allowances, tax credits and other R&D tax incentives available (*i.e.* after-tax cost), t is corporate income tax rate. In economic terms, the model represents a before tax rate of return on one euro (€ 1) of R&D investment – in present value.

In accounting terms, the B-index formula represents a ratio of the after-tax cost (ATC) of € 1 of expenditure on R&D divided by 1 less the corporate income tax rate. The ATC enters the numerator of the B-index equation. It is defined as the net cost to the company of investing in R&D. taking account of all available tax incentives for R&D (Warda 2009)

4. Results and discussion

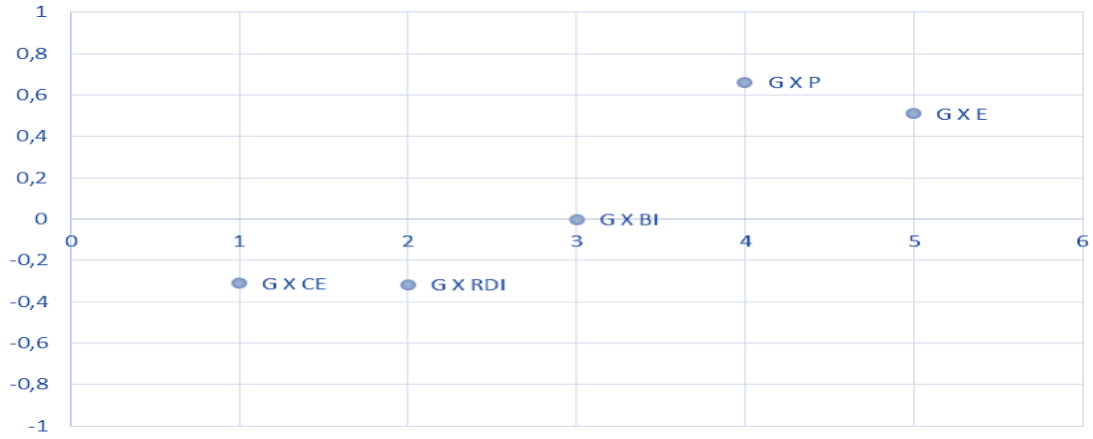
The selected indicators should show mutual dependence according to the theories and the above mentioned studies. One way to measure this dependence is via the correlation coefficient. The correlation coefficient indicates the direction of dependency, but do not suggest causality assessed variables. The correlation is expressed by the following equation (3).

$$K_{XY} = \frac{cov(X,Y)}{\sigma_X \sigma_Y} \tag{3.3}$$

where: X is the mean value matrix companies´ growth and Y is the mean value matrix capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability, growth rate of R&D employees in V4 countries.

This indicator should be in the interval from -1 to 1. Values closer to the value of 1 would suggest that with increased comapnies´growth is growing capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees of the company. Values closer to the value of -1 would suggest that with decreased comapnies´growth is growing capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees of the company. Values which are zero signal independent of one another. The following figures reflect the degree of interdependence of monitored parameters in individual industries in V4 countries.

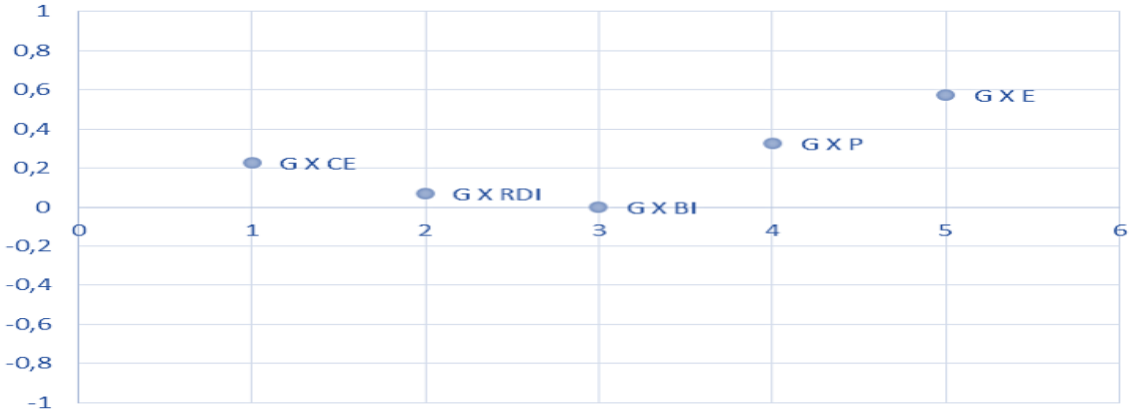
Figure 1. Correlation of selected variables in relation to companies´ growth in low-tech firms in V4 countries



Source: author´s processing

Figure 1 presents correlation of variables such as capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees in relation to companies´ growth in low-tech firms in V4 countries. We can see that relation between companies´ growth and R&D tax incentive generosity is uncorrelated. It means that there is no dependency in terms of correlation. The results show that there is significant positive correlation between companies´ growth and variables such as profitability and growth rate of R&D employees. It means that companies´ growth increases with increasing profitability and growth rate of R&D employees. There was found slightly insignificant negative correlation between companies´ growth and variables such as capital R&D expenditure and R&D intensity. The companies´ growth decreases with increasing capital R&D expenditure and R&D intensity.

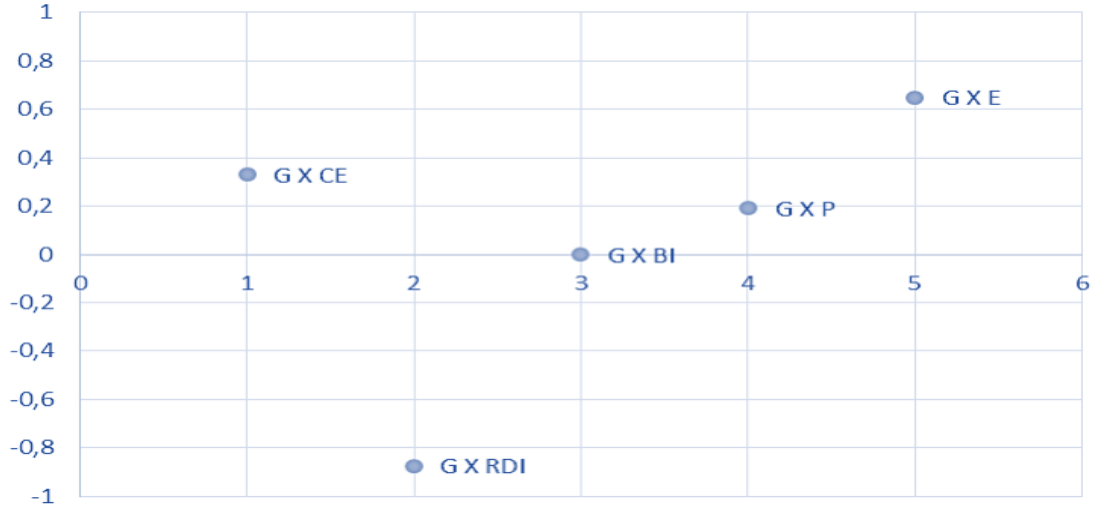
Figure 2. Correlation of selected variables in relation to companies´ growth in medium-tech firms in V4 countries



Source: author´s processing

Figure 2 presents correlation of variables such as capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees in relation to companies´ growth in medium-tech firms in V4 countries. The correlation companies are very similar in medium-tech as in low-tech firms. Variables such as capital R&D expenditure and R&D intensity are exception. These variables are positively correlated in relation to companies´ growth. Corporate growth will increase with the growth of these variables.

Figure 3. Correlation of selected variables in relation to companies´ growth in high-tech firms in V4 countries



Source: author´s processing

Figure 3 presents correlation of variables such as capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability and growth rate of R&D employees in relation to companies´ growth in high-tech firms in V4 countries. The results suggest that there is a very significant negative correlation between companies´ growth and R&D intensity. Companies´ growth increases with increasing R&D intensity.

This part of the paper is also focused on the estimation results of the generalized method of moments (GMM) including their comments. Using the generalized method of moments (GMM) we will try to determine which variables affect the companies´ growth. To estimate companies´ growth was used the following equation:

$$Git = \alpha \pm \beta_1 * \Delta DERit{-}1 \pm \beta_2 * CE \pm \beta_3 * RDI \pm \beta_4 * BI \pm \beta_5 * P \pm \beta_6 * E + \varepsilon it \quad (3.4)$$

For estimating the linkages between companies´ growth and selected factors (explanatory variables) was detected resulting equation estimating factors affecting companies´ growth in V4 countries. The results of the generalized method of moments (GMM) are included in Table 3.

Table 3. The impact of selected variables on companies´ growth in low-tech firms in V4 countries

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.1455642	0.002132	37.812342	0.0045
CE	-11.466644	0.025356	-1.292182	0.0000
RDI	16.934082	0.003456	4.9779944	0.0023
P	5.8978700	0.048504	13.976559	0.0000
E	1.8942185	0.008774	2.444356	0.0000
Effects Specification				
Cross-section fixed (orthogonal deviations)				
Mean dependent var	8.434987	S.D. dependent var		19.694738
S.E. of regression	60.878663	Sum squared resid		26368700
J-statistic	25.000087	Instrument rank		25

Source: author´s processing

Table 3 illustrates the impact of selected variables on companies´growth in low-tech firms in V4 countries. It is evident that the analyzed sample exhibits positive relation in the context of R&D intensity, profitability, companies´growth in previsou period and growth rate of R&D employees. The obtained results suggest that the impact of R&D intensity on companies´ growth is significantly positive for low-tech firms. The most important relation was found within R&D intensity. The model suggests that companies´ growth increases with increasing R&D intensity. This is consistent with study Del Monte and Papagni (2003) and García-Manjón and Romero-Merino (2012). Similar results can be observed for the variables such as profitability and growth rate of R&D employe. There was recorded a positive relation between profitability and companies´ growth. It means that growth of profitablity will cause companies´ growth. This is consistent with study Lian *et al.* (2011). Growth rate of R&D employees is the last positively statistically significant variable. The increase (decrease) in growth rate of R&D employees will cause companies´ growth. This is consistent with study Triguero-Cano *et al.* (2012). The opposite situation was observed for capital R&D expenditure. There was recorded a negative impact between capital R&D expenditure and companies´ growth. In other words, the decrease of capital R&D expenditure will cause companies´ growth. This is consistent with study Soares Tiago *et al.* (2012). The results indicate that companies´ growth in previous years leads to an increase in the monitored period.

Table 4. The impact of selected variables on companies´ growth in medium-tech firms in V4 countries

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.464345	0.079738	23.367602	0.0038
CE	-32.335325	0.013599	-2.338766	0.0000
RDI	18.000483	0.040397	-48.399487	0.0000
P	9.1275534	0.005542	11.100088	0.0000
Effects Specification				
Cross-section fixed (orthogonal deviations)				
Mean dependent var	0.940331	S.D. dependent var		34.567753
S.E. of regression	42.93869	Sum squared resid		1.24E+09
J-statistic	18.456675	Instrument rank		25

Source: author´s processing

Table 4 presents the impact of selected variables on companies´ growth in medium-tech firms in V4 countries. The results indicate positive relation between companies´ growth and variables such as profitability, R&D intensity, growth rate of R&D employees and companies´ growth in previous peorid. The most important variable that affects the companies´ growth is R&D intensity. Growth in this variable causes the companies´ growth. The second most important variable is profitability. In V4 countries will be recorded companies´ growth with increasing profitability. The opposite result was observed for capital R&D expenditure. There was recorded a negative impact between capital R&D expenditure and companies´ growth. The companies´ growth will be recorded with decreasing capital R&D expenditure. Other variables were not statistically significant.

Table 5. The impact of selected variables on companies´ growth in high-tech firms in V4 countries

Variable	Coefficient	Std. Error	t-Statistic	Prob.
G(-1)	0.586508	0.130517	34.07833	0.0000
RDI	11.960988	0.000454	1.8421384	0.0000
P	24.8658353	0.003479	2.3991883	0.0000
Effects Specification				
Cross-section fixed (orthogonal deviations)				
Mean dependent var	-6.457335	S.D. dependent var		32.454045
S.E. of regression	39.48858	Sum squared resid		3051646
J-statistic	15.10558	Instrument rank		25

Source: author´s processing

Table 5 presents the impact of selected variables on companies´ growth in medium tech firms in V4 countries. The obtained results suggest positive relation between companies´ growth and R&D intensity. companies´ growth in previous peorid and profitability. The most important variable is profitability. This finding is different than low-tech firms and meidum-tech firms. It means that growth of profitablity will cause companies´ growth. The obtained results suggest that the second most important relation was found within R&D intensity. The obtained results suggest that the impact of R&D intensity on companies´ growth is significantly positive for high-tech firms. The model suggests that companies´ growth increases with increasing R&D intensity. Other variables were not statistically significant. The results are consistent with the above studies. The investment in R&D can significantly enhance companies´ growth potential. Firms facing severe financial constraints tend to reduce R&D expenditure, resulting in lower returns from R&D.

Conclusion

The economic and social growth is dependent on the level of research and development activity in different countries. The economic growth can mean also the increase in the competitiveness on stable competitiveness. Information, innovation and knowledge has attained significance in economy. The key role is played by research and development. Companies and economy can obtain advantages within the ability to find new information and to create new knowledge and to transform it into new technologies, services and products. All technological innovation activities comprise scientific, technological, organizational, financial and commercial steps, including investments in new knowledge. It is intended to lead to the implementation of technologically new or improved products and processes. R&D is only a part of these activities and may be carried out at different phases of the innovation process. R&D intensity is used as an indicator of an economy's and firm´s relative degree of investment in generating new knowledge.

The aim of this paper was to evaluate the influence of research and development on companies´ growth in individual industries in V4 countries from 2003 to 2014. Another target of this paper was to identify which selected factors affect companies´ growth. Using generalized method of moments (GMM) was tested the influence variables such as the firm growth rate, capital R&D expenditure, R&D intensity, R&D tax incentive generosity, profitability, growth rate of R&D employees on companies´ growth in individual industries in V4 countries.

In low-tech firms, the model results showed a positive effect of the R&D intensity, profitability, companies´ growth in previous period and growth rate of R&D employees on companies´ growth. The model results also showed the negative impact of capital R&D expenditure on companies´ growth.

In medium-tech firms, there was recorded a positive relation between companies´ growth and variables such as R&D intensity, profitability, companies´ growth in previous period. The results also suggested a negative relation between companies´ growth and capital R&D expenditure.

In high-tech firms, the model results indicated a positive relation between companies´ growth and variables such as R&D intensity, profitability and companies´ growth in previous period. Others variables were not statistically significant.

In general, R&D investments are crucial for economic growth. Innovation is the engine of a knowledge economy. Research and development (R&D) is the key ingredient of the innovation process. Research and development ensures the generation of new knowledge and technologies.

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Attitude of the Future Young Managers to Business Model Processing at the Faculty of Economics, Technical University

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Abstract:

In nowadays fast changing world, the education is key factor in shaping and preparation of future managers. This paper describes importance of education of process modelling for future, fresh-graduated managers, where uptake of new information and communication technologies (ICT) should determine and essentially affect the way the business acts. The aim of this paper is to present importance of strengthening basic e-skills and principles of business informatics for young generation. Therefore, is subject Informatics II continuously improved and adjusted for business needs. This process and ways of subject realization and evaluation and what impact the update process are shortly described within the paper.

Keywords: business process modelling; e-competences; e-skills; marketplace requirements; project based learning; managing education process; human resources development

JEL Classification: A230

1. Introduction

There is no doubt, that Information and Communication Technologies (ICT) affect development of human society significantly. The ICT contributes not only to development of IT sector, but essentially affects other sectors, enhances their economic productivity and growth. From begin of 1990s information technologies started transforming of "previous century" companies and their habitual processes, with aim to bring them to new century. With this, new type of industrial engineering was created. (Davenport and Short 1990) Today, globalization and using of ICT in enterprise environment is fact, that everyone has to face to. Modern business process management is based on dissemination of free knowledge. Staying competitive is not just about tracking news and innovation in the ICT field. The most important factor is human resources development, because people are engines of change, those who use the technology and are warranty for continuous evolution and bring added values to business.

The future managers should be persons opened toward changes, innovation, creativity and its implementations, skilled in risk treatment, etc. (Abbas and Madni 2013), (Howard 1996) And here is most important role of education, because it forms future human resources and can prepare young people for future challenges. At the faculty of Economics, Technical university of Košice, we educate future managers, which knowledge and skills in the field of informatics are demanded. Although our students are considered by their employers as non-professionals in the field of informatics, we can announce that in each job they will face to some kind of information system or software, because using of them is nowadays matter of course. Subjects concerns on ICT and covers basic introduction into ICT or generally needed ICT skills like networking, design and editing HTML pages, text processing, basics of programming (subject Informatics I), introduction to business informatics (Informatics II, Economic information systems, Data presentation and visualization) and e-services in financial institutions (Bank electronic services). This composition was designed with aim to propose to our students' competitive advantage on the labor market after graduating education at our faculty.

2. Human resources development in context of business informatics

In the European Union development strategy formulated in the Europe 2020 document (European Commission 2015) it was indicated, that the aim of the EU is the achievement of smart growth. That should be reached by the realization of three priorities: the increase in employment, the increase of productiveness and the social cohesion (Illés, Dunay and Jelonek 2015) and specialized agendas: Digital Agenda, Education and Learning, E-skills and Employment. Despite of mentioned various activities, there is still present interesting paradox that "*although millions of Europeans are currently without a job companies have a hard time finding skilled digital technology experts*" (European Commission 2016).

The European Commission in 2012 adopted *The Communication on Rethinking Education* (European Commission 2012a). Main idea of this document is to adapt education to workplace needs. This should be done especially by ensuring deliver the right skills for employment, involving new ways of teaching and learning and finding and promoting new approaches to Funding and Partnerships with closely linked another agenda - Agenda for new skills and jobs (European Commission 2012c). Today there are about 23 million people are currently unemployed across the EU - 10% of the active population, and on the other hand there are enough free jobs. However, skills of available human resources do not fit the employers' requirements. For that purpose, the 'New Skills for New Jobs' initiative designed agenda setting out to promote better anticipation of future skills needs in order to develop better matching between skills and labor market needs. That needs to be done to bridge the gap between the worlds of education and work (European Commission 2012c).

Referring (Careers in Business, 2009), the role of higher education could be defined as *'to equip students with the knowledge, skills and competences that they need in the workplace and that employers require; and to ensure that people have more opportunities to maintain or renew those skills and attributes throughout their working lives*'. Connected to previous, before education itself, first we have to analyze marketplace requirements of our graduates' qualification in way to be able to produce students for nowadays labor market needs. In Careers in Business (2009), Doyle (2016), Mar (2016), Norton (2012), Révészová (2016) are presented main requirements on the managers, managerial positions: oriented on opportunities, self-discipline and personal organization, trust in own capabilities, tolerance of uncertainty, risk and failure, leading skills, creativity and innovation, communication and strategy skills, decision-making and interpersonal skills, decision making skills, planning skills, communication skills, negotiation skills, skill to delegate authorization. From the point of view of youth employability is important to prepare the graduates to the role of employee in the already existing company, or to role of creator of new business. Management of the learning process gives chance to enhance the learning effects. Designing and implementing innovative learning methods as well as pedagogical methods facilitating learning is one of nowadays challenges that business schools and universities face.

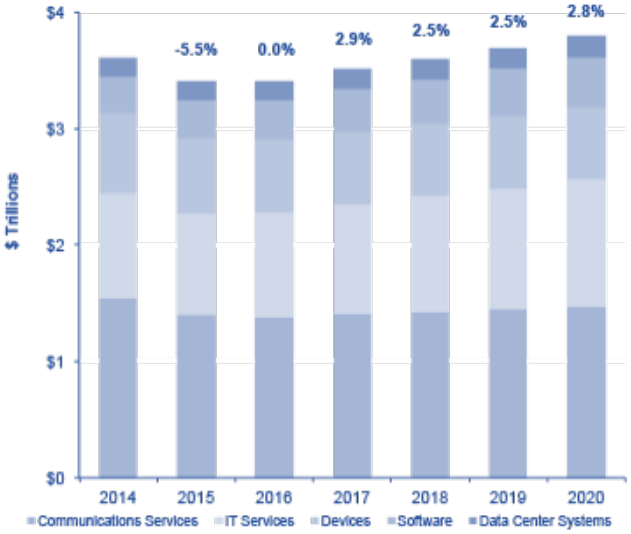
Nowadays still more organizations require employees understanding the work of enterprise system and integrated business processes (BP). Business process management includes methods, concepts and techniques to support the design, configuration, administration, enactment, and analysis of business processes (Weske 2007). Business process models (BPM) are used for understanding, analyzing, implementing, maintaining and improving business processes. From mentioned, dominant role in formulating competitive business process management plays business process analysis and modelling (Li *et al.* 2015). The variability of BP is dependent on their performance and relevance to the organization's strategy and management is the principal part of organization. Its objective is to ensure its respond to changing demands in the changing external socioeconomic, technological environment and keeping track of ICT development and ability to implement innovation into existing processes. The IT contribution to organization is to support the flow of real-time data, its changing into information and the subsequent synthesis of this information into knowledge (Howard 1996). BPM is the best way, how to model - present all processes including technology, to make a big picture of what's going on, to find weak places and to step ahead from concurrency.

From Pudło and Gavurova (2013) follows that in addition to 'traditional' managerial skills there is need for another one: "*to understand the overall technology landscape and how it is impacting the way we work*", because

"*managers who have a good understanding of what is happening with technology will always be able to adapt and evolve ahead of the competition*".

IT branch is not usually cheap and its effects are not always striking immediately. The IT sector is one of most growing and most dynamic branches where a lot of money is being spent. Gartner - worldwide information technology research and advisory company - estimated worldwide development of IT expenditures for next year's (Figure 1) (Lovelock *et al.* 2016).

Figure 1. Dollar value IT spending growth in 2016 revised to perfectly flat 0.0%



Source: (Lovelock *et al.* 2016)

Especially, based on Gartner's *IT Spending, Worldwide, 2Q16 Update* there is growth about 1.1% of spending into enterprise software comparing value spent in 1Q2016 and 2Q2016. We can find there, that expenditures should be systematically enhanced, what of course means more IT projects, more job positions and of course bigger demand on well-educated managers able to lead all technology development in an organization. According to the Standish Group report (Hastie and Wojewoda 2015), published in 2015, 71% of all projects are challenged, meaning that those projects are either not finished on time or fail (Table 1). In practice these conditions often occur simultaneously.

Table 1. Modern resolution (on time, on budget, with a satisfactory result) of all IT projects

	2011	2012	2013	2014	2015
Successful	29%	27%	31%	28%	29%
Challenged	49%	56%	50%	55%	52%
Failed	22%	17%	19%	17%	19%

Source: (Hastie, Wojewoda, 2015)

Really interesting finding coming out from Standish Group survey (Hastie and Wojewoda 2015) is, that especially smaller projects tend to finish more often successful. As project are more complex, only a few of them is finished on time, on budget and with satisfactory results (Table 2).

Table 2. Modern resolution of all IT projects by size

	Successful	Challenged	Failed
Grand	2%	7%	17%
Large	6%	17%	24%

	Successful	Challenged	Failed
Medium	9%	26%	31%
Moderate	21%	32%	17%
Small	62%	16%	11%

Source: (Hastie and Wojewoda 2015)

From the point of view of providing more practically oriented education there are some interesting statements published by Wrike (Bonnie, 2015) in project management statistics from 2015:

- organizations lose $109 million for every $1 billion invested in projects and programs;
- only 64% of projects meet their goals;
- 70% of companies' report having at least one failed project in the last year.

In this survey was announced, that average cost overrun was 59% and average time overrun 74%. On average there have been delivered only 69% of features, too. As reason for project difficulties was mentioned *e.g.*: changing priorities within organization – 40%, inaccurate requirements – 38%, change in project objectives – 35% or inexperienced project managers - 20%.

Of course, we cannot generalize those statistics for any country in the world, but all those facts show, that there is lack of well-prepared managers able to use modern tools enabling them to manage bigger projects, to support the aim of their company and to make their market position better. According to (Meritz 2012), the real reason of failure of IT projects is not technical, but social. If IT project participants have to face the problem rather than consult it, resistance to information systems increases and will continue to do so in the future. The dominance of process thinking within Information Systems Development contributes to this development. This perspective could be a result of the mindset of IT scientists and practitioners (Dumay 2004). From facts mentioned above and the Table 2 could be summarized, that there is very high demand for well-educated managers skilled in BPM, able to lead more complex projects and communicate with IT specialists. It determines one of most crucial part in future managers' education.

Business process modeling (also called Process modeling) can be defined as analytical representation of an organization's business processes by using BPMN (Business Process Modeling Notation) (Chapman 2016). It represents critical and key part of business process management (Stuart 2012). For global competitiveness is important to strengthen the cooperation between education institution and industry. This can be done by transfer, research and innovation. That is why the importance of BPM (business process modelling) leads us to include this topic to our subject Informatics II.

In connection of finding out the appropriate way of providing knowledge to the students, authors in (Grabis, Sandkuhl and Stamer 2015), (Panulinová 2010) states and experimentally verified, that traditional methods of learning, traditional materials do not describe processes executed in praxis, enough. Also step-by-step instructions, desired by students, reduce the need for in-depth, detail exploration of the features of BIS (business information system). To manage learning process effectively in order to enhance the interest of learners, their preferences and educational needs should be recognized as they can be a wide source of knowledge on designing the teaching process. Find out the appropriate balance among classical education methods, on-line tools and activities is crucial part of new education. Following we present our approach how to reach that status.

3. Business process modelling in education process at Faculty of Economics

Education process provided by our faculty is structured with the intention to correspond as much as possible to the requirements of financial institutions and to enable our graduates to apply for managerial positions in public and private sectors (Faculty of Economics 2012). As follows from previously mentioned, young generation of managers cannot exist without extensive knowledge in fields like human resources management, finance, investment, but also have to have soft skills in ICT and ICT related fields, what means to understand processes itself and new technologies implemented by businesses (Pudlo and Gavurová 2012, 2013). The accurate level of knowledge and skills in these fields helps managers to understand the process of work, take control over it and of course to modify

it and do right decisions at the right time, mostly based on data coming out from different business information systems. Business process modelling (BPM) and business process models are the tool which helps to non-IT users to understand and cooperate on business process innovation (Révészová 2016). Via modelling the process is determined what the steps are and what sort of participation are needed from the people and the systems at any point in the process (Meritz 2012). Despite the fact that modeling is considered as a part of IT business, it is important to note, that IT is not only one sector, where BPM can be used. BPM is covered also by plenty of other analytical positions, like Financial Modeling Specialist, Business Analyst, on-line Banking Analyst or BPM developer. Research among different sites dealing with job offers (Europe Language Jobs 2016), (Indeed 2016), (JobisJob 2016), (Profesia, spol. s.r.o, 2016) resulted in findings, that there is around 480 507 jobs around the world connected to the business process management and 4539 job positions requiring especially business process modelling knowledge. These numbers represent a 1.4% increase over the data achieved from these portals before half a year. From these facts, we can conclude that despite the fact that BPM has been defined already in the 90s of the last century and today presents base for the management of most enterprises operating on the marketplace, there is still shortage of employees skilled in this field.

To support our students in their preparation for the future jobs and reflect on current market requirements, students are during every year of their study introduced into various ICT fields and its application, connection to the world of economy, for example via studying subject Informatics I, Informatics II, Electronic bank services, Application for fundamental data processing, Data visualization and presentation, and Economic Information Systems (Vejačka 2016).

The content of the compulsory subjects was also adjusted to our finding from introduction survey realized at the beginning of students' study at the faculty which pointed out that relatively high proportion of our students did not properly comprehend and manipulate with basic terms, algorithms, program languages, applications, patterns and methods based on fundamental principles of Informatics. Therefore, in the past, the aim of subjects Informatics I and Informatics II was to support our students to achieve ECDL Standard Profile (defined by new ECDL profile specification), which covered 7 main modules: *Concepts of Information Technology, Using the computers and Managing files, Word processing, Spreadsheets, Database, Presentation and Information and communication* (ECDL Foundation 2015).

Paradoxically, our graduates were well skilled in using computer and MS Office applications, but they have problem to apply their knowledge at work. They missed knowledge about business environment and processes used for managing the enterprise. In connection of fast development business informatics and students' feedback performed every year at the end of semester, we realized that there is need for change in content of the mentioned subjects. The greatest importance to the Business informatics field is put within compulsory subject Informatics II into which we introduced the Fundamentals of business informatics and Business process modelling topics in the academic year 2006/2007.

At the beginning, the newly added part - Information Systems - was not perfect, because it was mostly concerned on transfer the theory to student without any practical involvement. During almost 10 years' period we did many of improvements and changes:

- in *2006/2007* were introduced new topics concerned on BPM - Fundamentals of business informatics and Business process modelling via printed study materials and face-to-face lectures, where we tried to explain the fundamentals of business informatics and importance of business process modelling for process management in enterprises.
- in *2009/2010* and *2010/2011* there had been done a transfer of whole subject content with all supportive materials to LMS Moodle. Within this period, we developed different kind of tutorials and video tutorials for tasks solved during the subject study. At the same time, we introduced PBL (Project Based Method) method into semestrial projects.
- in *2011/2012* was subject extended by chapter Business data analysis with best practices, best semestrial project from previous years and this field was also implemented into semestrial project.
- in *2013/2014* we decided to upgrade the semestrial project requirement by business process modelling part.

- in *2015/2016* the Tools for business data processing and Trends of business informatics topics we included into subject via face-to-face lectures, electronic study materials, practical exercises concerned on problem solution (problems concerned on accounting, reporting via MS Excel, data analysis via MS Access, business process modelling via ARIS).

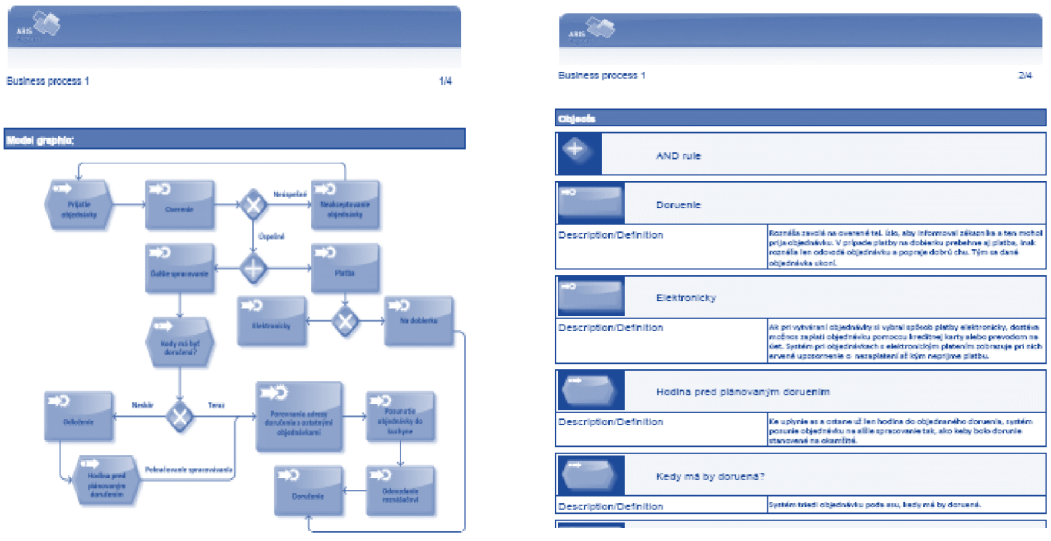
Based on (Chapman, n.d) and marketplace requirements on managerial positions the content of the subject is built up to help student to understand IT processes and way how the ICT can help in development and innovation processes in business environment. It is ensured by five main topics:

- *Fundamentals of business informatics* - history, of business informatics, the introduction into different information systems used in enterprises like ERP (enterprise resource planning), CMS (content management systems), SCM (supply chain management), BI (business intelligence), eBusiness applications, etc.
- *Business process modelling* (BPM) - processes in the business itself and ways how and what kind of data management need to model and improve business processes.
- *Business data analysis* - different types of data used in business environment and for what purposes they are used.
- *Tools for business data processing* illustrate how ICT tools can be used for data processing and modelling. For that part of subject we examine and use tool like ARIS, MS Excel, MS Access.
- Trend of business informatics - upcoming technologies and their benefits for companies.

All that endeavor aimed to enhance students' involvement in their education and discovering new knowledge and skills. The ordinary used teacher centered approach was exchanged to learner centered approach employing project based learning. Students achieve practical skills in field of business process modelling and user requirements definition using various study materials and students' activities during studying the subject. Semestrial project is designed to enhance students' creativity, problem solving, and management and presentation skills. It is based on PBL (Sam Houston State University, n.d.) methods which seems to be the best choice for motivating and interesting for the students, though in the first stage it requires more effort from the teacher, because instead of traditional knowledge "transmitter" we change into guide who help in case of problem occurrence. Within semestrial projects students were instructed how to develop a "product" mini IS. The work on semestrial project should be described by three phases:

1. Design of "User requirements" document, which contains description of company and its main process. Students have to analyze described process and use ARIS and UML standards to model the process (Figure 2).

Figure 2. Main business process model - outcome from ARIS application



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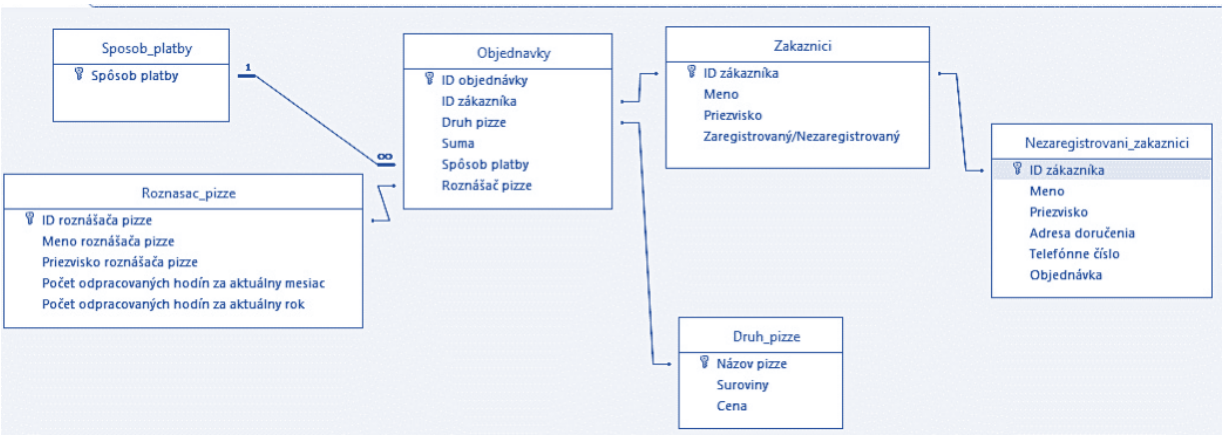
2. Problem definition represents and describe the problem found in main process of the company, its users and their role, define IS of the analyzed company and design the solution. In problem solution phase they have to clear via case diagrams actors, use cases and scenarios, class diagram (Source: own) – data needed and their relationship.

Figure 3. Class diagram and its realization – outcome from MS Access



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3. At least students are asked to design data model and real relational database based on their own user requirements document. This phase seems to be most complicated for students. To both side of education process (for us as teachers and also for the students) it is demonstration of real life – if they do not take enough case in business process modelling, they obtain dysfunctional data model/database and their business can't use them for what they planned.

4. Evaluation of education process and most important outcomes

Education process is not isolated and static, but it presents living organism based on its participants' knowledge and skills, their motivation and content of the education process. It can be outlined by specific, generally well known phases: *Subject preparation, Subject realization, Subject evaluation, Subject update*. Every phase has its own importance to the education process, but for innovation and development process is most crucial subject evaluation phase. Via evaluation it could be assured quality level, but also as a tool for subject realization quality enhancement. To evaluate subject quality, teacher can use various tools for evaluation of subject quality:

- *Interview with teachers* help us to get opinion on newly included study materials, students' activities;
- *Using feedback questionnaires*, we monitor different parts of student opinion and try to develop the course to reach best results on the final results of the subject and development of knowledge of our students in the field of information system and management based on business process knowledge;
- *Final results analysis* is used to control and evaluate real skills and knowledge of the students and gives us information, which part of subject is most difficult to understanding and applying for the students.

All above mentioned tools help us to find the balance between students' expectations and interests and marketplace requirements (included into subject content). For finding out the correct ratio we are leaded by four levels of Kirkpatrick's evaluation model (Chapman 2016), (Kirkpatrick Partners 2016), (Mind Tools Editorial Team n.d.).

During the academic years 2010/2011 – 2015/2016, at the end of the semester, were students asked to fill a questionnaire about their attitude to this subject with the aim to achieve their reaction and behavior about learning process of the subject. The respondents were students already finished the mentioned subject, so they evaluate subject as a whole and its parts separately after met all necessary items, e.g. practical test, semestrial project and theoretical test. The subject was learned by 971 students (Table 3), but number of possible respondents is lower,

because the questionnaire could be filled out just by students who already finished the subject (*i.e.* 854 students in total). Students were introduced to our intention to improve subject based on questionnaire results and had choice whether they want to take a part on questionnaire. The result was, that unfortunately not every student wanted to give us feedback and we achieved just 691 responds in total.

The final subject evaluation questionnaire contains questions concerned on different parts of education process: *sociological date* (their gender, previous education), *satisfaction with subject content as a whole and specific parts, evaluation of the subject as a whole, specific parts, provided study materials quality and accessibility, evaluation of the teacher's approach, their opinion about usefulness of achieved knowledge and skills in their future life*. The most interesting and important results which we achieved via confrontation questionnaire results with final subject evaluation results based on achieved grades and results of teachers' interview are presented following.

Table 4 presents the comparison of results achieved by students finishing their study of the subject (Teachers' evaluation - TE) and rating the subject itself by the students (Students' evaluation - SE). As can be seen, students' rating is better than results of evaluation of their knowledge and skills achieved during their study. At the beginning of the innovated subject realization there were just small differences between TE and SE values. Within last two years, situation significantly changed. Most of students, approximately 75% of students rated subject as very good/good (A, B), but their knowledge and skills result are much worst – in the year 2015/2016 the A, B rates were achieved only by 30% of students. In order to analyze possible reason of this change we interviewed teachers of the subject.

From interviews done revealed, that it can be caused by total unfamiliarity with newly included content of subject. In 2014/2015 was semestrial project upgraded by design of small relational database model. It was based on their own user requirements. Finally, this year we added applications regarding business informatics. So from traditional subject with main aim, to learn students to use MS Office products, we transfer it to business informatics and its requirements, design, usage concerned subject. This interesting and important area is totally new for students. But from year to year they had to learn much more new information, so it is main reason for their worse evaluation.

Table 4. Course rates: comparison of average teachers' and students' evaluation values evaluation (SE – students' evaluation, TE – teachers' evaluation)

Academic year	Grade level											
	A		B		C		D		E		FX	
	91 – 100%		81 – 90%		71 – 80%		61 – 70%		51 – 60%		< 50%	
	SE	TE	SE	TE	SE	TE	SE	TE	SE	TE	SE	TE
2010/2011	13%	6%	40%	38%	40%	38%	7%	5%	0%	0%	0%	0%
2011/2012	3%	5%	7%	31%	13%	35%	8%	8%	0%	1%	0%	0%
2012/2013	27%	4%	93%	21%	75%	36%	23%	12%	5%	0%	0%	0%
2013/2014	16%	0%	60%	21%	50%	40%	8%	28%	5%	6%	3%	5%
2014/2015	9%	4%	66%	25%	49%	26%	17%	12%	10%	3%	16%	13%
2015/2016	20%	1%	55%	12%	27%	19%	17%	32%	4%	16%	21%	19%

Source: own

Concerning on marketplace requirements as ability to implement new ideas into existing process, planning skills, orientation in ICT field we analyzed achieved knowledge and skills of our students after finishing subject Informatics II. Table presents achieved results of students. It is divided into particular parts – Theoretical knowledge (TK) - students have to exhibit their orientation in the terms, usually used in business informatics and BPM and Practical skills (PS), where students are asked to solve problem using available applications (Excel, Access). TK was evaluated by two different points of view: by on-line test of theoretical knowledge and semestrial project. In semestrial project were students asked to apply their knowledge into virtual business environment. As is presented in the Table 5 till 2014/2015 were better rates achieved for theoretical part of the subject. However, students had permanent problems with solution of the problem using real applications.

Table 5. Comparison of achieved results from theoretical knowledge (TK) and practical skills (PS) evaluation

Academic year	Grade level											
	A		B		C		D		E		FX	
	91 – 100%		81 – 90%		71 – 80%		61 – 70%		51 – 60%		< 50%	
	TK	PS	TK	PS	TK	PS	TK	PS	TK	PS	TK	PS
2010/2011	11%	12%	43%	23%	35%	19%	5%	22%	4%	24%	2%	0%
2011/2012	0%	11%	21%	20%	40%	32%	28%	22%	6%	14%	5%	0%
2012/2013	5%	9%	39%	22%	29%	30%	10%	29%	6%	9%	10%	0%
2013/2014	5%	5%	30%	19%	32%	23%	14%	27%	4%	11%	15%	15%
2014/2015	14%	8%	38%	25%	19%	22%	12%	23%	3%	8%	14%	14%
2015/2016	1%	9%	12%	17%	19%	35%	32%	21%	16%	17%	19%	1%

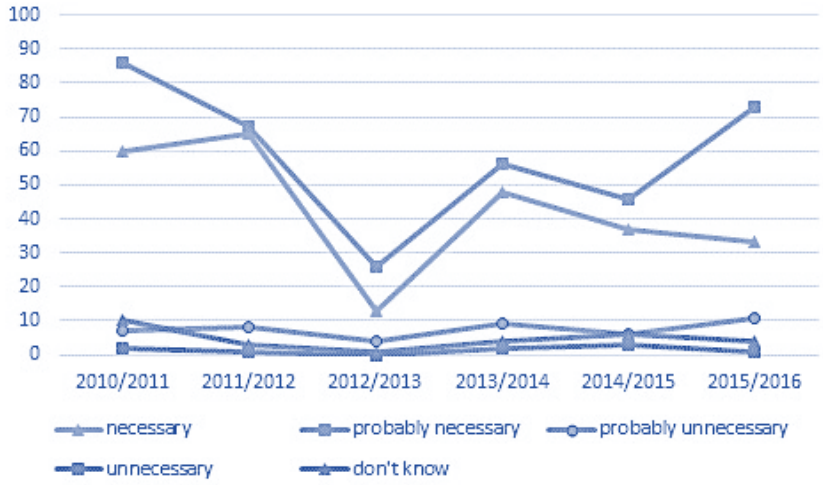
Source: own

In school year 2015/2016 we published more new study materials, video tutorials and co-operation activities (forums, wikis, etc.) via LMS Moodle. Result was that it helped to enhance the level of students' practical skills. Students used that in proper way to implement it into their semestrial projects. However, at the same time, we found out, that students considered theoretical knowledge as less important for them. While asking them, what is that reason to that attitude, the answer was, that theoretical fundamentals could be browsed by Internet anytime, but practical skills cannot be achieved so easy.

Except the students' knowledge and skills grades we were interested about their opinion on the subject content. During monitored period 69% of students was satisfied with it (they choose A-very satisfied, B-satisfied) and just 17% of student was discontented (D – unsatisfied, E – really unsatisfied) and 7% of all students don't want to share their opinion with us (FX). These results show, that the content of the subject is designed well and there is no need for another huge changes. From their verbal declarations we have found out, that they expected more practical examples and of real working business IS. These examples and also practical exercises are included into higher year of their study, *e.g.* Data visualization and presentation, Economic Information Systems (Vejačka 2016), etc.

Since the subject Informatics II is concerned on specific field of ICT – business informatics and we are interested in question, whether knowledge and skills achieved within this subject will be needed for their professional life and development. As is shown in Figure 4, students understand very clearly the importance of business informatics for their future job.

Figure 4. Results of students' opinion on their professional life



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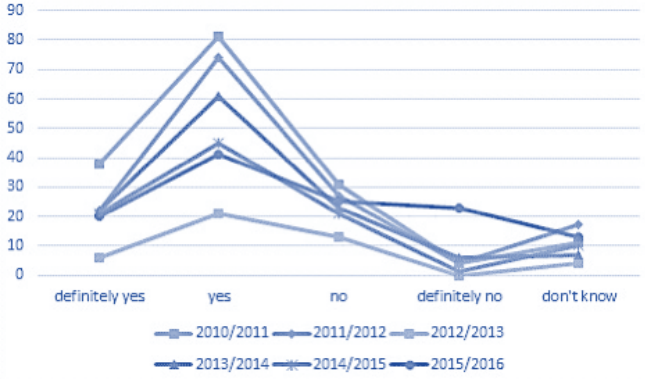
We consider the business process modelling as key part of business informatics. That is because innovation process in each organization is closely connected to business process modelling. Because of that we highlight its importance in every topic taught within subject. We try to support it by various kind of resources, examples, exercises, etc. In questionnaire we were interested in students' opinion on importance of BPM. Results of this question (Figure 5) confirmed, that our students realized importance of this area. At the same time, it can be also understanding, that materials provided to them are sufficient for introducing to business informatics, too.

Figure 5. Results of students' opinion on importance of business process modelling topic

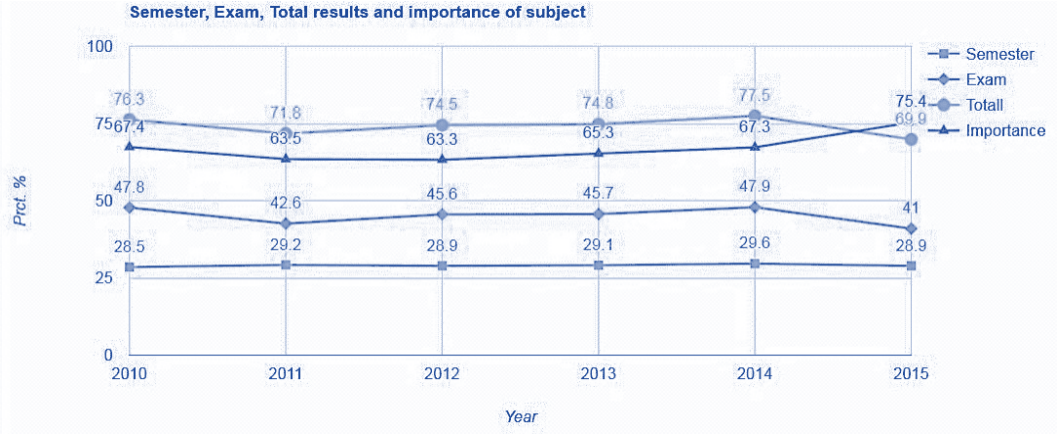


Source: own

Those lines at Figure 5 show, that from year 2010 to 2014 students considered process modelling to be important for them on average on 66%. In year 2015 there is big growth, approximately up by 10% to 76%. By average 3 out of 4 students considered this topic as important for them. In previous chapter was described, that there have been many changes in the subject comparing content of previous years. As most important we can assume especially practical exercises – the way, how can be used achieved knowledge of this topic in practice. Only this can bring real activities of nowadays managers to students. This can show, how process modeling can be useful in praxis. From our own student experience, we know, that bringing company activities to universities is be very useful for both sides - students and companies. In this way they can find out, what they maybe will have to face to in their next life. Other changes in educational process, as data analysis or using practical tools have underlined importance of this subject and have made it more interesting, too.

Last analyze we would like to present is overview of relation between students' end year grade and their attitude about importance of this subject. In next Figure 6, you can find achieved results.

Figure 6 Relation between students' end year grade and their attitude about importance of this subject. In next figure you can find results



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We can find out, that however average grade in last year decreased, importance of subject in minds of students increased. So as the teaching process had changed, and had become more strictly, students probably realized, that its content may be important for them. Even if their grades were lower, they did not mind to admit, that it is really useful. That is really good information for teachers, that educational process has been set right way.

Generally, we wanted to present in this last part some interesting findings after evaluating end year questionnaires:

- students puts the subject better grade than teacher to students' knowledge;
- despite of enrichment of study materials, students have permanent problems with solution using real applications;
- importance of theoretical parts decreases during the years, on the other hand importance of practical parts increases;
- students understand the importance of business informatics for their future jobs;

Based on these results we have driving engine to continuously improve the subject content and implemented learning methods. This is the challenge of our future work.

Conclusion

Computing and creativity are main forces of innovations. This is the way, how Informatics II is being taught, in order to help to enhance both of them. Creativity can be developed via semestrial project and computing knowledge and skills can be improved by various (practical oriented) tasks during the face-to-face classes. Students work with various tools. With them they can better understand how are data transformed to information and how can they be used by business. This helps our students to avoid common scenario, when graduates enter labor market place and they too often discover, that they do not have the skills and competences, which they need for their future careers. More than 4.5 million young people (aged 15-24 years) are today unemployed in the EU what presents 21% (European Commission 2012b). Although our graduates usually don't have problem with employability, we have to follow EC agendas about connected human resources development. It means, that we have to analyze pros and cons of education provided by us from both sides - from teachers and students. The way how we do it and most interesting outcomes were presented in the paper. As good results can be included fact, that about 75% of students is in average satisfied with the Informatics II subject content and special topic business process modelling and at about 66% of students consider the BPM as important field in their future life. An even worse

grade average from last year didn't caused decreasing of level of importance. More strictly, rules and change of educational process applied in last year have woken up interest of this subject and have revealed its future potential. Real challenge for our future education is to find balance between high level of students' satisfaction, high grades achieved by students and real marketplace requirements. The success of Informatics II subject is in feedback achieved also by our graduates working at the different positions within companies like T-Systems, IBM, etc. who agreed on, that in hindsight they discovered what they have learned through this subject.

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Problems on Forming System of Indicators to Estimate Efficiency of Social and Economic Development of the Country

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Abstract:

At the present time the task on increasing the efficiency of the social and economic development of the country prevails in Russia. It contributes to increasing the social and economic potential of Russia.
In this context, there is a need to develop theoretical and methodological provisions of estimating the efficiency of the social and economic development of Russia. In spite of a great number of works on the economic development of the country, it is necessary to note insufficient consideration of methodologies and indicators related to increasing the efficiency of social and economic development as a system. The existing methodologies of estimation are meant to measure indicators for every specific period. It cannot objectively estimate social and economic development. Thus, this article offers the development of theoretical provisions on estimating the efficiency of social and economic development in dynamics.

Key words: public production; social and economic development; integrational processes; transformation; dynamics

JEL Classification: H53; O10

1. Introduction

Factors caused by the globalization have an impact on the social and economic development of any country (Bandurin 1999). One of the most important problems of the interrelated world community is not the cooperation of various social and economic systems any more but the interrelation of split-level economic structures that are characterized not only by the degree of development but also by the degree of the involvement in the global division of labor and the global economy (Biyakov 2004, Gusev 2015).

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When considering the system of indicators that define social and economic development of the country, it is necessary to turn to the European experience of the social and economic development that is reflected in works of Wishlade, Galbraith (2002) and Fedorenko (1975).

Russian authors paid more attention to the analysis of the system approach to researching indicators. They include works of Fedorenko (1975), Lopatnikov (1976), Tyuhnin (1972), Tsygichko (1991), Syroezhkin (1976), and Illarionov (1996).

2. Method

The main peculiarity of the economic system is the purposeful conduct of any of its elements when the relation of the system elements is supplemented by their indivisibility and mutual correlability.

The diversity of forms and methods related to researching the social and economic development points at the impossibility to reflect such development by one or several indicators. Problems disappear if an attempt is made to accept one indicator as a criterion, even if it rather comprehensively characterizes success of the social and economic development, for example, only GDP or the amount of the revenues earned by enterprises of the country (Ruyga 2009).

That is why none of the cost or natural indicators of the economic activity results can become a thorough criterion of estimation. However, some economists think that "these are the tempos of the economic growth and speed of the GDP increase that reflect the level of the national economy efficiency" (Galbraith 2002, Illarionov 1996). This research offers to turn to the method of researching indicators of the social and economic development in dynamics.

The English economist R. Harrod formulated the fundamental equation of the economic growth that can explain various states of the dynamic balance. The basic idea of his theory is called "the accelerator principle". It is related to the fact that the growth or decrease in the revenue causes the change of investments that is proportional to the revenue change. Analyzing factors of the economic growth, R. Harrod paid attention to the labor employment. Besides, he included the endogenic function in his model. This function is based on the principle of acceleration and expectations of entrepreneurs in relation to the aggregate demand.

The starting point of the model is investing that aims at extending production capacities.

R. Solow offered the model that caused numerous researches on the basis of production functions. R. Solow relates the economic growth to the change of the level of savings, the increase in population, and scientific and technological progress. For his calculation he uses several indicators that reflect it: production volumes, capital, labor, and level of knowledge in the society. This model is more practical because it allows not only to observe how the economy has changed for a specific period of time but also to compare the growth of certain countries. The R. Solow's growth model is meant for researching the dependence of the economic growth on savings and capital formation.

Basic processes of the country development researched in works of Russian economists (Lomova 2010, Melkumian 2013, Smirnov *et al.* 2009, Suslova *et al.* 2015) and indicators that characterize these processes most comprehensively were taken as the basis of conceptual and theoretic provisions on forming the system of indicators related to estimating the social and economic development.

In order to develop the system of indicators to estimate the efficiency of the social and economic development, we will give definitions to dynamic criteria, because the system is based on economic and mathematic, and statistical methods of analyzing temporal series.

The model of forming the dynamic criterion is based on the system approach that allows to reflect the most important social and economic aspects of the country development. This model offers the generalizing estimation of the actual dynamics of social and economic indicators when comparing it with the dynamics of their growth tempos taken as a dynamic standard. Issues related to forming a dynamic standard have already been considered in works of a number of national researches. However, they have been considered exclusively on the level of a region or a certain enterprise. These are such researchers as Biyakov, Syroezhin I.M., Pogostinskaya N.N., Pogostinskiy Yu.A., Saareper M.I., Eissner Yu. N., Stojanovic Dragisa, Tonkih A.S., and Dianov A.Yu.

The estimation of the social and economic development efficiency offered by the authors can be applied more widely, and not be limited by a specific set of indicators system.

Syroezhin (1980) offered the research approach by using a dynamic standard. Then it was developed by his followers Pogostinskaya and Pogostinskiy *et al.* (2000). The theory of dynamic standard is based on the principles of dynamic comparability and hierarchy of indicators of the social and economic development, *i.e.* characteristics that cannot be compared in the static position become comparable in dynamics. The matter is that taking into account the inhomogeneity of indicators, it is difficult to compare them if to consider them as statistic values (Zeldner 2012, Tyuhtin 1972). However, the dynamics reflects a sort of order that can act as a sample when ranging indicators according to the growth tempos. Moreover, in dynamics temporal characteristics of the system have a natural order, and can be ranged and subordinated to one another.

According to the concept of I.M. Syroezhin, the activity of any system is a selection and implementation of a set of relations from a variety of possible relations, as well as supporting or breaking the existing relations.

In its turn the system can be represented as a set of economic indicators. Using the ranging of indicators according to the growth tempos, it is possible to make such order that can express requirements to a better mode of activity and act as a sample. Such order is called a normative system of indicators, *i.e*. the aggregate of indicators organized according to growth tempos so that the support of this order during a long time interval provides the best mode of the economic system functioning. Using the dynamic model, it is possible to reveal the efficiency of the social and economic development in dynamics unlike static characteristics that fix such development only at the specific moment.

Social and economic development constantly changes. Final results change at every new stage of such development. Accounting dynamics allows to differentiate one variant of development from another, a certain stage from the subsequent or preceding one. We offer a process methodological approach. Its essence is in the fact that social and economic phenomena are considered as processes that interrelate with one another. Social and economic development is formed as a result of parallel agreement of economic and social interests of many business entities that are related with many entities (Wishlade 2000, Sadohin 2012). This aggregate process is in the form of a number of particular processes implemented by social and economic entities via their economic activity (Tsygichko 1991). Efficiency of the social and economic development lies in the organized functioning of all particular processes.

The estimation of the efficiency of social and economic development must take into account top priority areas of both economic and social development (Tyukavkin 2014, Influence of the Financial and Economic Crisis of the Years 2008-2009 on the Economy of Krasnoyarsk Region, 2012). For example, the Russian Federation sets such strategic goals as "… achievement of the level of economic and social development that complies with the status of Russia as a leading world state of the XXI century, and holding top positions in the global economic competition and reliably providing national safety and exercising constitutional rights of citizens".

It is offered to classify the particular process that forms the aggregate social and economic development according to the following systems:

- system of basic processes that make up the nuclear of the social and economic development;
- system of auxiliary processes that support the system of basic processes;
- system of processes indirectly related to the social and economic development that fulfils functions of social provision;
- system of processes that affect the implementation of the social and economic development.

System approach to analyzing the social and economic development is the tool that allows to successfully solve various management tasks, and the representation of the aggregate of processes of the economic subject as an integral system allows to estimate the efficiency of such development in terms of unified methodological positions. The system approach means the use of a number of general methodological provisions when researching systems.

Firstly, it is necessary to form the criteria of estimating the efficiency of social and economic development. Thus, it is possible to research social and economic development by using two types of criteria: static and dynamic.

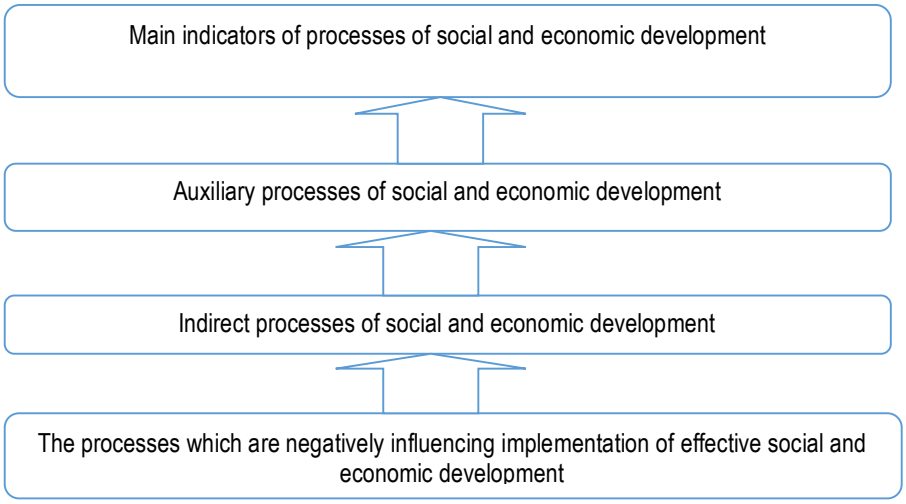
The static criterion is applied everywhere when forming statistic indicators of the social and economic development. However, the statistic criterion is not informative. The dynamic criterion reflects the development of processes system. It reflects the state the system of processes aspires. The model of efficiency of the social and economic development can be represented in the generalized form as follows:

$$A \succ B \succ C \succ D ,$$

where: A is the speed of development of basic processes of the social and economic development, B is the speed of development of auxiliary processes of the social and economic development, C is the speed of development of indirect processes of the social and economic development, and D is the speed of development of processes that affect the implementation of the social and economic development.

Every process provides several indicators that directly characterize every process of the social and economic development. The set of indicators of the efficiency of social and economic development contains only those indicators that reflect basic social and economic processes. Selection of the research object depends on the research goals and is not limited. It is offered within the research to trace indicators of the efficiency of social and economic development to the organized system where every process will be given a specific position in a certain system, *i.e.* indicators will have a special interrelation with one another.
Thus, the system of indicators will be allocated according to definite social and economic processes (Figure 1).

Figure 1. System of Indicators of Social and Economic Development Indicators



The main requirement of the methodology is that indicators must reflect the process of the social and economic development: basic processes of the social and economic development, auxiliary processes of the social and economic development, indirect processes of the social and economic development, and processes that affect the social and economic development (Demchenko and Yudina 2014).

When estimating the efficiency of the social and economic development, one has to often face the impossibility to choose one generalizing indicator of efficiency, and moreover, the impossibility to define the goal of an indicator via quantitatively set parameters and characteristics. Basic processes of the social and economic development are characterized by basic macro-economic indicators. Indicators related to the efficiency of social and economic development that were formed for four main types of processes allow to form a comprehensive system of indicators that reflects the sample efficient social and economic development of the country (Table 1).

Table 1. System of indicators to estimate efficiency of social and economic development

Position of indicator in the general system	INDICATOR
System of indicators reflecting basic processes of the social and economic development of the country	
1	GDP
2	Volume of foreign investments in Russian economy
3	Export
System of indicators reflecting additional processes of the social and economic development of the country	
4	Population
5	Economically active population
6	Students
System of indicators characterizing indirect processes of the social and economic development	
7	Living wage
8	Monetary expenses and savings of the population
9	Population's housing
System of indicators that affect efficient social and economic development	
10	Level of criminality
11	Level of unemployment
12	Infantine mortality

It is necessary to note that the system of indicators included in every process can change depending on the researches goals, researcher's preferences and specificity of the object under research. We have offered 12 indicators that are directly related to one another and the social and development of the country. These indicators are ranged in a special manner: GDP must be the greatest indicator according to the acceleration, and infantine mortality must be the smallest one according to the acceleration. According to the authors, this is a sample of developing the ideal system of social and economic development.

3. Result

The offered model for estimating the efficiency of the social and economic development of the country is based on the following approach. Firstly, the structure of the social and economic development efficiency is analyzed. Then the integrating indicator that allows to provide comparability of estimations is formed.

There is such characteristic of a movement as acceleration. It is peculiar of uniformity in any types of inertial systems of references. It allows to compare dissimilar indicators of the social and economic development regardless of the units of measure they are considered in.

In this research acceleration acquires a special economic content. The acceleration is used to achieve the comparability of indicators related to the social and economic development. Indicators of the social and economic development and its efficiency estimation will be represented as temporary systems. The calculation of the indicator growth tempo results in defining the speed of its movement, and the acceleration is fixed by calculating the tempo of tempos. Having values of accelerations at every moment of time for all indicators, it is possible to define the efficiency of the social and economic system as a consequence of estimating the processes that take place in it. After defining the priorities of temporal changes for every indicator and in the system of indicators within the dynamic criterion, it is necessary only to compare the criterial state of the system and the actual one. In order to do it, it is necessary to use the rank correlation.

It is necessary to use only official statistical data for the analysis. In this research we will only compare the systems of indicators of the social and economic development for 1994-2003 and 2004-2013 (Official Website of the Ministry of Finances of the Russian Federation; Federal Service of State Statistics). It will allow to reveal the efficiency of the social and economic development over the recent 10 years as compared to the development of the country at the end of the XX century. The comparison of two decades allows to follow the changes in the social and economic development of the country in the synchronicity and coherence of the development of basic processes, etc.

The estimation of the efficiency of the social and economic development is modeled according to several stages. At the first stage it is necessary to formalize the dynamic criterion reflected in the criterial order of the movement of indicators that were selected to estimate the efficiency of social and economic processes. The criterial order is the rank series that contains the selected organized indicators in accordance with the adopted criterion:

- basic processes of the social and economic development,
- auxiliary processes of the social and economic development,
- indirect processes of the social and economic development, and
- process that prevent the social and economic development.

The criterial order is not an absolute value but a system of indicators that have dynamics of accelerating in accordance with their normative order. At the second stage temporal series are smoothed. It is necessary to perform the initial processing (smoothing) of the temporal series by using the procedure of standardizing according to Formula 1. For example, in the temporal series X_1, X_2,. X_k every new element of the smoothed series S_i is calculated according to Formula 1:

$$S_i = 1 + (X_i - M_e)/(X_{\max} - X_{\min} + 1), \quad (1)$$

where: M_e is a median of the temporal series, X_{max}; X_{min} are the maximum and the minimum terms of the series; i = 1,...,k.

The advantages of this approach lie in the decrease in the total inaccuracy of the transformation. The conducted researches (Buyakov O.A., 2004) showed that in case of the median smoothing we got the accuracy about 4%, in case of the sliding smoothing – 8%, and in case of the exponential one - 11%. When calculating the growth tempos, the median smoothing allows to easily calculate all indicators, because the transformed temporal series lacks zero and negative components under the absolutely complete coincidence of this trend with the initial one. At the third stage of the model formation, it is necessary to form the actual rank series of the indicators movement. That is why it is necessary to do the following actions:

- to calculate the tempo of indicators growth,
- to calculate the acceleration of the indicators values, change, and
- to range the list of indicators according to the criterion related to the decrease in the value of acceleration of their movement. thus, the first rank will be assigned to the indicator with the greatest acceleration, and the last one will be assigned to the indicator that has the smallest acceleration.

One of the problems that may occur when calculating indicators is to define ranks of indicators with the same values of acceleration. It is necessary to define them for substantial considerations that result from specific tasks of the research. When calculating this third stage, several ranks series will be obtained (Table 2). They reflect the dynamics and structure of the movement of the analyzed indicators of the social and economic development.

Table 2. Matrix of positions of indicators movement

Indicator	Criterial order of movement	Actual order of movement according to the period				
		T_1	T_2	T_3	…	T_K
Indicator 1	1	X_{11}	X_{12}	X_{13}	…	X_{1K}
Indicator 2	2	X_{21}	X_{22}	X_{23}	…	X_{2K}
Indicator 3	3	X_{31}	X_{32}	X_{33}	…	X_{3K}
…	…	…	…	…	…	…
Indicator N	N	X_{N1}	X_{N2}	X_{N3}	…	X_{NK}

At the fourth stage of the research two rank series – criterial and actual – are compared and correlated. In order to estimate the closeness, congruity or incongruity of actual and normative series, it is necessary to use coefficients of the Spierman (for fluctuations) and Kendall (for inversions) rank correlation.

For every indicator from the list, the square of difference (fluctuation) between its position (rank) in the normative regulation and the rank in the actual regulation is calculated according to Formula 2:

$$Y_i = (X_i - X_k)^2, \quad (2)$$

where: Y_i is the difference between the rank of the i indicator in the criterial regulation and in the actual one, X_k is a rank of the indicator in the criterial regulation, and X_i is a rank of the indicator in the actual regulation.

Then we calculate the sum of squares of fluctuations for all indicators at the considered period of time and calculate the Spierman coefficient according to Formula (3):

$$K_s = 1 - \frac{6 \cdot \sum_{i=1}^{N} Y_i}{N \cdot (N^2 - 1)} \quad (3)$$

The coefficient of the rank correlation of Kendall is calculated in several steps.

Firstly, for every indicator they calculate a number of other indicators that in the criterial regulation have a higher position than the position of the indicator under consideration, and in the actual regulation it has a lower rank than the rank of the indicator under consideration (Formula 4):

$$S = \sum_{p=k+1}^{N} a_p \qquad a_p = \begin{cases} 1, x_k > x_i \\ 0, x_k < x_i \end{cases} \quad (4)$$

where: k is the position of the indicator under consideration in the criterial regulation, S is a number of inversions for this indicator, p is positions of the indicators that are compared with the indicator under consideration, N is a number of indicators included in the list of the system characteristics, a_p is a function that shows whether the indicator under consideration is in inversion with the indicator compared with it (if so, $a_p = 1$, on the contrary $a_p = 0$), and $x_k(x_i)$ is a rank of the indicator in the actual regulation that has position k(p) in the criterial regulation.

Secondly, the total number of inversions for all indicators is calculated, and the coefficient of correlation of Kendal is defined:

$$K_k = 1 - \frac{4 \cdot \sum_{i=1}^{N} S_i}{N \cdot (N-1)} \quad (5)$$

Both coefficients (K_s, K_k) estimate the closeness of this rank series to the series accepted as a sample (criterial) at the interval from -1 to +1. The +1 estimate occurs when the actual series coincides with the criterial one, and -1 occurs in case of them compete multi-directionality.

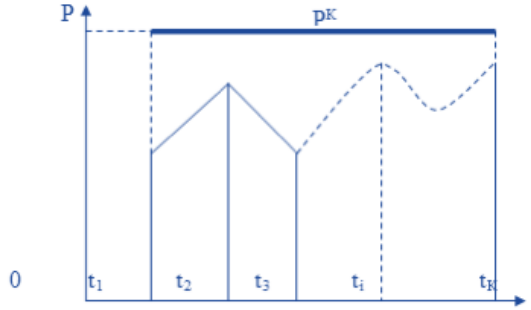
The obtained results must be analyzed as follows. If the indicators are positive, it says that the social and economic development and its efficiency are improved. If the indicators are negative, the social and economic development is inefficient and there is a fluctuation of the development system from the optimal one. It also shows the worsening of the efficiency of the social and economic development.

The indicator of the resulting estimate of closeness of the actual structure of system indicators system to the criterial (sample) one is based on two coefficients of the rank correlation for this period of time and can be calculated using Formula 6:

$$R = \frac{(1 + K_s) \cdot (1 + K_k)}{4} \quad (6)$$

The resulting estimate shows how much the character of changes in the structure of the system relations complies with the selected criterion of the estimation. In other words, it is possible to say that this indicator allows to estimate the efficiency of the taken strategic decisions in accordance with the set criterion. The range of this indicator change is from 0 to +1. Herewith, +1 is a complete congruity of changes in the structure of the system relations with the selected criterion, and 0 is a complete incongruity of changes in the system in relation to the selected criterion. The section limited according to P^K at the time interval (t_1, t_k) reflects the situation when at any moment the potential of the country is used entirely (Figure 2). The section limited by kinked and point-to-point curves at the time interval (t_1, t_k) reflects the real estimate of the efficiency of the social and economic development.

Figure 2. Geometrical interpretation of the efficiency of social and economic development



The value of this level can be estimated by correlating the areas of the second and first sections. Taking into account that $R^K = 1$, it is offered to use the following formula:

$$L = \frac{0{,}5 \cdot (R_1 + R_T) + \sum_{i=2}^{T-1} R_i}{T-1} \quad (7)$$

where: T is a number of time periods, and R is an indicator of the resulting estimate obtained according to (6).

The more coherent the processes of the social and economic development that take place in the country is, the greater value L (maximum L = 1, minimum L = 0) will have. Thus, the quantitative estimation of the efficiency of the social and economic development has been formed. Then it is necessary to add the qualitative estimation that will allow to make the conclusion about strong and weak points in the social and economic development. The initial data for such estimation will be acceleration of movement of indicators for every system related to estimating the efficiency of the social and economic development.

For this purpose, in this research the authors will use the weighing coefficients to reveal the values of the acceleration for every indicator under research. The weight of every acceleration indicator will define its position in the system for a block of indicators. Table 3 shows the numeric values of coefficients for a system of blocks including not more than ten indicators.

Table 3. Weighing coefficients to calculate the average value of the indicator acceleration in the block

Indicator No.	Number of indicators in the block								
	2	3	4	5	6	7	8	9	10
1	0.622	0.472	0.386	0.329	0.288	0.256	0.232	0.211	0.195
2	0.378	0.286	0.234	0.199	0.174	0.155	0.140	0.128	0.118
3	–	0.242	0.198	0.169	0.148	0.132	0.119	0.109	0.100
4	–	-	0.182	0.155	0.136	0.121	0.109	0.100	0.092
5	–	–	-	0.148	0.129	0.115	0.104	0.095	0.088
6	–	–	-	-	0.125	0.111	0.101	0.092	0.085
7	–	–	-	-	–	0.109	0.098	0.090	0.083
8	–	–	-	-	–	–	0.097	0.088	0.081
9	–	–	–	-	–	–	–	0.087	0.080
10	–	–	–	-	–	–	–	–	0.079

After calculating the average values of accelerations of indicators for each of the four blocks, we will obtain the matrix (Table 4) to define weak (the least efficient) and strong (the most efficient) indicators of the social and economic development. Using the changes of values in Table 4 and taking into account the criterial feature, it is possible to observe the process of transformation of the system of the social and economic development and make conclusions about the reasons that caused such transformation. In order to give quantitative estimation to the transformation, it is offered to calculate the level of synchronousness of the social and economic development (Demchenko and Melnikova 2015).

Table 4. Matrix of data to define strong and weak points

System of indicators	Average value in the block according to the period				
	T_1	T_2	T_3	…	T_K
Basic processes of the social and economic development	U_{11}	U_{12}	U_{13}	…	U_{1K}
Additional processes of the social and economic development	U_{21}	U_{22}	U_{23}	…	U_{2K}
Indirect processes of the social and economic development	U_{31}	U_{32}	U_{33}	…	U_{3K}
Processes that prevent the social and economic development	U_{41}	U_{42}	U_{43}	…	U_{4K}

In Table 4 values $U_{11}…U_{4K}$ take into account the values of indicators shown in Table 1 for the specific period (quarter, year). It is reasonable to define the level of synchronousness (SY) in relation to indicators of the basic processes of the social and economic development because they determine the tendency of the country development. This indicator will reflect the level of synchronousness of other systems of indicators in relation to the system of basic indicators. The range of the value change is from –1 to +1. Herewith, the upper value is possible only in case of the absolute synchronousness of processes, and the low value – in case of complete asynchronous behavior of the processes development (Formula 9):

$$SY = (K_1 + K_2 + K_3)/3, \quad (9)$$

where: K_1 is a coefficient of the correlation between the speed of basic and auxiliary processes development, K_2 is a coefficient of the correlation between the speed of the basic and indirect processes development, K_3 is a coefficient of the correlation between the speed of the development of basic processes and processes that prevent the social and economic development.

4. Discussion

Thus, with the aid of synchronousness and mathematical statistics, it is possible to obtain more veracious data about the social and economic development. Based on the obtained results of the research, it is possible to make the following classification of the efficiency of social and economic indicators (Table 5).

Table 5. Function of elements of the social and economic development according to stages of its life cycle

Element/phase	Process	Process dynamics
Formation of efficient social and economic indicators	Integrating	Synchronization of processes
Development of efficient social and economic indicators	Selective	Accelerating processes
Recession of efficient social and economic indicators	Stabilizing	Slowing of processes
Depression of efficient social and economic indicators	Disintegrating	De-synchronization of processes

In all stages of the life cycle of the social and economic development, basic processes of the country act as a buffer that smoothens contradictions stimulated by such development. We think that the ideal variant of the social and economic development is the one when particular processes related to basic processes have the greatest acceleration, and processes that prevent the social and economic development have the smallest acceleration. In other words, the aggregated process of the social and economic development must have the direction on the most optimal trajectory in relation to a criterion.

Based on the stipulated methodology of estimating the efficiency of the social and economic development, it is possible to represent an ideal model of management when all processes are synchronized and agreed. It is possible to achieve it if basic processes achieve the greatest acceleration, then auxiliary processes follow, indirect processes achieve the medium acceleration, and the processes that have a negative impact on the social and economic development of the country achieve the smallest acceleration.

Conclusions

Thus, the authors have developed the adapted recommendations for estimating efficiency of the social and economic development of the country. They include various scenarios of the system formation: formation, development, recession and depression. It is similar to the life cycles of economic processes.

Stages of the social and economic development depend on the speed of the development of processes described in the methodology of estimating the efficiency of such development. After estimating efficiency of the social and economic development by using the offered methodology, it is necessary to aspire for forming and developing the ideal model of the system related to the social and economic development.

Table 6 shows the results of calculations according to the methodology offered by the authors. It is related to two periods and specifies types of the social and economic development in every year.

Table 6. Types of social and economic development during the 1st and 2nd periods in Russia

Years	1st period										2nd period									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Typological nomination of efficiency of the social and economic development	Lagging I	Favorable	-	-	-	-	-	Lagging I	-	Favorable (ideal)	Favorable (ideal)	Favorable (ideal)	Depressive II	Depressive II	Lagging I	-	-	-	Depressive II	Favorable

It is possible to make the conclusion from the obtained results from Table 6 that during any crisis and post-crisis periods the whole Russian system of the social and economic development was in the form of systemless process. Period 1, *i.e.* during the transitional economy, contains the largest number of such systemless years.

In the second period the system character and efficiency of the growth of the social and economic development are observed more intesively. However, the 2008-2009 crisis and the post-crisis period show that economy of the country is not ready for such global problems. It is only by 2013 when Russia managed to achieve the favorable level of development. That is why it is possible to make the conclusion that in the second period indicators of the social and economic development are more systemized and can be estimated.

In case of the favorable ideal development of social and economic indicators (it was in 2003-2005), the speed of growth of basic and auxiliary processes surpass the speed of indirect processes. In this case it is possible to speak about stable social and economic development: the level of the population's life improves, a low level of unemployment remains, industrial production and social infrastructure, as well as other features of high economic activity are intensively developing. In case of the favorable development of social and economic indicators (it was observed in 1995 and 2013), the basic peculiarity is the advanced growth of processes that prevail social and economic development in relation to indirect processes.

On the basis of the 2013 data, it is possible to imagine the development of social and economic indicators according to two scenarios. In one case the speed of indirect processes will grow, and the speed of processes that prevent development will decrease. It is peculiar of the mode related to diversifying the country economy. In other case, the situation may worsen up to the transformation of the social and economic development to the depressive type. In order not to allow the second scenario, it is necessary to strive for the ideal model of the social and economic development like the one in 2003-2005.

In 2014-2015 it is necessary to pay attention to the growth of the following areas of the social and economic development: to increase the living wage in the country, to improve the conditions that allow to increase expenses and savings of the population, to develop new methods to provide the Russian population with housing with the aid of state programs, to decrease rates for mortgages, and to simplify administrative barriers when constructing new residential houses.

Thus, on the basis of the obtained results the work considers and offers to implement the adapted scenarios of developing the system of the social and economic indicators of the country: formation, development, recession, and depression. They are analogous to the life cycles of economic processes. The stages of the development depend on the speed of development of processes related to the indicators of the social and economic development

that are described in the methodology of estimating the efficiency stated in this article. After estimating the efficiency of the social and economic development according to the methodology, it is necessary to strive to form and develop the ideal model of the system related to managing the social and economic development of the country. The ideal model of the efficient social and economic development is a system where all indicators are agreed, synchronized, and efficient. Practical importance of the results is found in the fact that the offered adaptive methodology can be used on various levels of management. It is relatively simple for applying and can research various quantitative and qualitative indicators of the social and economic development of the country.

In order to approach the ideal model of efficient social and economic development of the country, it is necessary to take a number of measures, including the following: to start using the developed methodology in program products of the statistical informational system of Russia, and to automate procedures related to estimating efficiency of the social and economic development. It will allow to increase the veracity of the analysis of such development and to timely reveal disagreement of social and economic processes. It is also necessary, on the basis of constant monitoring of the social and economic potential of the country development, to form programs of the social and economic development of Russia, which, being within a system but not separately, will have an impact on indicators; to continue further research of the increase in the efficiency of the social and economic development by using the developed methodology with a more detailed and increased set of indicators by considering every subject, city, economic zone, and area.

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Effects of Minimum Wage Rate towards the Unemployment Rate

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Abstract:

In Malaysia, the minimum wage policy was announced by the prime minister on 15 October 2010. It is also known as one of a government policies instruments vide New Economic Model (NEM) in order to transform economy in Malaysia from a middle-income to a high-income economy by the year 2020. The aim of this policy is to protect the right of the citizens who are earning especially low income per month and low skilled. The purpose of this paper is to investigate the effects of the minimum wage rate towards the national unemployment rate. It is done by conducting a very important process which is collecting data and information regarding the paper. It is then followed by preparing a full report on the related topic which is the effects of minimum wage rate towards the national unemployment rate. The data that been collected based on the problem statements and also based on the objective of the study related to the effects of minimum wage rate towards the national unemployment rate. This paper also conducted in order to examine the effect of the minimum wage rate on the rate of working adults as well as the preferences of the labours whether to work a part time or full time, which finally will reflect on the national unemployment rate.

Keywords: wage rate; unemployment rate; economic model; income

JEL Classification: J5; J6

1. Introduction

A minimum wage is basic wages that have been paid to the workers excluding any allowances or other payments per month. This minimum wage implementation can be said to reduce poverty by increasing the purchasing power of the poor through increased wages. Minimum wage is legally the lowest wage that an employer is allowed to pay an employee. In Malaysia the national minimum wage was announced by the prime minister on 15 October 2010. It is also one of a government policies instruments vide New Economic Model (NEM) that was introduced by Malaysian Prime Minister Najib Razak on 30th March 2010 in order to transform economy in Malaysia from a middle-income to a high-income economy by the year 2020. Human capital plays an important role in achieving economic growth and development (Islam *et al.* 2016a). In the effort to attract the automotive manufacturers and major international component to invest in Malaysia, government has developed good government policies which

emphasizes on political and economic stability, well economic fundamentals, as well as practical (Islam *et al.* 2016b).

The main idea of the study is to find out on how the national minimum wage can affect the national unemployment rate. In conducting this study found out whether this minimum wage policy that was implemented in Malaysia would affect the labors directly or not. Moreover, do not have any robust data available on some types of workers who are more likely to be on the minimum wage, such as new migrants, temporary workers and disabled workers. Besides, there ate estimates assume that all 16 and 17 year olds are eligible to earn at least the adult minimum wage because the Department is unable to estimate how many of them may be eligible for the new entrants' minimum wage.

2. Literature review

2.1 Minimum wage policy in Malaysia

The minimum wage rate is applicable to all of the employers with six and more workers in Malaysia, including the foreign workers started from 1st of January in the year 2013. In addition, the micro or the small enterprises are also been allowed to delay the payment of minimum wage to further 6 months from the initiating date. Furthermore, according to National Wage Consultative Council (2012), the government has set the minimum wages up to RM900 per month for the workers in Peninsula and RM800 for those are working in Sabah, Sarawak as well as the workers in Federal Territory of Labuan (Ministry of Human Resource 2013). Plus, the time that was given to the SMEs' employers to apply the minimum wage for foreign workers was until 31st of December in the year of 2013.

In addition, as stated before, according to the study that has been conducted by some economist, such as Jonathan *et al.,* and some others researchers shows that, the minimum wage policy that has been implemented in their respected countries gave the largest impact on the low-skilled workers, who have few alternatives and their lifetime earnings will be affected by the delaying entry into the work force and losing valuable job experiences that they have gain before. Besides, this minimum wage policy significantly increased jobs for the low-skilled workers and the employment rate has increased as well.

In Malaysia the national minimum wage was announced by the prime minister on 15 October 2010. It is also one of a government policies instruments vide New Economic Model (NEM) by transform economy in Malaysia from a middle- income to a high-income economy by the year 2020. Referred to the resent analysis, in 2009 the normal wage rate in Malaysia was around RM 800. While in 2010 it has been increased to RM 900 (Ling 2014). Besides, it is to ensure the workers among Malaysian people can meet their basic needs and create the necessary environment for industries to move up their values chain. As mentioned before in the first chapter, in the introduction part, the government minimum wage policy is a policy that sets minimum wage rate that must be paid by all the employers to their employees with aim to protect the rights of the citizens who are earning especially low income per month and low skilled.

The implementation of the minimum wage rate is one of the ways in order to reduce the problem of discrepancy in distributing the wealth in the country, though the real solution needs to be more collaborative efforts. So that, the government have to be more aware and concern on the in setting the minimum wage policy, by accounting the various social and economic reflection such as cost of living, productivity, competitiveness and employment. Hence, the minimum wage implementation itself is insufficient. For more info, based on a study that have been conducted by CIMB (2012) has found that, RM900 minimum wage level was about 49.9% of the national mean wage of RM1,804.43 in the year 2010.

On the other hand, in Peninsular Malaysia, the new minimum wage rate which is around of RM900 was about 20.4% less than the year of 2012 average salary which was RM1,131 (Huie 2012). Hence, the implementation of this minimum wages policy might bring some other problems in many aspects. Since, the part time workers or are generally not be kept safe by this minimum wage policy, there might be a chances of hiring the part time workers by replacing them with the full time workers. Plus, it is generally depending on the scope of the implementation of the minimum wage policy.

Not to forget, other developing countries that have implement this minimum wage policy, such as Indonesia and Brazil indirectly raised the number of part time workers and reduce the number of full time workers, (Carneiro 2000, New Delhi: National Commission for Enterprises in the Unorganized Sector 2007). Since the part time workers are not going through the same protection as full time workers did, the invasion of the part time workers will definitely increase the unemployment rate in the labor market. So that, it is important to focus on this minimum wage policy might also persuade the hiring of the illegal workers who are not protected by employment security, work security and also the social security.

The implementation of the minimum wage policy in Malaysia is expected to develop the social and financial condition of Malaysian workers (NA Ibrahim 2012). Based on a study that have been conducted, in the year 2009 there are around 33,8% of workers from the private sector earned less than RM 700 monthly, which relative to the country's Poverty Line Income (PLI) level of RM800. Thus, the main goal of this minimum wage rate implementation is to ensure that all the employees in Malaysia earn more income than the Poverty Line Income (PLI) as the country being transformed into the high level of income nation (World Bank 2011).

Furthermore, this minimum wage policy is being implemented in order to support the Malaysians ambition to become a high income nation by setting the floor wages for all employees in Malaysia. In that point, Kaviarasu (2013) who is an economic analyst has identified that there is powerful empirical evidence that shows, there are countries which implemented the minimum wage in order to obtained a positive wage effect and a small percentage of negative employment effect among the workers who were covered by the minimum wage policy if the wage is set more than the market equilibrium level.

In addition to it, the implementation of the minimum wages will increase the competitive advantage in order to help to resolve the imbalances and imperfections that occur in the free market economy. However, the new minimum wages policy that has implemented in Malaysia is still in the beginning of process; therefore, more research have to be conducted in order to provide some brawny empirical evidence to support this implementation of minimum wage. Regarding this, a World Bank (2011) study has found that a minimum wages rate of less than RM 1000 per month or RM 4,88 for per hour would not affect the firms, employment, foreign direct investment or migrant flow into the country significantly.

Bank Negara Malaysia (2013), came up with some assumption, where through this implementation of the minimum wage rate it is expected to have a positive impact on the Malaysian economy. Nevertheless, the government of Malaysia has found that Malaysian employers may face challenges as they adjusted to this new minimum wage policy. Still this minimum wage rate is one of the excellent moves on order to make sure that this is a right way for Malaysia to join the ranks of some 150 countries which has implemented with these minimum wages policies.

In addition, on 28th September in the year 2011, the National Wages Consultative Council (NWCC) was established to undertake the research on all matters that are related to the minimum wages and to make recommendation on the minimum wages to the Government. The members of the NWCC are the chairman, deputy chairman, secretary, employee members, employer members, public officers and other members. For more effectiveness, the Council has to make sure that the number of employer and employee representatives are equal all the time.

2.2 Minimum wage in other countries

In general, the minimum wage policy has been known as the lowest payment rates to workers on accomplished their work task that have been given to them in the time. In some of the developing countries such as Malaysia, China and South Africa, the main motive of the implementation this minimum wage policy is to protect the unskilled or the low skilled workers as well as the working youngsters from being discriminated and pay equally as other workers as well. In mean time, this minimum wage policy also has been a tool in improving the standard of living low wage workers.

In context of Malaysia's minimum wages, it is known as the lowest hourly, daily or monthly salary that the employers are legally paying to their workers and it is the lowest wage rate where the workers may sell their labor force said one of the economy analysts Kaviyarasu (2013). This minimum wage policy had been implemented since

from 1st January 2013 in order to protect lower wage workers in market economy. Furthermore, this policy is also protecting the low skilled workers or unskilled employee and maintains the employment chances of entry level for all industries and sectors that were operating in Malaysia. Meanwhile, in South Africa with the largest labor supply marker has introduced minimum wage in order to develop the country's economic level and also in order to reduce the poverty level (Bhorat 2013).

However, if there is any of the sectors is not considered as vulnerable, hence that related sector will be not applicable in applying this minimum wage policy regardless of the fact that some workers from that particular sector will be paid very low wages. On the other hand, for those who are known as vulnerable workers whereby working in the that nine selected sectors, if the labors feels that their employer is found culpable by paying below the minimum wage, then the workers can make a complaint to the Department of Labor or to Trade Union representative, thus there will be action taken where the employer can be fined. In addition, the minimum wage rate was that implemented in South Africa usually will be fixed within one year and also will be adjusted annually (Bhorat 2013).

In detail, from China expectation, the minimum wage policy had been implemented about ten years ago, which was in the year 2004 by the Ministry of Labor and Social Security of China. The minimum wage rate in China will be updated for every two years (Ling 2014). According to the "minimum Wage" article III, the minimum wage is a payment that needs to be paid by employers to their workers who are workers who are working in the labor contract law to provide normal working hours under the premise of labor. In addition, the China's minimum wage policy is intent on the regional level as well as compared to South Africa, where, in South Africa the minimum wage is determined at national, regional, sectorial plus the different skills level.

Moreover, the China's minimum wage is between RMB 500 to RMB 1120 where it is around RM 265 to RM 594. Whereas, the poverty level of china was around RMB 1196 which is RM 634 per capita annual income. (Tin *et al.* 2013). In China, the minimum wage policy have been implemented in two different ways, where, the wage been paid monthly and hourly. This both monthly and hourly minimum wage policy constituent includes the fixed and different types of elements. Hence, there are several factors that need to be considered in implementing this minimum wage policy. The factors that must be focused in implementing this minimum wage are such as, the living cost of resident per capita, individual working insurance premium for an individual, housing fund, the average wage, the unemployment rate and also the stage of development of the country.

In addition, the above statement which is on China's monthly minimum wage it is refer to local employment rate and the cost of living, the urban consumer price index, social insurance payment of an individual worker and housing fund, the average wage, and the development of economy. While, the hourly minimum wage, is been paid according to the basic pension and medical insurance, job stability, working conditions and also the labor potencies (Lin *et al.* 2004). Therefore, the China's minimum wages are different as according to their economic developmental and changes as well compared to other countries. In contrast, the minimum wage rate in Malaysia is unified and equally paid for all of the workers with contract of service that are includes local and foreigner workers in all of the sectors that are operating in Malaysia.

The minimum wages implementation and practices that have been done in other developing countries seems to be in different ways in implementing this minimum wages policy. In state, South Africa and China are countries which known to be having the largest population countries in the world. By having the largest population rate, the both country possess to huge labor intensive manpower in their country's production line. Furthermore, there are many substantial companies that had invested its main production industry in China due to huge labor intensive manpower which has lowest labor cost for example, Apple Inc.

2.3 Minimum wage theories

In this minimum wage study, two theories can be related that have been used in one of the study that conducted in Tanzania regarding to this minimum wage rate. Those theories are namely the theoretical foundation of a low wage approach and the theoretical foundation of a high wage approach. The low wage rate is one of the development strategy that preferred by most of the economist because for them the high wage rate have a negative effect on economic development and change through among reducing capital formation; it is also increases the strains on

government's budget by deducting the revenue and at the same time it increases the cost of delivering the public services. According to the economists, the high wage policy will also affect the balance of payments and raises the unemployment rate in the industrial sectors as well (Alarudeen 2011).

In this low wage policy most of the economists are very concern about the formation of the capital which is very important in driving the economic development. According to the study, anything that increases the country's capital stock, it can make the workers to be more productive in the industrial sectors which can benefit the workers whether directly or indirectly. In contrast, anything that causes an increment in labor cost to the capitalists will affect the profit where the profit will decrease and the formation of capital will also be slow.

As mentioned in the study that have conducted in Tanzania, the large number of labors which supply with low labor cost is one of the important thing in boost the development of an economy in each and every country (Chaira 2011). Besides, I have found that there are a large number of labor supplies with low cost in the agricultural sector. This would be a better choice for the firms to extract the workers by paying a real wage that are being paid in the industrial sectors as well. To add, the high wage policy is considered as the one of reinforce to the budget constrain.

In most of the African countries the government is the major employer; in this state the high wage that paid to the government servants will significantly increase the current expenditure and the cost of delivering services (Kea and Godius 2012). While with the low wage rate policy these funds can be used in infrastructure and administration developments. Hence the low wage rate indirectly contributes to the creation of tax base and it also has a positive effect on development by reducing the expenditure and increase the revenue in the government's budget. The major constraint confronting a developing economy might be the 'bottlenecks' which attributes to the lack of the capital, intermediate inputs and raw materials that cannot be generated domestically.

According to the development economists, counsel that the wage restraint said that, other things that are equal and pursuit of the low wage policy will be able to reduce the constraint that happens in the balance of payment. The low wage rate will increase the flow of the foreign exchange and the foreign investment by reducing the outflow of the foreign exchange that are necessary to pay for the imported goods (Jomo and Hui 2007). Whereas, the high wage rate will increase the cost of the production of the export goods and this will increase the price of the goods that being exported. At the end, this will lead to the reduction in the exports and the foreign exchange will be affected as well.

According to Keynes (1936), the minimum wage rate that being implemented must be affect the sufficient number of employees and should be adjusted from time to time. For more, the minimum wage rate also should be increased based on the trend of the current productivity growth and the targeted inflation rate by the central bank. However, according this Keynesian perspective there no any relevant positive or a negative unemployment affects that resulting that caused by the changes that happened in the minimum wage rate. Whereas, for the neoclassical paradigm on minimum wage rate shows that there are a negative effect on the employment rate.

This made the employers or the related companies to trash to follow after the minimum wage policy that was implemented by the government. Hence, this shows that the policy makers of Malaysian economy, in implementing this minimum wage, they should concern and review on how and what they have to do in order to create a fair and reasonable wage policy which can be accepted by everyone. In order to that, the policy makers should have a look on the minimum wages policy that have been implemented in other countries such as in China which is with two different ways and South Africa where this both countries implemented the minimum wages policy by categorized into few sectorial and were reflect based on the cost of living of the urban and as well as the economic developmental of the country (Bill 2009).

Moreover, in Malaysia there are 13 states, and there only few number of states which are urban area. The rest of it is still considered as rural area. In that case, it is not fair if the minimum wages level which covers the same rate for all of the states (Ling 2014). In state, the Federal Territory Kuala Lumpur where it is deficient for the new minimum wages rates which is RM900 per month. This is because; the living cost in the city is high. This minimum wage policy is also being an important instrument in order to reduce the working poverty level and gives a social protection to the vulnerable workers. This is to ensure the low paid workers have a basic standard of living and at the same time, those workers also can meet their basic needs.

2.4 Keynes theory on minimum wage

Based on the study that has conducted, I have come to the theoretical framework part which is going to cover the economic effects of minimum wage in the Keynesian paradigm. In this Keynesian paradigm, it is covered by the effects under the assumption of the homogenous labor and the effects under the assumption of the heterogeneous labor. These both assumptions of homogenous and heterogeneous labor is being analyzed with using the price level effect, the distribution effects and also the employment effects. Since, this research is based on the effects of minimum wage on the unemployment rate; it will be focused to concentrate in the employment effect that been elaborate in the Keynesian approach.

First of all, the explanation will be on the effect under the assumption of the homogenous labor in Keynes approach. According to the Keynesian approach there is no relationship between the changes that happens in the wages and also the changes that happens in the employment rate; and this is because wage costs are directly influence the price level (Herr *et al.* 2009). In addition, an extremely low nominal wage and the cuts of nominal wage will lead to the deflation which will create a problem in the financial system and will cause a loss in total production and in the employment rate (Herr 2009).

On the other hand, an extremely higher nominal wage increases will cause the inflation which will be overcome by the monetary policy. This inflation also will lead to the lost in the production and will affect the employment rate as well. In this Keynes approach it is stated that this minimum wage rate can help in support to the development of the nominal wages and also in preventing the deflationary developments.

Secondly, this study will focus on the effect under the assumption of heterogeneous labor which was also explained in the Keynesian approach. In this part, it is assumed that the heterogeneous labor with various wage rates and it is being analyzed the economic effects of minimum wages under the employment effect. In this case, if there is a change in the minimum wages will modify the wage structure. So that, it is more complicated to analyze the employment effect compared to a situation of a uniform wage rate (Katz 2007). To add more, the changes that occur in the wage structure will cause an automatic change in the relative price. Moreover, it also will affect the distribution of income.

In general, we do know that the semi-conductor industries are the input of many other industries as well. So that, the increase that happens in the price level of the products that been produced in the semi-conductor will directly affect those industries that are related. At the end, all of the industries that are related will now move towards the new profit maximizing technology as well because of the changes that happened in their inputs (Herr 2008). Thus, the related industries also will shift to more labor intensive industry as their capital inputs have become more expensive. Finally, all of the industries that are using the semi-conductor as its input will change their price and their inputs composition. These changes then will affect many other industries and will lead to major changes in the price level, the input demand and also in the usage of the technology.

At last, the complete structure of the price level, the creation of the inputs and the output structure will change the whole economy which finally will show the employment rate. Whereas, in the hair dressing industry, it is not possible have any changes in the technology and the outputs that are produced in this industry in not the inputs of any other industries. Related to this, any changes that happens in the minimum wage, will also affect the hair dressing industry as well. In state, if there is an increase in the minimum wage rate will lead to the increase of the hair dressing service price as the wage costs increases. This situation also will cause the hairdressers to lose their job at last.

In this hair dressing industry the wages can be increase or decrease, and it depends on the price elasticity of hair dressing services (König/Möller 2007). The increase of the price level in the hair dressing industry will reduce the number of consumers because they have to pay more. This will finally affect the whole industry and will lead to a phenomenal where the employment rate in the economy will chance and it will be very difficult to predict. To be summarized through this theoretical part, it is get to know that the minimum wage will lead the wage structure, the price level, input and output demand.

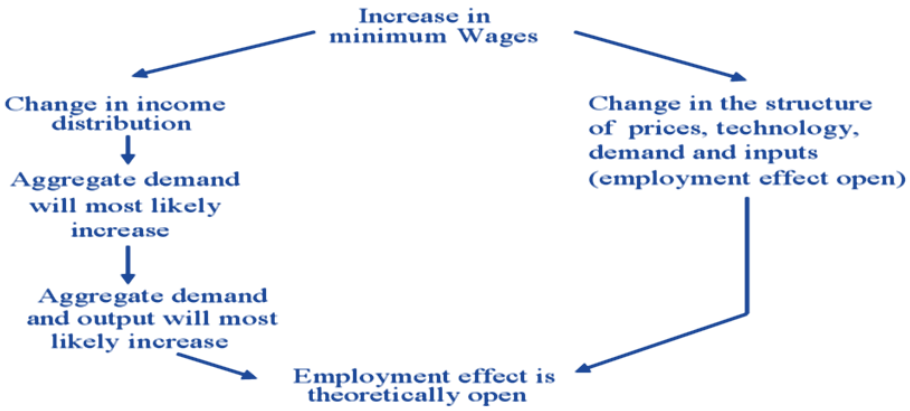
Besides that, an increase in the minimum wage will bring a change in the distribution as well. This distribution changes is because, when the minimum wage increases the workers who are earning a low income will be more

beneficial. According to Keynes (1936), the low income households tend to have a huge propensity to spend than the high income household, and an increase in the minimum wage will increase the aggregate demand. At this situation, the production and the outputs will increase. Here it is clearly explained that, the increase in the minimum wage rate will lead to a change in the distribution of the income level.

In further, a higher minimum wage will increase the income level of the workers. As it is, the single households might be directly pushed above the poverty line. Whereas, the welfare level of the bigger households also increase as the minimum wage rate increases. It is also expected that all of the low income jobs will be demolished by the higher minimum wage which can affect the poverty negatively. All in all, this minimum wage have to consider as a very important element in overcome the poverty. Yet, it is something impossible, because not all the poor people work in the formal economy and some of them are being unemployed (Card/Krueger 1995).

To be concluded, in this Keynes paradigm the aggregate demand is the main instrument in driving the employment rate. Furthermore, the changes that happen in the relative price structure and also the changes in the allotment of the employment and other input factors will be the secondly important element in determining the employment rate. This shows that, the Keynesian economists do not advocate that the changes in the wage structure will lead to a reduction in the unemployment rate.

Figure 1. The employment effects of the minimum wages in Keynesian paradigm



In their expectation, the higher demand mainly, in the investment demand will be the correct element in overcome the unemployment rate. Plus, if the Gross Domestic Product (GDP) is limited, then it is impossible in reducing the working hours, and the only solution will be to employ more workers. Finally, in the Keynesian perspective seems that there is no relevant positive or negative effect in the employment which is determined by the changes that happens in the minimum wages. The main info that has been concentrated is where the aggregate demand is the one which drive the employment rate and not the processes in the labor market which is shown in Figure 1.

A higher minimum wage leads towards more equal income distribution. From this, it is expected that the positive demand is an implication as the lower income earners consume more using their income. The changes in the wage structure will lead to the changes in the price level and also in the usage of the new technologies. At last it is emphasizing that the empirical analyses show that there are only insignificant employment effects and there was no negative once related to the increase in the minimum wages.

In addition, the study found out the impact of this minimum wage on employment growth and wage earnings or costs. There are economies who estimate that there are impacts on job growth which are based on a conventional model of firm decision-making, whereby the firms operate in perfectly competitive markets which adjust their firm's outputs and inputs, including labor according to the relative prices. Plus, this modeling approach does not adequately reflect the dynamic nature of employment responses to changes in minimum wage, and particularly, any investments that the employers make in order to increase the productivity of low paid workers.

A recent study that has been done by Jonathan and Jeremy (2013), who are economists at Texas A&M University, has found that, the most leading employment effect due to this minimum wage policy is a decline in the hiring of new employees." According to them this effect takes place over time as the employers shift to the labor-saving methods of production. Plus, since the minimum wage policy has the largest impact on the low-skilled workers, who have few alternatives and their lifetime earnings will be affected by the delaying entry into the work force and losing valuable job experiences that they have gain before.

In a recent case study, that controls for confounding factors that make it difficult to isolate the impact of an increase in the minimum wage on employment for low-skilled workers, which have been carried out by Joseph, Richard, and Benjamin (2012), find out that when New York State increased the minimum wage from $5.15 to $6.75 per hour, in the year 2004 to 2006, there was around "20.2 to 21.8% reduction in the employment among the younger who are less-educated individuals," with the greatest impact on 16 to 24 year olds.

Moreover, advocates of the minimum wage like to point to the "natural experiment" that David and Alan (1993), conducted to find out whether a minimum wage policy that have implement in New Jersey adversely effected the employment rate in the fast-food industry compared to Pennsylvania, which did not increase its national minimum wage. Besides, based on the telephone surveys that have been conducted by David Card and Alan Krueger, they get to know that the authors concluded that the minimum wage policy significantly increased jobs for the low-skilled, fast-food workers in New Jersey (Neumark and Wascher 2000).

In addition, Arindrajit et al. (2014), for example, use county-level data over a sixteen and half year period to examine the impact of the local differences that occurred in minimum wages on employment in restaurants, which primarily hire low-skilled workers. Furthermore, according to their analysis and assumptions, they found that there were no adverse employment effects. Besides, based on one of the study, that has been conducted in Australia, shows that the employment rate has increased as well. Human resource practices have widely been accepted factors which can improve employee skills, foster motivation and commitment, this in turn increases intention to stay longer with the organization (Joarder *et al.* 2015).

Alnasser *et al.* (2013) addressed that it is even more important than low prices and web presence as online customers are provided with more product or service choices with reduced costs. The perceived service quality includes guarantees customized services and performance of delivery. Islam and Patwary (2013), discussed the corporations are feeling anxiety of high costs in order to think either they should hire disabled employees or not. Few disabled experts demanded, those organizations hire the disabled employees they are being posed for some additional work, spare costs. Market implications help in either encouraging or discouraging the purchase of such product in the economy. It may also help in determining the direction of the local industries and the marketability of their product, which help in increasing productivity or improvement in such products (Islam and Abdullah 2013). The success of emerging economies from Asia, in terms of their exports, has ignited great interest to comprehend the international marketing strategies used to enhance export performance in the Asian region (Alshammari and Islam 2014).

The aim of this study is to identify the effects of the implementation of the minimum wage rate on the national unemployment rate. This research is done because of the implementation of the minimum wage rate in Malaysia. This national minimum wage rate is being implemented in Malaysia in the year of 2010 by the Prime Minister which is also known as an instruments vide New Economic model (NEM) by transform economy in Malaysia from a middle- income to a high-income economy by the year 2020. Besides, the aim of this policy is to protect the right of the citizens who are earning especially low income per month and low skilled. Through this minimum wage rate I wanted to know the effect on the national unemployment rate. Is this minimum wage rate that been implemented has reduce the national unemployment rate. Furthermore, through this research it can be find out the other alternatives that can be carried out to reduce the national unemployment rate and at the same time the current minimum wage rate can be raised as well.

3. Research methodology

The research design is a main guideline in performing the flow of the research process systematically and successfully. This research is done by conducting a very important process which is collecting data and information

regarding the topic. It is then followed by preparing a full report on the related topic which is the effects of minimum wage rate towards the national unemployment rate. The data that been collected based on the problem statements and also based on the objective of the study related to the effects of minimum wage rate towards the national unemployment rate.

3.1 Research instrument

In this research, the instrument that been used to collect the data regarding the effects of minimum wage rate towards the national unemployment rate is a questionnaire forms. The questionnaire that is prepare and distributed to the selected 100 respondents is created, based on the topic of the research, problems that faced by and also the aim of the study together with some relevant facts. In the other research's, this questionnaire form was being used by the researcher as well to gather information regarding their topics.

In addition, the elements in the questionnaire form was prepared by referring to the examples in the online as well as the questionnaire that been created and used other past research's that are kept in the UUM library and adjust it according to the topic of the research.

3.2 Analytical method

In this research, the analytical method were used is an econometric method. This econometric method is one of the methods that are used to find out the relationship between the independent variable and dependent variable can be f. In addition, in those past research papers that I have referred, I got know, that this econometric method has been used frequently in finding the result of the research. Besides, the equation methods that, used to analyze effects of minimum wage rate on the national unemployment rate is multiple linear regression models.

3.3 Research equation

The research equation that used in this research study is a multiple linear regression model. This equation was created based on my research topic and used it to do the empirical analysis. Moreover, this multiple linear regression model is suitable to be used in my research because the model is created by using more than one independent variable. The research equation is as followed.

$$Ui = \beta 0 + \beta 1X1 + \beta 2X2 + \mu i.$$

where: Ui = national unemployment rate; $\beta 0$ = minimum wage rate; $\beta 1X1$ = working references; $\beta 2X2$ = working adults rate; μi = is the random error.

All these independent variables were chosen in creating this research equation. In addition, these variables are actually can affect the national unemployment rate and were really acceptable in finding the result of my research. The factors that can identify the effect of the minimum wage rate towards the national unemployment rate is been used to create this research equation model as the variables.

3.4 Data analysis methods

Data that were collected from the questionnaire is analyzed by using the statistical analysis. This statistical analysis was done by using one of the software that known as Statistical Package for the Social Science (SPSS) version 22. In this research, the SPSS software helps to interpret the collected data through the questionnaire that were distributed to those 100 respondents. Plus, this interpretation is done in order to test the significance or the relationship between the independent and the dependent variables more accurately. In finding the result of my research, will be carried out; which is Pearson Correlation Test and the Descriptive Statistics.

Pearson Correlation Test: Through this Pearson Correlation Test, the relation between both the two or more variable can be measured. Plus, in this correlation test analysis does focus on the variables that influence it. Some more, the advantage of this correlation test is based on the value that represent by "r" which known as the higher correlation coefficient. Moreover, in this Person Correlation Test, the value of "r" shows the strongest positive correlation as it is approaching the value of positive one (+1).

Descriptive Statistics: Descriptive statistics is used to summarize the data that been collected. In this descriptive statistics, the Frequencies Procedure is used for the categorical data. Through this the mean and the standard deviation of the data also have been in this research. Furthermore, the Descriptive Procedure is used for the scale data.

4. Result and discussion

This research was conducted on the effects of minimum wage on the national unemployment rate. We have distributed my questionnaires to the respondents in order to find out about the effectiveness of this minimum wage policy that been implemented in the year of 2010 until now. So that, I created the questionnaire regarding my topic and distributed it to those individual who are 18 years old and above randomly in the selected area.

4.1 Mean and standard deviation of the variables

In this particular part, it will be focused on mean and the standard deviation of the variables that been using in this research study. This part is also discussing regarding the mean and the standard deviation in order to judge the highest and the lowest value of the variable that been using in this research such as the unemployment rate, minimum wage, the working preferences which are part time and full time workers and finally, the working adults.

4.1.1 Mean and standard deviation: Unemployment rate

This unemployment rate is the dependent variable in this research. The mean and the standard deviation of this part show the highest and the lowest value of the effect on the unemployment rate due to the implementation of the minimum wage. Plus, Table 1, the highest mean score is (5.00). Whereas, the lowest standard deviation is about (0.000). This shows that the minimum wage policy is effecting positively towards the national unemployment rate; where this minimum wage is contributing in decreasing the Malaysian unemployment rate. Furthermore, the second highest mean value is (4.59).

Table 1. Unemployment rate

ITEMS	Mean	Standard deviation	Minimum	Maximum
Is the Malaysian unemployment rate is high?	2.08	1.079	1.00	4.00
The unemployment rate is	2.79	0.769	1.00	4.00
This minimum wage is contributing in decreasing the Malaysian unemployment rate	5.00	0.000	5.00	5.00
Is the unemployment rate among the working adults is increasing due to this minimum wage?	1.43	0.498	1.00	2.00
Is this minimum wage decreasing the unemployment rate among part time workers?	4.59	0.726	3.00	5.00

Thus, this minimum wage is decreasing the unemployment rate among part time workers and the second lowest standard deviation is (0.498) it shows that the unemployment rate among the working adults is seems decreasing due to this minimum wage. According to this table most of the respondent agreed that this minimum wage is decreasing the national unemployment. Further details regarding the mean and standard deviation on the unemployment rate is shown in the table below clearly.

4.1.2 Mean and standard deviation: Working preferences

The second variable in this research is working Preferences which contain the part time and full time workers. In the table 2, the highest mean value is (5.00), where it shows that most of the respondents prefer to work full time due to this minimum wage. The second highest mean (4.85) goes to the statement which indicating that the employment rate of the full time workers is increasing because of the implementation of minimum wage. Whereas, the most least value of the standard deviation is (0.000). In addition, the second least value of the standard deviation is (0.672). So that, it indicating that due to this minimum wage implementation the employment rate among full time

workers is increasing. All in all, most of the respondents saying that this minimum wage rate makes them to work full time. Table 2 shows more information regarding the respondents' prospection on the working preferences.

Table 2. Respondents' working preferences

Items	Mean	Standard deviation	Minimum	Maximum
Do you prefer to work full time?	5.00	0.000	5.00	5.00
Is the number of part time workers decreasing because of this minimum wage?	4.55	0.739	3.00	5.00
Is the full time workers are earning more income than part time workers due to this minimum wage?	4.65	0.672	3.00	5.00
Is this minimum wage rate is increasing the rate of full time workers?	4.85	0.458	3.00	5.00

4.1.3 Minimum wage

In the table 3, the value of mean and as well as value of the standard deviation on another variable of the research which, is the minimum wage have been shown clearly. The largest value of the mean is (5.00) and lowest Standard deviation value is (0.000), this shows that the respondents overall agree with this minimum wage policy.

Table 3. Mean and Standard Deviation of Minimum Wage

Items	Mean	Standard deviation	Minimum	Maximum
Do you agree with this minimum wage policy?	5.00	0.000	5.00	5.00
Is this minimum wage is decreasing the unemployment rate in Malaysia?	4.92	0.273	4.00	5.00
Is this minimum wage is decreasing the unemployment rate of low wage workers?	4.85	0.458	3.00	5.00
Is this minimum wage is increasing the unemployment rate of employers	1.06	0.239	1.00	2.00
Is this minimum wage is decreasing the unemployment rate among working adults?	4.92	0.273	4.00	5.00
If the current minimum wage rate increase future the unemployment rate will decrease.	4.78	0.416	4.00	5.00

Next to it, the second highest mean value (4.92), indicates that this minimum wage is decreasing the unemployment rate in Malaysia. Plus, the second least standard deviation value is (0.239) this shows that the respondent is saying that the employers are not going out of the business. The clear detail on this variable is been showing in the table 3.

4.1.4 Working adults

Table 4 is showing the information regarding the effect of minimum wage on working adults. This section, the highest mean value is (5.00). Whereas, (0.000) is the lowest value of the standard deviation. These both values indicate that if this minimum wage rate is increase in future than, the unemployment rate among working adults will decrease. In addition, the second highest mean score (4.62) as well as the least standard deviation value (0.488) shows that this minimum wage policy is beneficial for the working adults, where the unemployment rate among working adults is decreasing. Finally, the respondents are saying that this implementation of the minimum wage is increasing the number of working adults. Overall, it stipulates this minimum wage is giving the positive impact on the adult workers. More information regarding it has been included in the table below.

Table 4. Mean and standard deviation on working adults

Items	Mean	Standard deviation	Minimum	Maximum
Is the unemployment rate of working adults is decreasing due to the minimum wage rate?	4.62	0.786	4.00	5.00
Will this minimum wage rate decreasing the unemployment working adults by the year 2020?	4.58	0.496	4.00	5.00
If this minimum wage rate is increase, will the unemployment rate of working adults will decrease in future?	5.00	0.000	5.00	5.00

4.2 Empirical data analysis and findings

4.2.1 Pearson correlation analysis

This Pearson Correlation is being used to identify the relationship between the two quantitative and continuous variables. The value of (r) will measure the strength between the two particular variable. Whereas the value of probability (P value) will show the significant level of the variable as well to decide whether the hypothesis null is accepted or not. This Pearson Correlation Analysis is being used in this research study to identify the relationship between the dependent and independent variables as well as the signification. In addition, this test is being used to decide the acceptation of the null hypothesis. The first hypothesis will as follow:

H1: There is a relationship between the minimum wage rate and national unemployment rate

The Pearson Correlation Analysis shows the relationship between the two different variables which are national unemployment rate and the minimum wage rate. It shows that, there is a significant relationship between these two variables. The r value (0.215) and the p value (0.032) shows the strength between minimum wage rate and the national unemployment rate is weak and the significant level between these two variables is significant at ($p < 0.05$). Thus, the null hypothesis (H0) is accepted. The statistical formula can be written as ($r(98) = 0.215$, $p < 0.05$). This means, there is a relationship between the minimum wage rate and the national unemployment rate where, the minimum wage rate is decreasing the national unemployment rate. The information is shown in the Table 5.

Table 5. Pearson Correlation Analysis on the minimum wage rate and the national unemployment rate

Variables	r value	p value	Magnitude relationship
Minimum wage rate	0.215	0.032	Weak

Note: * Correlation is significant at the 0.05 level (2 – tailed).

H2: There is a relationship between national unemployment rate and working preferences due to the implementation minimum wage

Through this study we would like to identify the effect of minimum wage on the respondents' working preferences whether they prefer to work part time of full time which at last will react on the national unemployment rate. So that, the Pearson Correlation test have been conducted on the national unemployment rate and the respondents' working preferences. The test shows that there is a significant relationship between national unemployment and the respondents' working preferences due to this minimum wage. The strength between this moderate which shown by the r value (0.430) and the significant level is at ($p < 0.01$) where the p value is (0.000). Thus, the null hypothesis (H0) is accepted. The statistical formula can be written as ($r(98) = 0.430$, $p<0.01$). This means, there is a relationship between the national unemployment and the respondents' working preferences due to this minimum wage. Where, due to this minimum wage, the respondents overall prefer to work full time which final will decrease the national unemployment rate. The details regarding this have shown in the Table 6.

Table 6. Pearson Correlation Analysis on the working preferences and the national unemployment rate

Variables	r value	p value	Magnitude relationship
Working Preferences	0.430	0.000	Moderate

H3: There is a relationship between national unemployment rate and the working adults' rate due to the minimum wage rate

Through this hypothesis, I would like to identify the effect of minimum wage on the working adults' rate, whether the number of working adults is increasing due the implementation of the minimum wage which will increase the national employment rate. To identify the result, the Pearson Correlation test has been conducted on the national unemployment rate and on the working adults' rate. The test shows that there is a significant relationship between national unemployment and the on the rate working adults due to this minimum wage implementation. Even though there is a positive relationship between the national unemployment rate and the rate working adults, the strength between these two variables is weak. This is shown by the r value (0.213) and the significant level is at ($p<0.05$) where the p value is (0.033). Thus, the null hypothesis (H0) is accepted. The statistical formula can be written as ($r(98) = 0.213$, $p < 0.05$). This means, there is a relationship between the national unemployment and the working adults rate due to this minimum wage. Where, the implementation of this minimum wage has increased the number of working adults which finally contributes in decrease the national unemployment rate. Further details are as shown in the Table 7.

Table 7. Pearson Correlation Analysis on the working adults and the national unemployment rate

Variables	r value	p value	Magnitude relationship
Working Adults	0.213	0.033	Weak

Conclusion

Conducting this research paper more information regarding this minimum wage policy that been implemented in Malaysia as well as in other countries have been gained deeply. There countries those are facing problems because of this minimum wage. Yet, in Malaysia it is an effective policy in overcome the national unemployment rate. Furthermore, this minimum wage rate also being very beneficial to the labors overall. It is also known as one of a government policies instruments vide New Economic Model (NEM) in order to transform economy in Malaysia from a middle- income to a high-income economy by the year 2020. Plus, the aim of the implementation of this minimum wage policy in Malaysia is this policy is to protect the right of the citizens who are earning especially low income per month and low skilled.

Through this research, it is get to know that the minimum wage rate is effecting positively in decreasing the national unemployment rate. Because of this minimum wage rate, those who are working as part time workers before, choose to work full time. This finally, increases the employment rate of the full time workers. In addition, this minimum wage rate also seems to increase the participation of the working adults in the working field. The positive changes that happen in the rate of working adults reflect positively towards the national unemployment rate, where the overall national unemployment rate have decrease.

Moreover, in the methodology part, the final result on the respondents' data shows that there is relationship between the variables of this research. The Pearson Correlation and Descriptive Statistics show the result clearly. Through these tests, it has been confirmed that the minimum wage rate is reacting positively on the national unemployment rate where the unemployment rate has decrease. These tests also shows what does the respondents who represented the Malaysians overall, and they are really agree with this minimum wage rate.

At last, this research will be very help full to those who are conducting research on any topics that are related to this research. Plus, this research also will be good information provider to those who wants to know about the minimum wage rate and its contribution in reducing the national unemployment rate. Furthermore, this research paper also will be as a value able informatics for those individuals who do not have any idea or knowledge on this minimum wage and its effects on the national unemployment rate.

In conducting this research, it is recommended that, the research on this minimum wage rate have to be improved from time to time to make sure that this minimum wage policy is giving benefits to all of the users. Through that research, there must be changes on the minimum wage rate which the research have to be a guide line in improving efficiently not only by focusing on the low wage workers but also in context of all the related labors in Malaysia. The future researches also hope to be focus on the teenage group or on the other parties related to the unemployment rate.

Furthermore, it is also recommended to conduct a research on the minimum wage rate on contributing the economic growth. It can be investigated whether this minimum wage rate implementation is contributing in improving and increasing the economic growth in Malaysia. By conducting the related researches it can be find out whether, is this minimum wage policy is really effective in increasing the economic growth in Malaysia and is it use full in achieving the objective in the year 2020.

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Would It Be Helpful to Have Credit Ratings to Prevent the Initial Public Offering Underpricing?

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Abstract:

In this study, the effect of the credit rating on the IPO pricing has been analysed. The analysis of the companies which were listed in Korea Exchange and made IPO from 2002 to 2014, found out that the companies which had the credit rating had less underpricing IPOs than those which did not have. The results showed that the underpricing IPO has nothing to do with the level of credit rating and the difference in the credit rating entities and that the existence of the credit rating itself plays a big role in removing the uncertainties and information asymmetry on the corporate values. Same as the final underpricing ***IPO***, the companies which have the credit rating were also found to have less adjustments of the public offering price during the period of demand forecasting. These results show that the credit rating plays a big role in removing the information asymmetry in the IPO market.

Keywords: credit rating; initial public offering (IPO); underpricing; Heckman model; information asymmetry

JEL Classification: G10; G14; G24; G29; G39

Introduction

The IPO funding for inducing the outside investment is an effective tool for increasing the capital required for the corporate growth. But it can be found from the past records that the newly issued shares were traded at a far higher price than the IPO price here in Korea and in advanced overseas markets as well. So, if we assume that the price formed at the market reflects the true value of the companies, we can infer that the IPO price is formed at relatively low price. As the IPO underpricing may be considered as the cost from the viewpoint of the IPO companies, it has been studied both in financial businesses and colleges. There is a hypothesis on the cause of the underpriced IPO among others, which argues that the underpricing is caused by the uncertainty as it is hard for the potential investors to get precise information about IPO Company prior to the listing of the companies. In this study, the empirical analysis was focused to find out whether the IPO companies having the credit rating prior to IPO have less information asymmetry so that the underpricing IPOs for those companies are less likely to happen. This study has

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studied 706 IPO cases during 2002 to 2014, which were listed in Korea Exchange and found out that the IPO companies evaluated the credit rating have less underpriced IPOs.

IPO is conducted through a lot of processes such as selection of underwriter, preliminary audit of the company prior to the listing, filing of the securities, demand forecast, public offering and final listing. Though the IPO processes are designed to remove the uncertainties on the corporate values which may exist among the stakeholders such as the issuing company, underwriter and investors, there is still the uncertainty due to the difference in the volume of information owned by each stakeholder and due to this uncertainty, the underpriced IPO continues to happen from the time of the studies made by Ibbotson (1975) and Ritter (1984). Beatty and Ritter (1986) showed that the underpriced IPO is positively related to the uncertainly on the value of issuing company based on the hypothesis of information asymmetry. Rock (1986) argued that the issuing company selects the method of underpriced IPO to avoid the chance of the winner's curse which may happen due to the information asymmetry among the stakeholders and give more inducement to the IPO for the investors.

To resolve IPO underpricing, the method of minimizing the information asymmetry between investors would be the most effective one as shown in the study by Michaely and Shaw (1004) on the homogeneity in the acquisition of information among investors. However, this method may be limited to IPOs in the specific fields. Therefore, it would be better alternative to the issuing company to appoint a more reputable underwriter to get rid of the uncertainty on the IPO price for the investors although it may cost more. However, the prior studies show that there is less correlation between the reputation of underwriter and the IPO underpricing. It may be caused by the fact that the reputation of underwriter not only reduces the information asymmetry but also affects the IPO underwriting in other way.

On the other hand, An and Chan (2008) suggested the credit rating as a means of reducing the information asymmetry among the transaction participants. Even though the credit rating just represents the possibility of redemption of the debt security by the debtors or the redemption capability of a company, it can be broadly interpreted as the value of the company evaluated by the credit rating agency from the view point of an independent third party using not only the disclosed data but also the internal data. So, if an issuing company has a credit rating prior to starting IPO, it would help the stakeholders to reduce the uncertainty on the value of that company and thus affect the IPO pricing. As shown in the study made by An and Chan (2008), this study focuses on the empirical analysis to find out whether the credit rating has the information effect even in Korea and whether it could reduce the IPO underpricing.

The study has the following implications: First of all, based on the hypothesis of information asymmetry, the empirical analysis found out that there are the difference in the IPO underpricing depending on the existence of credit rating, thus indicating that the information asymmetry among the transaction stakeholders has effect on the IPO pricing and that the existence of credit rating can alleviate the level of information asymmetry among the transaction participants and the difference in the level of IPO underpricing. It was also found that the companies evaluated the credit ratings have less adjustment in offering price during the demand forecasting period, thus showing that if a company has the credit rating prior to IPO, the uncertainty on the value of the issuing company can be reduced. In addition, the study analyzed whether the credit information grade prepared by the credit research company, which is similar to the credit rating provided by the credit rating agency, alleviates the information asymmetry. In this case, the credit information grade was found to have the same effect as the crediting rating has. This may be caused by the fact that even though there is a big difference between credit rating and credit information grade, the credit information grade has some information effects as the people are confused about the difference between them due to its similarity in the form and that the credit information grade is often used in the bidding made by the public entities such as Public Procurement Service.

The paper is composed of the followings: Chapter 2 describes the prior studies on IPO underpricing and the credit rating. Chapter 3 sets up the hypotheses on the effect of credit rating on IPO underpricing through the provision of information on the company while Chapter 4 explains the empirical analysis model and basic statistics for the verification of the analysis data and hypotheses. Chapter 5 reports the findings from the empirical analysis while Chapter 6 makes the conclusion of the study.

1. Literature review

IPO underpricing is the phenomenon in which the public offering price for the initial public offering is formed at the lower price, widespread worldwide up to date. According to the study by Ritter and Welch (2002), from IPO made during 1980 to 2001 in US, the average revenue was 18.8% compared to the sock price at the date of IPO. This phenomenon was found not only in US but also in Korea as consistently shown in the studies by Kim Eung Han and Lee Young Gi (1988), Kang Hyo Seok (1990), Lee Seong Gyu and two others (1995), Choi Mun Su (1999), Park Gwang U and two others (2007), Lee Jong ryong and Jo Sung Uk (2007). Since Ibbotson (1975) and Ritter (1984) suggested the existence and the cause of the IPO underpricing, there have been a lot of theoretical descriptions on the cause of IPO underpricing such as information asymmetry hypothesis, signaling hypothesis and market making hypothesis. Among them, the information asymmetry hypothesis proposes that IPO underpricing happens due to the information asymmetry among the main stakeholders in IPO such as issuing company, underwriter and investors. Among the theoretical hypotheses on IPO underpricing, the information asymmetry among the stakeholders is considered as the basic and critical cause of the IPO underpricing.

If there is discrepancy of obtained information about IPO Company among the investors, the uninformed investors are more likely to participate in IPO of overestimated pricing than the informed investors. In that case, the general investors may avoid the IPO investment to avoid the winner's curse. According to Rock (1986), the issuing company selects the option of underpricing of new shares to get rid of the problem which may arise from the information asymmetry, induce the general investors to participate in IPO and compensate the general investors for the possible losses. According to Beatty and Ritter (1986), the expected value of the underpriced issue is related to the degree of the uncertainty for the investors. The information which needs the cost for reducing the uncertainty of the corporate value is similar to the call option that its exercising price is IPO price, thus the value of call option will be increased according to the increased uncertainly on the value of the issuing company. Due to the information asymmetry, the higher uncertainly on the value of the issuing company, the lower IPO price investors would ask to enhance the value of call option. Therefore, the IPO underpricing is positively correlated with the investor's uncertainties.

The effect of information asymmetry on the IPO underpricing also means that if the investors are homogenous and they share the corporate value in the capital market in advance, the information asymmetry will be removed and there is less possibility in the occurrence of the winner's curse, thus reducing the cases of IPO underpricing. Michaely and Shaw (1994) argued that as the most institutional investors avoid the investment in MLP (master limited partnership) IPO due to the tax problems, the information on MLP is more widely spread than IPO of the general companies in a homogenous way. Though the level of underpricing in 39 MLP IPOs completed during 1894 to 1988 was just -0.04%, while in non-MLP IPO was 8.5%. Schenone (2004) argued that if the underwriter (bank) has a history of transaction in the past through the related finance prior to IPO, the information asymmetry can be reduced and that would result in the reduction of the level of IPO underpricing. Actually it was found that the companies having the financing performance with the banks prior to IPO showed the reduction in the level of underpricing by 17% in average compared to those having no experience.

As the IPO underpricing caused by the information asymmetry is the significant cost for the issuing company, the companies are tempted to reduce the cost. Habib and Ljunggvist (2001) told that the issuing company would take the actions bearing the cost up to the ultimate expenses reaching the ultimate benefit and that one of the methods is to appoint an underwriter with good reputation in the market. However, there are opposite views of the effect on the underwriter of the high reputation. The studies using the data of 1970s and 1980s (Carter and Manaster 1990, Megginson and Weiss 1991) showed that more reputable underwriters had less underpricing. But the studies based on the data of early 1990s (Beatty and Welch 1996) showed that there is positive relation between the reputation of underwriters and the IPO underpricing. These opposite results may be caused by the fact that the reputation of the underwriter not only reduces the information asymmetry but also makes effect on IPO underpricing in another way. For example, Loughran and Ritter (2004) argued that the underwriter may cause not only principle-agent conflict but also the strategic underpricing due to the investment bank's rent seeking behavior.

On the other hand, the IPO underpricing is related to the information asymmetry in the process of IPO. The underwriter plays a most critical role in deciding on the IPO price and allocating the new issues. The underwriter is tempted to get the private information from the investors in the process of the allocation of new issues (Benveniste and Spindt 1989) and give the preferential allocation of the underpriced new issues to the investors having information to cooperate with them (Gondat-Larralde and James 2008). In addition, Hanley (1993) argued that the range of price adjustment may be considered as a measure for the level of information provided during the demand forecasting process. It can be expected that if the underwriter can effectively obtain the information from the investors in the demand forecasting process or if the information asymmetry between the underwriter and the investors is reduced, the range of price adjustment would be reduced in the demand forecasting process.

According to the prior studies on the hypothesis of information asymmetry, IPO underpricing is caused by the information asymmetry among the transaction participants. It can be inferred in the opposite way that if the information asymmetry among the transaction participants is reduced, IPO underpricing would be less likely to happen. From this point of view, An and Chen (2008) suggested the credit rating as a means of reducing the information asymmetry and they also argued that IPO underpricing was significantly reduced when the credit rating decreased the level of information asymmetry.

The credit rating is the evaluation of company's capability to redeem its own debt securities or to repay its debts and has been studied in information effect perspective with the relation of the company's funding capability. The prior studies showed that the credit rating provided by the issuing company and an independent credit rating agency alleviates the constraining conditions in the capital market which are caused by the information asymmetry and enables the company to access the capital market (Faulkender and Petersen 2005) They also argued that the credit rating also enables other financial institutions except the major bank to participate in IPO, thus making it easy for the company to get funded through the debt (Sufi 2007, 2009) and also acting as a critical parameter in pricing of the debts and making a very critical role in the company's funding and selection of investment. The prior studies on the information effect of the credit rating in the stock market were mainly conducted on the disclosure of the change in the credit rating. The findings in these studies show that the information effect varies depending on the direction of change of credit rating and that when the credit rating is changed to the down direction, it shows the negative return on the stock due to the information (Holthausen and Leftwitch 1986, Hand *et al.* 1992, Goh and Ederington 1993, Jorion and Zhang 2007, and Kim and Narbar 2007). The similar results are obtained in the domestic studies (Ju Sang Ryong 2001, Park Hyun Seop and Song In Man 2005, and Park Hung Jin and Lee Sun Hee 2005). In addition, Kim Tae Gyu (2012) argues that this phenomenon occurs due to the information asymmetry between companies and that the companies with lowered credit ratings have higher information asymmetry than those with raised credit ratings.

2. Hypotheses on the effect of credit rating on the IPO underpricing

The credit rating agencies provide the investors with the independent evaluation on the company's possible insolvency. They also provide the general investors of limited access the information on the capability of redemption of the debts and the general information of the company. In this process, the credit rating agencies reflect the information disclosed in the market and the internal information of the company as well. For example, during the evaluation period, the issuing company provides the credit rating agencies with its own internal information such as the strategic plan, the decision made by the board of directors, the expected performance, and asset sales plan, which in turn are provided to the investors in the form of the credit rating by the credit rating agencies.

In this study, IPO underpricing has been analysed with focus on the information asymmetry existing in the domestic capital market. Therefore, it is expected that the fair and reliable credit rating information on the IPO Company in the capital market can alleviate the information asymmetry and reduce the level of IPO underpricing. For this purpose, the first hypothesis is that the credit rating and IPO underpricing have the positive relation. When this first hypothesis is tested, the test would be also conducted to find out the additional information effect according to the type of credit rating (for corporate bond, CP, asset backed securities and ICR (issuer credit rating) and the credit rating agencies (NICE Investors Service Co., Korea Investors Service Inc, Korea Ratings and SCI Rating Information Inc) during the IPO process.

Hypothesis 1: The company evaluated credit rating prior to IPO is less likely to have underpricing owing to the reduced information asymmetry than those with no credit ratings.

When the Hypothesis 1 is tested, the effect of the credit information grade evaluated by the credit researching company would be analysed. The credit information grade is the credit information data of the companies prepared by the companies which are permitted to do the credit searching business according to "Act on the Use and Protection of Credit Information" (such as NICE Information Service, Nice Dun & Bradstreet, Korea Enterprise Data, Ecredible Co., Ltd, SCI Rating Information Inc. Even though there are a lot of differences between the credit information data and credit rating, the information users have difficulty in distinguishing one form the other as they are displayed in the same or similar marks. Though it is hard to consider the information effect of the credit information grade as the same with the credit rating, it is noteworthy as most of the companies preparing IPO have not got the credit rating but have just the credit information grade which can be used for the bidding in the public entities such as Public Procurement Service.

In case of the existence of the credit rating affecting IPO underpricing, its effect on the relation between IPO underpricing and the level of credit rating is additionally analysed. The prior studies indicate that the cause of IPO underpricing is the information asymmetry, which argues that what affects the IPO underpricing is not the size of the values but the uncertainty on the values. As the credit rating indicates the financial stability and reliability of a company, the level of credit rating can have effect on the value of the target company. However, once the credit rating is granted, it does not affect the variability of the value of IPO Company. In this study, the second hypothesis is whether the level of credit rating provides other information on the variability of the company's value in the IPO market.

Hypothesis 2: The level of credit rating would not affect underpricing; for the information asymmetry explaining the cause of IPO underpricing is affected by whether the credit rating is owned or not, while it is not affected by the level of the credit rating itself.

On the other hand, the underwriter conducts the research on the demand for and the market price of the new issues from IPO and tries to get the information on the true value of the company from the investors. Considering this, it can be said that the level of the price adjustment to be conducted based on the collected information is the measure for the alleviation of the information asymmetry. The third hypothesis is that the credit rating affects not only the final IPO underpricing but also all process in the IPO. If the credit rating is used to alleviate the information asymmetry in the process of IPO, the range of the price adjustment to be made during the demand forecast would be bigger for the companies with no credit ratings than companies with credit ratings.

Hypothesis 3: The range of the IPO price adjustment would be reduced for the companies with the credit ratings; for given that the IPO price is decided by the range of the suggested price for the public offering and the analysis of the investor's demand, the information asymmetry may be reduced during the process of finalizing IPO price depending on whether the company gets the credit rating or not.

3. Data and analysis method

Data

For the analysis of the effect of the credit rating on IPO underpricing, this study selected 706 IPO companies from the companies in financial business and SPACs (Special Purpose Acquisition Company) newly listed on Korea stock exchanges such as KOSPI and KOSDAQ from 2002 to 2014. As reported in (Table 1), there are 134 companies obtained the credit rating among 706 companies from the research of domestic credit rating agencies such as NICE Investors Service Co., Korea Investors Service Inc, Korea Ratings and SCI Rating Information Inc.

Table 1. Current status of the credit ratings of IPO companies

Year	Quantity of targeted IPO companies	IPO companies with credit ratings	
		Quantity	Share (%)
2002	96	3	3.1
2003	52	6	11.5
2004	41	9	22.0
2005	63	11	17.5
2006	49	3	6.1
2007	62	11	17.7
2008	35	4	11.4
2009	56	14	25.0
2010	70	17	24.3
2011	69	23	33.3
2012	26	13	50.0
2013	38	9	23.7
2014	49	11	22.4
TOTAL	706	134	19.0

Source: Authors' calculation

For the selection of samples, the security issue performance report, security report, and prospectus were reviewed from DART (Data Analysis, Retrieval and Transfer System) and the date of the listing, the band of public offering prices (high and low), public offering price, total number of listed shares, and number of new issues were collected. The share price, return ratio and accounting data (such as total assets, sales, operating profit, net profit, fixed assets and R&D cost of the samples were collected from DataGuide provided by FnGuide. The information on the credit rating issued in one year advance to the date of listing (including date of evaluation, person in charge of evaluation, evaluation grade, name of securities and credit rating, etc.) were collected from TS 2000 provided by Korea Listed Companies Association. To classify the credit rating for 134 companies in our sample, we report the credit rating companies that issued the ratings in (Table 2).

Table 2. Classification of credit rating

Explanatory variables	NICE Investors Service Co	Korea Investors Service Inc	Korea Ratings	Others
Corporate bond	30	17	17	1
CP	19	16	12	0
ICR	20	8	15	11
ABS	37	5	29	17
Total	106	46	73	29

Source: Authors' calculation

Selection of variables and theoretical background

In this study, the factors which affect the IPO underpricing are analysed and the underprice is the dependent variable measuring the level of IPO underpricing and is calculated as portion of opening price compared by offering price. The method of opening pricing has been changed in KOSDAQ from Oct. 1999 and in KOSDAQ from July 2000; the opening price at the date of IPO is decided by synchronized bidding price in the range of 90% to 200% of offering price. On the other hand, Credit Rating Dummy (CRD) is the most core explanatory variable in the study and it is also the dummy variable to represent the existence of the credit rating, also is the dependent variable to analyse the possibility of getting credit rating for Heckman treatment effect model at the same time. Under the hypothesis 1, in which the credit rating would reduce the level of information asymmetry and thus lowers the level of IPO underpricing, the expected coefficient of CRD is expected to be the negative (-) value.

The prior studies on the IPO showed that the explanatory in IPO underpricing is made up with the factors which affect IPO underpricing such as the company's characteristics, the characteristics of IPO issuing market and market. Ritter (1984), Loughran and Ritter (2004) argued that the older companies are more likely to be widely known in the capital market and that they are less inclined to the underprice. At this time, as the reputation is not increased in a linear way proportional to the potential of company, the LOGAGE (log(1+AGE)) was adopted to control the effect of company's potential.

Leverage indicates the level of debts for a company. Denis and Mihov (2003) argued that the existing debts mean the reputation of a company in the capital market. It was also found that companies of higher debt ratio more tend to use public offering (bonds) market. LOGSALE is the log value for the net sales in the year prior to IPO, which indicates the size of the company. According to Ritter (1984) and Arugaslan et al. (2004), the bigger sized companies are less likely to face the information deficiency in the market and also less likely to have IPO underpricing. KOSDAQ dummy is the dummy variables showing whether a company is quoted in the KOSDAQ. If a company is quoted in KOSDAQ, it is marked as 1. As the requirement of listing on the KOSPI is stricter than KOSDAQ, the companies quoted on KOSDAQ are smaller in size and has higher variability than companies listed in KOSPI, which resulted in higher information asymmetry. It is expected that the KOSDAQ companies are more likely to get IPO underpricing than KOSPI companies.

In this study, not only the characteristics of a company but also the IPO characteristics which affect the underpricing were controlled as the explanatory variables. The revision, which is the revision ratio for the IPO price means the ratio of update (revision) for the demand forecast period. It can be calculated as the ratio of offer price to the average initial filling price. Hanley (1993) discovered that there is the positive correlation between the revision public offering price and underpricing. This is called as the partial adjustment and it appears when the companies intentionally issue the new shares at underprice to show the positive information to the investors having information. In this study, the average in IPO public offering price band would be distinguished from the median in IPO demand forecast which is subsequently proposed to forecast the demand for the professional investors for the analysis of the effects. Log (Proceeds) is the explanatory variable for controlling the size of IPO issues and is obtained by logarithm of total revenue from IPO. Beatty and Ritter (1986) discovered that the companies having more IPO revenues are less likely to get the underprice, which is consistent with the expectation that the companies having smaller revenue in IPO would be more speculative than companies having larger revenue in IPO. Float was obtained in the ratio of number of new shares from IPO over the number of total shares issued. The bigger float value is more likely to cause the fewer shares. So, as the scarcity of the shares would prevent the investors from shorting, the float is expected to show the negative relation with IPO underpricing. The definition of each variable is reported in the following (Table 3).

Table 3. Summary of variables

Variable	Definition
Credit rating dummy	If the sample company has the credit rating 1 year prior to the date of listing, it is 1. If not, it is 0.
Underprice	It measures IPO underpricing. $\text{Underprice} = \left(\frac{initial\ price\ on\ the\ date\ of\ IPO\ listing}{IPO\ price} - 1\right) \times 100$
Revision (Offer)	Revision rate of IPO price $\text{Revision(Offer)} = \left(\frac{IPO\ price}{Average\ in\ he\ IPO\ price\ band} - 1\right) \times 100$
Revision (Bid)	Revision rate of IPO price $\text{Revision(Bid)} = \left(\frac{IPO\ price}{Median\ in\ the\ IPO\ demand\ forecast} - 1\right) \times 100$
Leverage	Debt ratio

Variable	Definition
	$\text{Leverage} = \left(\frac{Total\ debts}{Total\ assets}\right) \times 100, year\ immeidately\ prior\ to\ IPO$
Age	Year of foundation– Year of listing; the sample company
KOSDAQ dummy	If the sample company is quoted on KOSDAQ, it is 1. If not, it is 0.
Log(Sales)	It is the log value of the sales in the year immediately prior to IPO.
Log(Proceeds)	It is the log value of the total revenues from IPO.
Float	It is the ratio of new issues from IPO to the total issues $\text{Float} = \left(\frac{Number\ of\ new\ shares\ from\ IPO}{Total\ shares}\right) \times 100$
Lagged market return	It is the market return during 20 days prior to the date of IPO listing. At this time, the market return is decided based on the KOSPI index for the KOSPI company or on KOSDAQ index for KOSDAQ company.
Growth	Growth rate $\text{Growth} = \left(\frac{R\&D\ expenses}{Sales}\right) \times 100$
Industry fraction	Rate of holding the credit rating in the same industry (Korea Standard Industry Classification Code 9 (Large classification)
Tangibility	Fixed asset ratio $\text{Tangibility} = \left(\frac{Fixed\ assets}{Total\ assets}\right) \times 100, year\ immediately\ prior\ to\ IPO$
Profit	Profit ratio $\text{Profit} = \left(\frac{Operting\ profit}{Total\ assets}\right) \times 100, IPO\ year\ immediately\ prior\ to\ IPO$

Table 4 summarizes the key variables for the samples. The underpricing on the date of listing were 41.17% in average, which is significant as shown in the prior studies. It was disclosed that among 706 IPO companies used as samples, 19% of them had their own credit ratings and 86% of them were quoted on KOSDAQ. The lagged market return which shows the market situation prior to the date of listing was 0.53% in average. The REVISION is the revision rate of the IPO price showing the updated (revised) rate during the demand forecast period. Though revision (offer) and revision (bid) were found to be opposite in average, their medians were found to be similar to each other and are more variable based on the band of the IPO price than the demand forecast.

Table 4. Summary statistics

Variable	Quantity	Average	Median	Standard deviation	1/25 value	1/75 value
CRD	706	0.19	0.00	0.39	0.00	0.00
Under price	706	41.17	32.24	39.26	6.17	76.92
Revision(Offer)	706	-0.72	2.33	14.51	-9.09	9.09
Revision(Bid)	608	2.10	2.70	10.84	-3.68	8.68
Leverage	706	42.54	42.66	17.61	28.95	55.16
Age	706	12.38	10.00	9.35	6.00	15.00

Variable	Quantity	Average	Median	Standard deviation	1/25 value	1/75 value
KOSDAQ dummy	706	0.86	1.00	0.35	1.00	1.00
Log(Sales)	706	17.58	17.42	1.28	16.77	18.14
Log(Proceeds)	706	16.35	16.24	1.09	15.61	16.88
Float	706	25.14	25.00	10.60	20.01	30.00
Lagged market return	706	0.53	0.52	7.51	-3.83	4.91
Growth	706	2.53	0.33	14.89	0.00	2.23
Industry fraction	706	18.84	19.64	5.66	19.64	19.64
Tangibility	706	27.32	25.14	19.29	11.69	40.92
Profit	706	18.03	15.96	11.20	10.53	23.83

Source: Authors' calculation

Empirical models

In this study, for the analysis of the credit rating on IPO underpricing or IPO pricing, the level of the underpricing on the date of IPO was measured. Then, the factors affecting the underpricing and whether the company holds the credit rating are deemed as the explanatory variables as described before and the following regression formula can be used as below:

$$Underprice_i = \alpha + \beta \cdot X_i + \gamma \cdot CRD_i + \varepsilon_i \quad (1)$$

If γ is the estimate of OLS from the regression formula above and it is to be an unbiased estimate, whether the companies hold the credit rating (CRD) shall be independent from the potential IPO pricing and shall be randomly decided. However, the companies make their own decision on holding the credit rating as it incurs expenses; the decision on holding credit rating is made only when the benefit from it exceeds the cost of getting it. If the estimation is made using the regression formula (1) for all samples, the sample selection bias occurs. The Heckman selection model was used to solve this problem. For this, as stage 1, Probit model is used to estimate the probability of holding credit rating for all sample companies and then as stage 2, the regression formula specified as (1) was used to estimate the level of IPO underpricing which is revised of selection bias.

$$CRD_i^* = \omega \cdot Z_i + \eta_i \quad (2)$$

where $CRD_i = 1 \; if \; CRD_i^* > 0$ and $CRD_i = 0 \; if \; CRD_i^* < 0$,

The characteristics of the company influencing whether it is holding credit rating can equally affect the IPO pricing. In addition, as some variables are not observed, they can be included in the residual in two regression formulas (1) and (2). In this case, the correlation between two residuals can cause the endogeneity in (1) and CRD_i has the correlation with ε_i. Using the Probit regression analysis, ω estimate can be obtained. Based on whether the company has a credit rating, the self-selective adjustment factor of λ or inverse Mills ratio is estimated as below.

$$\hat{\lambda}_i = \frac{\phi(\hat{\omega} \cdot Z_i)}{\Phi(\hat{\omega} \cdot Z_i)} \text{ if } CRD_i = 1 \quad (3)$$

$$\hat{\lambda}_i = \frac{-\phi(\hat{\omega} \cdot Z_i)}{1 - \Phi(\hat{\omega} \cdot Z_i)} \text{ if } CRD_i = 0$$

where Φ and φ show the cumulative distribution function and probability density function of standard normal distributions, respectively.

4. Results of empirical analysis

The Effect of holding credit rating on the IPO underpricing

Like IPO underpricing in other countries, IPO underpricing found in Korea is mainly caused by the information asymmetry in the capital market to a certain extent. (Hypothesis 1) says that if the credit rating data which is fair and reliable for the target company is supplied to the capital market, the information asymmetry can be alleviated in IPO process of that company, thus reducing the IPO underpricing.

Table 5. Probability of holding a credit rating

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	-1.3986	-1.1930	-7.6560	-0.8436	-1.6127	-1.0050	-0.7192	-7.5856
	(-9.21)	(-12.91)	(-9.02)	(-13.69)	(-6.98)	(-10.34)	(-6.97)	(-7.97)
Leverage	0.0118							0.0004
	(3.74)							(0.009)
Age		0.0238						0.0052
		(4.34)						(0.78)
Log(Sales)			0.3811					0.3516
			(8.03)					(6.14)
Growth				-0.0189				0.0028
				(-1.11)				(0.52)
Industry					0.0382			0.0185
Fraction					(3.29)			(1.61)
Tangibility						0.0045		-0.0005
						(1.59)		(-0.14)
Profit							-0.0091	0.0013
							(-1.79)	(0.21)
CRD = 0	572	572	572	572	572	572	572	572
CRD = 1	134	134	134	134	134	134	134	134
Pseudo-R^2	0.0208	0.0274	0.1097	0.003	0.0199	0.0037	0.0048	0.1159

Source: Authors' calculation

It is sums up the effects of the credit rating on the IPO underpricing through Heckman treatment effect model by Table 6. It shows that the companies holding the credit ratings are less likely to get IPO underpricing than those with no credit ratings. It was found out that if the case of log (sales) and log (proceeds) as independent variables is excluded from Table 5, the credit rating dummy has the significantly meaningful negative value. This is caused by the reduction in the information asymmetry when the size of a company is big or its IPO size is big. It shows that holding of credit rating affects the reduction of information asymmetry.

The credit ratings provided by the credit rating agencies are composed of corporate bond, CP (commercial paper), ABS (asset backed securities), ICR (issuer credit rating) and others. The analysis was additionally made to find out whether the type of credit rating which a company holds affects IPO underpricing.

Table 6. Effect of holding credit rating on IPO underpricing

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11
Intercept	47.0101*** (21.62)	46.6279*** (22.97)	35.7268*** (5.73)	48.4123*** (22.88)	48.3124*** (20.79)	41.3308*** (6.75)	53.3086*** (11.95)	193.4242*** (6.43)	124.612*** (3.52)	39.5944*** (3.99)	353.9087*** (9.18)
Credit rating dummy	-30.7839*** (-3.79)	-*** 33.6586 (-4.52)	-13.9 (-0.74)	-*** 35.9102 (-4.61)	-*** 35.3071 (-3.92)	-** 24.0333 (-2.21)	-** 25.0307 (-2.10)	-72.7655 (-1.18)	- 71.8217 (-1.15)	-*** 42.2076 (-4.81)	45.2338 (0.83)
Lagged market Return		1.789*** (8.84)								1.6523*** (8.43)	1.6262*** (8.65)
CRD*Lag Rm		-0.0971 (-0.20)									
Log(Age)			4.903* (1.88)							4.3504* (1.74)	3.8322 (1.53)
CRD*Log(Age)			-7.3106 (-1.24)								
Revision(offer)				0.6965*** (6.47)						0.5424*** (5.08)	0.7475*** (6.87)
CRD*Revision (Offer)				0.2019 (0.77)							
Revision(Bid)					0.407** (2.44)					0.2166 (1.59)	0.0879 (0.66)
CRD*Revision (Bid)					0.1124 (0.34)						
KOSDAQ dummy						5.7698 (1.01)				3.8219 (0.76)	-4.9004 (-0.96)
CRD*KOSDAQ						-4.3802 (-0.47)					
Float							-0.2512 (-1.63)			-0.1347 (-0.95)	0.0346 (0.26)
CRD*Float							-0.2399 (-0.66)				
Log(Proceeds)								-9.3072*** (-4.84)			-13.189*** (-6.78)
CRD*Log (Proceeds)								4.267 (1.34)			
Log(Sales)									-4.6189** -2.14		-6.3553*** (-3.26)
CRD*Log(Sales)									3.2424 1.15		0.4559 (0.16)
N	706	706	706	706	608	706	706	706	706	608	608
Chi-sq	14.39	108.32	18.55	71.49	26.07	14.73	19.47	38.02	18.45	146.17	(259.00)

Source: Authors' calculation

Note: ***, **, and * indicate statistically significant at the 1%, 5%, and 10% levels, respectively.

Table 7 reports the results when the dummy variables are added for each type of credit rating. They showed that holding of the crediting rating has effect on the IPO pricing but the dummy variable for each type of credit rating does not affect the IPO pricing. It means that the information asymmetry is removed by credit rating but the

difference in the type of credit rating does not give any effect. It can be considered that if the disclosure data and internal date of a target company is provided to the capital market and the credit rating is provided to the capital market through the analysis of the credit rating agency, the investors in the market considered that the information asymmetry for the company is removed to a certain level regardless of the type of the credit rating.

Table 7. Difference in the type of the security for credit evaluation

Variable	Bond	CP	ABS	Issuer Rating
Intercept	40.2197***	40.0931***	40.8189***	38.8664***
	(4.02)	(4.02)	(4.06)	(3.91)
Credit rating dummy	-40.7212***	-40.8217***	-44.2666***	-38.4349***
	(-4.38)	(-4.34)	(-4.87)	(-4.25)
Lagged market return	1.6549***	1.6512***	1.6455***	1.6406***
	(8.44)	(8.42)	(8.39)	(8.37)
Log(Age)	4.2722*	4.2980*	4.1636*	4.4479*
	(1.71)	(1.72)	(1.65)	(1.76)
Revision(Offer)	0.5401***	0.5402***	0.5429***	0.5559***
	(5.06)	(5.06)	(5.09)	(5.20)
Revision(Bid)	0.2162	0.2198	0.2171	0.2206
	(1.58)	(1.61)	(1.59)	(1.62)
KOSDAQ dummy	3.4550	3.4220	3.2492	4.5601
	(0.68)	(0.67)	(0.64)	(0.90)
Float	-0.1429	-0.1413	-0.1427	-0.1255
	(-1.01)	(-1.00)	(-1.01)	(-0.89)
Security type dummy	-4.3979	-5.0580	5.4357	-9.4969
	(-0.55)	(-0.46)	(0.77)	(-1.38)
N	608	608	608	608
Chi-sq	146.1	146	147.37	150.23

Source: Authors' calculation

Note: ***, **, and * indicate statistically significant at the 1%, 5%, and 10% levels, respectively.

In addition, the analysis was performed to find out whether the different credit rating agency affects IPO underpricing. This analysis was designed to find out whether the different credit rating agency makes any difference in the IPO market because the reliability of the credit rating may vary for each credit rating agency. (Table 8) shows whether the different creating rating agencies (NICE Investors Service Co., Korea Investors Service Inc, Korea Ratings) make the different effect on IPO underpricing. NICE, KIS, and KR are the major credit rating agencies in Korea so we put the dummy variable for the credit rating from these agencies separately and add the dummy variables in the regression model. Thus, the coefficients show the difference of the effect from each major agency against credit ratings from other institutes. As we can see in (Table 8), however, the coefficients of NICE, KIS, and KR dummy variables are not statistically significant except Issuer ratings from NICE which is marginally significant. Also, as reported in the last row, there was no different effect of credit ratings between these major agencies. Thus, we suggest that having the credit rating itself would affect the IPO underpricing but investors would put much attention to the agency who issued the ratings.

Table 8. Difference for the credit rating agencies

Variable	All	Bond	CP & ABS	Issuer Rating
Intercept	240.314***	96.782	304.426***	279.866**
	(4.73)	(1.14)	(3.38)	(2.28)
NICE dummy	8.183	-14.410	-3.052	20.260*
	(1.10)	(-0.57)	(-0.23)	(1.70)
KIS dummy	4.503	-27.745	-0.531	16.653
	(0.49)	(-1.06)	(-0.04)	(0.79)
KR dummy	0.756	-20.686	-5.126	7.249
	(0.10)	(-0.81)	(-0.37)	(0.56)
Lagged market return	2.110***	0.772	2.795***	2.215***
	(5.62)	(1.29)	(3.48)	(3.39)
Log(Age)	0.409	3.420	-3.574	-0.281
	(0.10)	(0.68)	(-0.48)	(-0.03)
Revision(Offer)	1.143***	0.557	1.591***	0.959**
	(5.13)	(1.15)	(3.83)	(2.61)
Revision(Bid)	0.079	0.614**	-0.394	-0.185
	(0.37)	(2.44)	(-0.87)	(-0.37)
KOSDAQ dummy	-10.944	26.331*	-25.149	-21.101
	(-1.25)	(1.70)	(-1.58)	(-1.33)
Float	0.158	1.228**	0.300	-0.110
	(0.65)	(2.41)	(0.69)	(-0.27)
Log(Proceeds)	-14.839***	-23.102***	-14.621**	-14.523**
	(-4.10)	(-4.02)	(-2.15)	(-2.06)
Log(Sales)	2.293	16.275***	-0.047	0.273
	(0.68)	(2.99)	(-0.01)	(0.04)
N	183	44	65	74
Adj R^2	0.368	0.551	0.4872	0.1603
test NICE = KIS (F-value)	0.29	2.29	0.07	0.03
test KIS = KR (F-value)	0.26	0.53	0.19	0.20

Source: Authors' calculation
Note: ***, **, and * indicate statistically significant at the 1%, 5%, and 10% levels, respectively.

The Effect of the level of credit rating on IPO underpricing

In the analysis above, we can understand that the existence of the credit rating can reduce the level of information asymmetry for a company and thus can reduce the IPO underpricing in the domestic market. But, it was found out that the type of credit rating and the credit rating agency does not make any significant difference in IPO underpricing. In this study, the analysis was additionally made whether the level of credit rating makes any effect on IPO underpricing by fragmenting the credit rating. This analysis was conducted because the difference in the level of credit rating has been significantly taken into account in the decision making on the investment in the capital market. Prior studies showed that the information asymmetry which makes effects on IPO underpricing, is related to the uncertainty about the value of the companies but is not related to the absolute value of the company. So, we can expect that the information asymmetry explaining IPO underpricing through Hypothesis 2 is just affected by the existence of credit rating not by the difference in the type and quality of the credit rating.

Table 9 shows the credit rating level for each kind of security, which is provided by each credit rating agency for the period of at least 1 year prior to the IPO date for the target companies. In this table, more than one credit rating agency are allowed to evaluate the credit ratings to the same company. NICE seems to be the most active credit rating agency in Korea as they issue the most issues in all kind of securities. However, this dominant is not due to any possible optimistic bias of credit ratings from NICE. As indicated in (Table 9), there seems to be no optimistic biases from a certain agency at all. The distribution of credit rating levels is pretty much the same for all agencies.

Table 9. Credit rating level for each kind of security provided by each credit rating agency for the period of at least 1 year prior to the IPO date for the target companies

Rating	CR level	Bond				ABS				Issuer Rating			
		NICE	KIS	KR	Other	NICE	KIS	KR	Other	NICE	KIS	KR	Other
AAA	19	0	0	0	0	0	0	0	1	0	0	0	0
AA+	18	1	0	1	0	0	1	1	0	1	0	0	0
AA	17	1	1	1	0	2	0	0	0	6	0	1	1
AA-	16	4	3	3	0	0	0	0	0	3	0	3	0
A+	15	7	5	3	0	2	2	2	1	3	1	2	2
A	14	5	2	2	0	4	2	3	1	7	1	6	3
A-	13	2	2	3	1	2	0	2	2	4	0	3	1
BBB+	12	3	1	2	0	2	2	2	0	1	1	3	0
BBB	11	1	0	0	0	2	1	0	2	3	1	2	4
BBB-	10	3	0	2	0	2	0	2	0	5	1	3	2
BB+	9	0	2	0	0	3	0	1	1	2	0	2	1
BB	8	2	0	0	0	1	0	2	1	2	0	2	2
BB-	7	0	0	0	0	0	0	0	1	0	0	0	1
B+	6	0	0	0	0	0	0	0	1	0	0	1	0
B	5	0	0	0	0	0	0	0	0	0	0	1	0
B-	4	0	0	0	0	0	0	0	0	0	0	0	0
CCC	3	1	1	0	0	0	0	0	0	0	0	0	0
CC	2	0	0	0	0	0	0	0	0	0	0	0	0
C	1	0	0	0	0	0	0	0	0	0	0	0	0
N		30	17	17	1	20	8	15	11	37	5	29	17

Source: Authors' calculation

Table 10 shows the results of the analysis on the effect of credit rating level on IPO underpricing for 133 companies, which show that the credit rating level does not make any difference on IPO underpricing. This result shows that the IPO underpricing is mainly affected by the information asymmetry based on the uncertainty of the value of the company. So, if the uncertainty on the value of the target company is reduced by the credit rating, IPO underpricing is less likely to occur regardless of the size of the value of the company.

Table 10. The effect of the credit rating level on IPO underpricing

Variable	All	Bond	CP	ABS	Issuer Rating
Intercept	93.1835	44.3789	140.0837	181.4073	124.1220
	(1.46)	(0.78)	(1.66)	(1.57)	(1.17)
Credit rating level	1.4643	1.4082	-0.9422	2.9807	1.7438
	(1.29)	(0.81)	(-0.32)	(1.62)	(1.19)
Lagged market return	1.4068***	1.2231*	0.6850	2.1922***	1.3445**
	(3.03)	(1.70)	(0.45)	(3.10)	(2.24)
Log(Age)	-5.3830	6.7199	-0.9385	-12.6229	-10.7905
	(-0.99)	(1.15)	(-0.11)	(-1.34)	(-1.38)

Variable	All	Bond	CP	ABS	Issuer Rating
Revision(Offer)	0.8026***	0.7212	1.6930***	0.8614**	0.8311***
	(3.26)	(1.56)	(3.76)	(2.35)	(2.75)
KOSDAQ dummy	3.7313	14.0963	-27.5342	0.4266	-1.8541
	(0.33)	(0.99)	(-1.07)	(0.02)	(-0.12)
Float	-0.4933	-0.0897	0.0972	-1.4746**	-0.6090*
	(-1.61)	(-0.24)	(0.22)	(-2.34)	(-1.67)
Log(Sales)	-2.7937	-3.0726	-4.9726	-5.5897	-3.7519
	(-0.91)	(-1.14)	(-1.35)	(-1.06)	(-0.71)
N	133	65	47	54	88
Adj R^2	0.1668	0.1552	0.2278	0.4267	0.1291

Source: Authors' calculation

The Effect of the existence of credit rating on the adjustment rate of IPO price

The IPO price is decided by the IPO price suggested based on the corporate value and the analysis of investor's demand. It is expected that if there is a lot of information asymmetry, the adjustment rate of the public offering price can be big in the process prior to the decision same as the final IPO underpricing level. On the contrary, if the credit rating is kept, the information asymmetry can be removed in the decision making process on the offer price. Thus, in case of the company having the credit rating, the adjustment rate of the offer price would be reduced during the demand forecast period.

Table 11 shows the result of the analysis of Heckman treatment effect model which use the REVISION (offer) as the dependent variable instead of IPO underpricing. It shows that if a company retains the credit rating, there is less adjustment in the public offer price. Especially, if a company has the credit rating of bond and ABS, its adjustment in the public offer price is less likely to occur. However, it was found that the existence of credit rating of CP and issuer rating does not make any significant effect on the adjustment of the public offer price.

Table 11. The Effect of the existence of the credit rating on the adjustment in the IPO price

Variable	All	Bond	CP	ABS	Issuer Rating
Intercept	-48.2671***	-48.3714***	-11.8537	-48.3747***	-10.9107
	(-4.08)	(-4.09)	(-0.79)	(-4.08)	(-0.82)
Credit rating dummy	-18.9647***	-18.8457***	6.8891	-18.8744***	5.2421
	(-8.04)	(-7.67)	(0.88)	(-7.72)	(0.91)
Lagged market return	0.2818***	0.2821***	0.2904***	0.2821***	0.2970***
	(3.98)	(3.98)	(4.04)	(3.98)	(4.14)
Log(Age)	0.6161	0.6055	0.0467	0.6279	0.0425
	(0.63)	(0.62)	(0.05)	(0.64)	(0.05)
KOSDAQ dummy	1.6443	1.6151	2.5229	1.6739	2.3964
	(0.86)	(0.84)	(1.23)	(0.87)	(1.18)
Float	-0.0533	-0.0540	-0.0645	-0.0530	-0.0658
	(-1.04)	(-1.05)	(-1.22)	(-1.04)	(-1.25)
Log(Sales)	2.8138***	2.8235***	0.5166	2.8165***	0.4546
	(4.46)	(4.46)	(0.60)	(4.46)	(0.61)
Security type dummy		-0.4692	-2.2385	-0.3282	4.9583*
		(-0.18)	(-0.58)	(-0.14)	(1.89)
N	706	706	706	706	706
Chi-sq	86.95	86.81	24.77	87.03	28.76

Source: Authors' calculation

Conclusion

The credit rating is an indicator showing the capability of a company to repay its debt securities. It is one of the sources which can provide the investors with the critical information on the companies in the capital market. This study found out that the credit rating has the role of informing the investor of the company's repayment capability and the information effect on the company's value as well, which result in additional effect of the credit rating would affect IPO underpricing.

The analysis was conducted on the newly listed companies in Korean Exchange from 2002 to 2014 (except the financial companies and SPACs) to find out whether the existence of the credit rating would affect the company's IPO pricing. The findings showed that the company which has the credit rating is less likely to get IPO underpricing. In addition, it was found out that the company holding the credit rating is less likely to get the adjustment in the IPO price during the demand forecast period same as the final IPO underpricing. The same results also applied to the credit information grade, which implies that the consistent IPO underpricing in Korean IPO market is caused by the information asymmetry to a certain extent and that the third party organizations such as credit rating agencies may have alleviated the level of the information asymmetry to reduce IPO underpricing.

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Strategic Management of High Technology Company Development based on Cloud Space Architecture

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Abstract:

High technology company development is focused on deep penetration of applied research, experimental and production activities in shared business processes, and ensuring sustainable growth of their scientific and technical level. Effectiveness of implementing the system of strategic management of company development is based on the organization of adaptation processes and subsequent adjustment of the strategic development program at all life stages of the product of high technology company in accordance with requirements of varied environment changes. Organization of the implementation process of the system is realized by developing an integrated model of interaction between structural elements in temporary space. In order to ensure the adaptation process of the strategic management system cloud space architecture is formed, in which information sources, information space field and disseminating information conditions could be defined.

Keywords: high technology company; strategic management; innovative development; research activities

JEL Classification: L10; M11, M15

1. Introduction

In the conditions of development of innovative economy, the primary is given to the process of achieving conditions for sustainable growth of scientific-technical and technological potential, which leads to a high demand in the establishment and operation of companies, focused on the development and production of high technology products. Specific features of these companies are the conditions for the creation of technology intensive, unique product by integrating research and production activities.

The effect of the uniqueness of science-intensive product in high-tech markets has a very short time frame that directs management activities on creating conditions of effective interaction of industrial, technological, innovative and organizational structures, in accordance with the dynamic development of research activities, providing a high level of economic efficiency and competitiveness of high technology company in the long term.

In this context, a priority role is given to the processes of strategic management, able to ensure sustainable growth in conditions of realization of prospective lines of development and achievement of strategic goals (Aniskin, Zhmaeva, and Ivanus 2012).

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The operation of high technology company is focused on deep penetration of applied research, experimental and production activities in shared business processes, and ensuring sustainable growth of their scientific and technical level with continuous adaptation to varied environment changes.

An important factor in the development of high technology company is the organization of effective system of strategic management aimed at achieving competitive advantages through targeted orientation of research and their transformation into a unique final product.

2. Strategic management of high technology company development

2.1 Structure of the system of strategic management of high technology company development

Points of coordination of operational and strategic management options have great significance at the present stage. A research of the current state and prospects for the development of domestic high-tech market allows making a conclusion that the lack of effective system of strategic management of high technology company development is a significant obstacle for high technology company operating (Aniskin, Zhmaeva, and Ivanus 2012).

The system of strategic management is characterized as a complex of methodological, organizational and intelligential management solutions of high-technology companies, focused on achievement of strategic development goals through elaboration of company development strategy and implementation of the program of strategic development of high technology company (Khrustaleva (Kurbatova) 2013).

Formation of system of strategic management of high technology company development is based on analysis of interaction between key factors of strategic development in conditions of continuous varied environment changes (Tompson 2015). Herewith a mechanism of making and implementing management decisions that are applicable to some long-term program elements, concepts, strategies of development of high technology company is processed. The main elements of the system of strategic management are:

- formation of strategic values for the development of high technology company;
- strategic choice of priority guidelines of the development;
- generation of high technology company development strategy;
- strategic evaluation of external and internal environment;
- high technology company development strategy realization program;
- formulation of adapting procedures and adjustment of the development strategy in varied external environment changes;
- strategic change in the company;
- resource base establishment for strategy realization.

The system of strategic management of high technology company development is focused on providing of continuous technology development, effective research activity arrangement and increase sensibility to innovations of business units of the company, which is involved in science-intensive product research and development:

- establishing of common innovative business culture;
- forming of managers' interest in the results of the project;
- generating of innovation management system and regulations in the company;
- forming of the resource base of knowledge-intensive projects;
- providing the connection between project and common business strategy of the company;
- establishing of knowledge management system in the company.

2.2 Adaptation of strategic management of high technology company development based on cloud space architecture development

Effectiveness of implementing the system of strategic management of company development is based on the organization of adaptation processes and subsequent adjustment of the strategic development program at all life stages of the product of high technology company in accordance with requirements of varied environment changes.

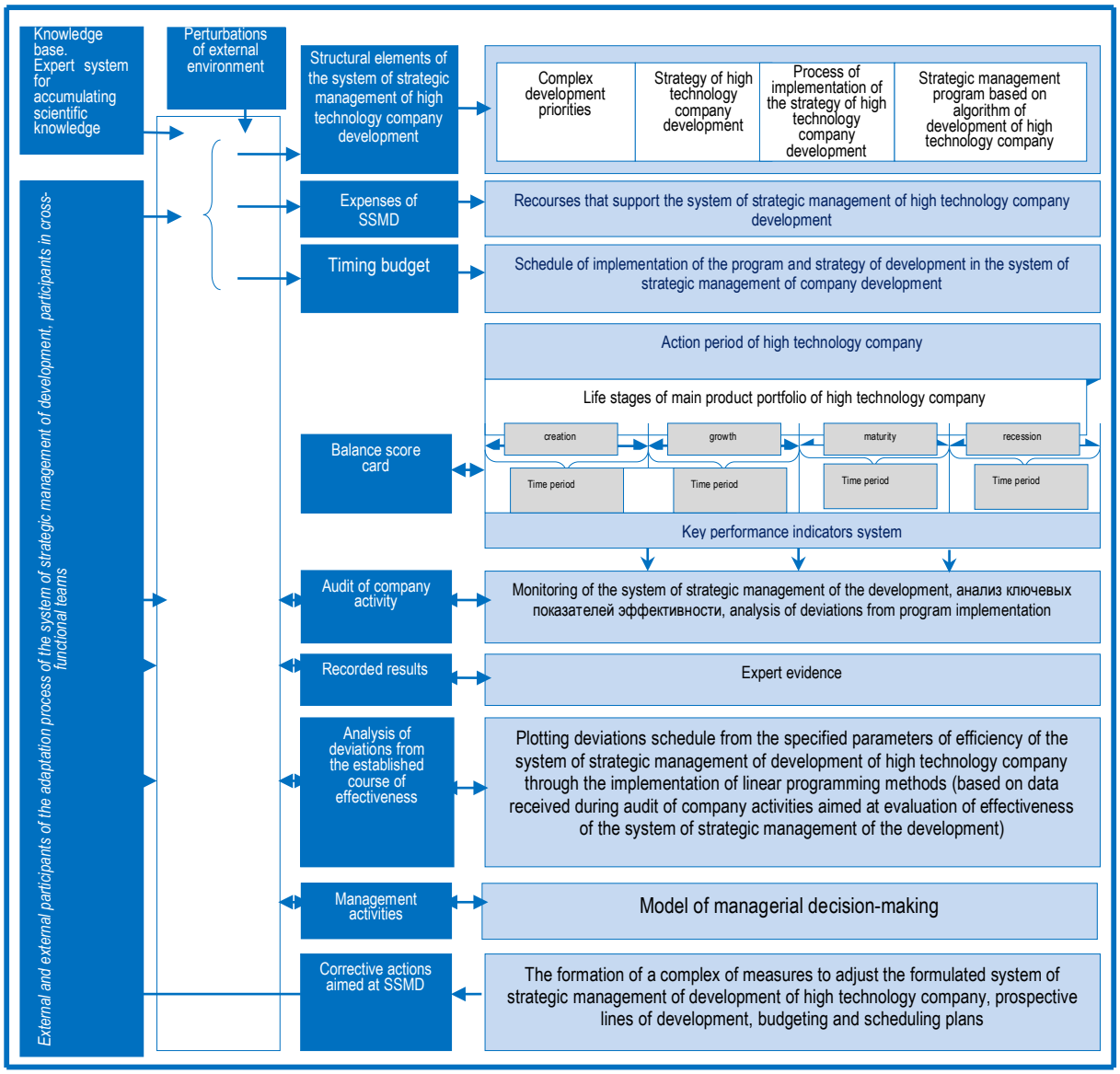
Taking into account specific character of high technology company operating, its focus on high tech market, it is desirable to orient the system of strategic management of company development towards realization of

adaptive changes during all life stages of the company and towards reorientation of resources supply with help of strategic course variance analysis or its full adjustment in case of effectiveness downsize.

Predominance of internal influences on adaptability is usual for high technology companies, because available scientific-based results forces production structures to adapt to new level of demands (Collis 2014).

Process of adaptation of the system of strategic management of high technology company development is represented in Figure 1.

Figure 1. Process of adaptation of the system of strategic management of high technology company development



Strategic management adaptation process involves following set of operations:

- at product creation stage initial development strategy is formulated in strategic management process, strategic goals and vision, prospective lines of development of research and production activities are evaluated, ways of creating competitive position and conditions for sustainable development of high technology company are defined;

- at market development stage strategic management of development orients operating activity of the company for providing long term competitive position and establishing good business reputation owing to penetration of science-intensive product into the market;
- at growth stage strategic management of development is aimed at providing conditions for sustainable growth subject to specified priorities, determining ways of most effective use of strategic development facilities; generating action plan for establishing of competitive positions for account of commercial and social effects from research and manufacturing of knowledge-intensive product;
- at maturity stage with help of strategic management of high technology company strategic goals are clarified, prospective lines of development is defined; several actions is generated that helps to support competitive level of knowledge-intensive product and to form in the company processes of adaptation to external influence and processes of maintaining sustainable growth conditions;
- at recession stage strategic management directs current activity of the company to generation of new unique competitive advantages, development of new innovations of the product, establishing conditions of adaptation of company to reorientation of production and management activities; determination of new competitive advantages of high technology company and development of conditions of effectiveness parameters achievement (Zaycev and Baranov 2009, Bogdanova and Lopatin 2010, Coveney 2004).

Managing the process of adaptation is an aggressive impact on the strategic management system in order to prevent negative impacts of environmental factors and loss of stability in the market.

3. Methods of support the adaptation processes of the strategic management of high technology company

3.1 Approach to building cloud space architecture of the system of strategic management

The key element in the provision of processes of adaptation of the system of strategic management is the organization of a common information space in which teammates of cross-functional teams involved in the development and implementation of strategic management programs and management impacts receive ongoing access to information and its exchange between teammates in real time (Baye 2013).

Organization of information space during the process of realization of customized strategic management of the development defines a number of requirements: accuracy of the information provided, timeliness and promptness of the information provided, ease of access to the required information for the participants of the implementation process of strategic management, security of information flows, the existence of a system of information protection, possibility of rapid processing of information flows.

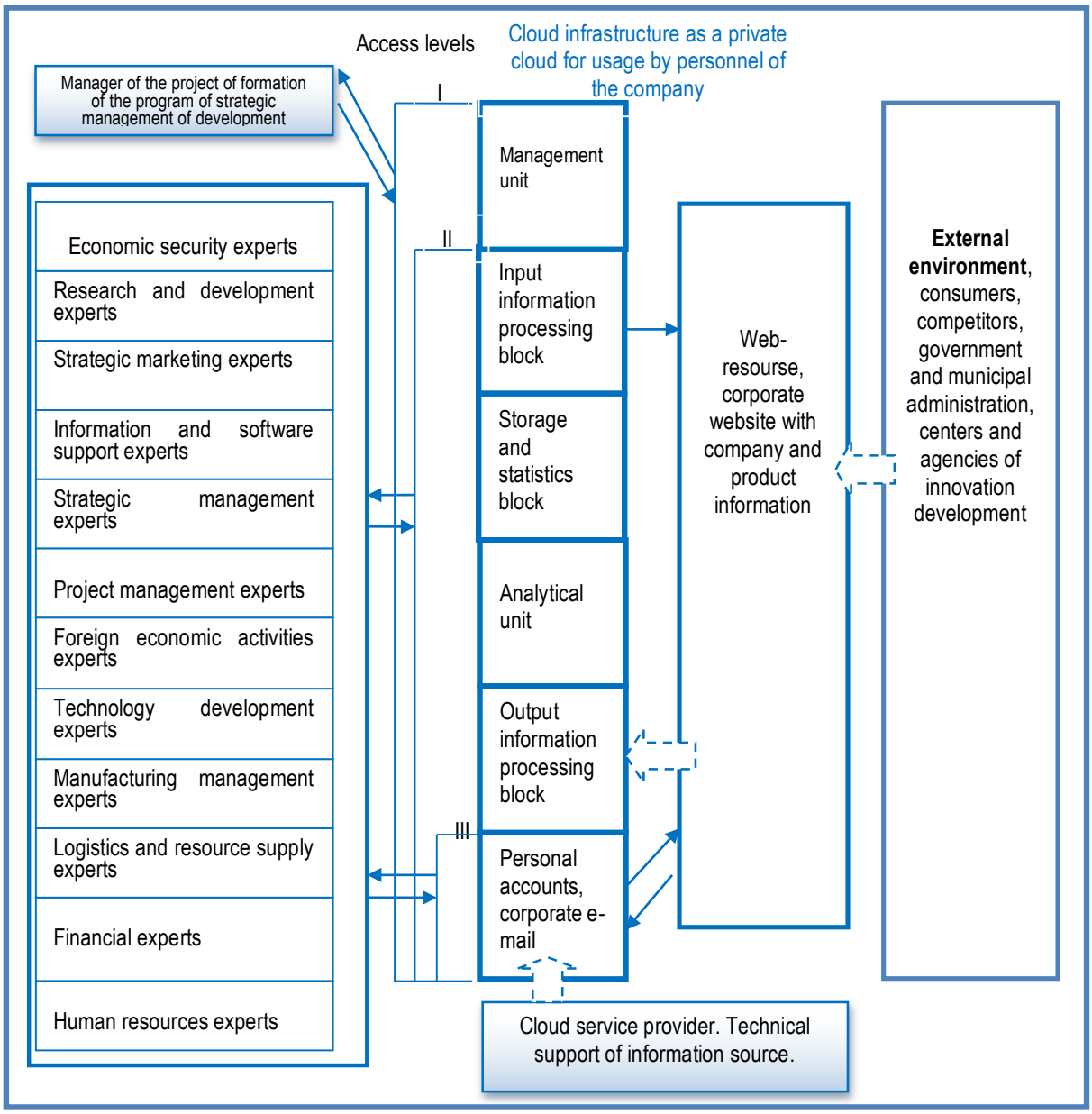
Based on the analysis of the main requirements to the information environment of a high technology company, it is advisable to make a conclusion in the research about the effectiveness of the implementation of cloud technology to the formation of the information space among teammates in the system of strategic management of the development (Kurbanbaeva 2012). The cloud environment, that is a powerful combination of cloud computing, network technologies, data storage solutions and management, implements a new generation of available on request and more cost-effective IT-resources and services without damage to security or functionality.

In order to ensure the adaptation process of the system of strategic management the cloud space architecture is formed, that can define the information sources, segment of information space, conditions for the dissemination of information. Using the technology of building a private cloud, the formation of the level of scalability of information flows, resource allocation, flexibility and automation is generated.

Cloud space data architecture is characterized by following: identifying the sources of information that forms the database, conditions and access limits of database; identifying a membership of the users of the information space; definition of the main structural components of private data cloud. The model of organization of information space, based on cloud technologies during the implementation of adaptive system of strategic management of the development, is presented in Figure 2. Cloud computing cost-effectively integrate infrastructure resources and provide them upon request with the possibility of scaling in multi-user and flexible community cloud environment (Kashirin and Radko 2016).

The usage of cloud infrastructure to create an information space gives the opportunity to monitor the implementation of individual tasks and the program in total regardless of the location of the team member and work time. Remote access increases the efficiency of cross-functional teams, reducing the time frames of the assigned tasks. Cloud technology service, offered by specialized provider, allows preventing the possibilities of adverse consequences and technical malfunction of information space work.

Figure 2. Organization of information space using clouds technologies for support of the processes of adaptation of the system of strategic management of company development



Information space is a cloud-based infrastructure with different levels of access for teammates, the writers of the program of strategic management and for outside users of the information space – prospect buyers of knowledge-intensive products, competitors, government and municipal administration, centers and agencies of innovation development. Members a cross-functional team to manage resources of input, storage, processing and

output of information flow could have cloud infrastructure exclusively for internal use. Cloud infrastructure consists of the following functional elements:

- input information processing block – software solution, computing the data, incoming to the information space from the writers of strategic management program, and ordering the data for sequential data processing;
- storage and statistics block is used as ф body of data for long term usage, the data enters to this block after computing and ordering;
- analytical unit is designed for ultimate processing of the data, received from internal and external sources, and output of reported data for supervising the implementation process of the program of strategic management;
- management unit is used for control of all elements of information space and for modification implementation in information space architecture;
- output information processing block – software solution, used for data layout in public domain and data recovery for internal use;
- personal accounts and corporate e-mail is used by program realization writers as cloud platform for software location and viewing the data from another blocks of information space (Gordyushin and Lebedeva 2014).

Access to corporate information space and input of information for processing, storing and forwarding is carried out from computer with Internet access, using personal account with login and password that is necessary for prevention of unauthorized entrance. Access to the information space could be divided into three levels:

- first, supreme access level allows usage of any element of information space, this level is used by management of cross-functional team;
- second level has a restriction to access to management unit and allows usage of all another parts of information space without access to rebuild its architecture;
- third level opens access only to corporate e-mail and personal accounts, cloud platform with information that can be used only with defined level of access.

For information output open web-resource is used, such as corporate website of the company with the data about produced knowledge-intensive product, technology and any other information about the company, without representing trade secrets or commercial classified information. The Web resource performs the function of the marketing tool.

Through the survey and questioning of visitors of the web resource the needs of knowledge-intensive product customers is revealed, both in current time and in the long term that works on adaptability of the system of strategic management (Khrustaleva (Kurbatova) 2015).

3.2 Evaluation of the effectiveness of the adaptability of strategic management to the demands of the external environment based on the use of multi-criteria models

In order to ensure the adaptation processes, it is necessary to organize the monitoring of the system of strategic management of company development in which the audit activity is carried out, aimed at the research of the causes of deviations from the specified performance parameters and compliance with the conditions of achievement of the established development areas.

A detailed predictive assessment of the effectiveness of the adaptability of strategic management to the demands of the external environment is advantageously carried out using methods of multivariable analysis. The investigated process could be represented as an aggregate of the following components: determine component, based on objective regularities of changes in processes; periodic component that is changed in specified period; random component that is little predictable (Dixit 2007).

Today, there are many multivariable models to assess the risks to the sustainability of the companies. In conformity to high technology companies, it is proposed to use Saifulin-Kadikov five-factor model; Taffler four factor model; Springate four factor model, nature of this models is presented in Table 1.

Table 1. The proposed multivariable model estimating the probability of bankruptcy

Indicator	Feature of the indicator	Content	High probability of bankruptcy	Medium high probability of bankruptcy	Low probability of bankruptcy
1	2	3	4	5	6
Saifulin-Kadikov model	*R=2X1+ 0,1X2+0.08X3+ 0.45X4+ X5*	X1 – asset coverage X2 – current liquidity ratio X3 – assets turnover ratio X4 – profits margin X5 – return on equity	R < 1	R = 1	R > 1
Taffler model	*Z = 0,53X1 + 0,13X2 + 0,18X3 + 0,16X4*	X1 – net profit/current liabilities ratio X2 – working assets/liabilities ratio X3 – current liabilities/assets ratio X4 – sales revenue/assets ratio	Z < 0,2	0,2 <Z < 0,3	Z > 0,3
Springate Model	*Y = 1,03 X 1 + 3,07X2 + 0,66X3 + 0,4X4*	X1 – floating capital/balance sheet ratio; X2 – EBT and interest due/balance sheet ratio; X3 – EBT/current liabilities ratio; X4 – sales revenue/balance sheet ratio	Y< 0,862	Y = 0,862	Y> 0,862

Integrated risk assessment of sustainability is carried out on the basis of correlation of the indicators to a common criterion of efficiency:

$$S = \sqrt[n]{\prod_{j=1}^{n} sj} \quad (1)$$

where sj – value of the private indicator of the risk of resistance development; n – number of parameters, j – value of the private indicator of the threat of resistance development.

This approach gives the possibility to analyse the process of implementation of promising directions of company development in the field of innovation management and research activities of the company, legal security of company in the field of commercialization and the degree of implementation of management functions in the adaptation of the results of research activities to the production of innovation.

On the ground of these data the possibility of participation of the company in the implementation of product innovations on foreign high-tech markets, the dynamics of changes of export volume and competitiveness of the company on foreign markets could be evaluated.

Conclusion

High-tech business is effective in terms of creating and implementing a radical innovation, providing a core competence dynamic development of high technology company and adequate response to the rapidly changing demands of the external environment, transformation of the results of research activities in fundamentally new product.

Proposed approach to the implementation of adaptive system of strategic management will allow high technology company following: to create corporate culture of innovation, to ensure focus on the achievement of strategic development goals in a resource-constrained environment, to form a seamless information environment that able to satisfy the needs of the participants of the process of adaptation in the information obtained in the process of building the knowledge base and the results of audit evaluation of the effectiveness of the system of strategic management, to develop the mechanism of impact of factors of external and internal influence on the effectiveness of the implementation of the system of strategic management, to develop the organizational

mechanism of management of processes of adaptation, providing effective interaction of the system of strategic management and the participants in the process of adaptation.

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Organizations Perception to Telework in Dubai: An Emperical Investigation

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Abstract

The aim of this study is to investigate the status of teleworking among private and public sectors in United Arab Emirates (UAE) and the factors that influence organizations in implementing telework. Fifteen small to medium sized Information and Communication Technology (ICT) organizations were targeted for the study. A survey was conducted among Information Technology professionals, in the UAE by distributing 600 questionnaires, out of which, 500 were returned, with a response rate of 83.33%. Quantitative and qualitative analysis was done with percentage, mean, standard deviation, Chi square and ANOVA. The survey result indicated that there are major differences in adoption pattern of public and private sectors in UAE although most of the private and public sector prefer teleworking.

Keywords: teleworking; telecommuting; homeworking; virtual working; teleworkers; telecommuters

JEL Classification: J81

Introduction

With the rapid proliferation of Information, Communication and Technologies (ICT), the concept of working anywhere, anytime, and with anyone has become a reality owing to easy connectivity, collaborations, and communications, thus forcing many organizations to adopt teleworking. The term teleworking (also known as telecommuting, homeworking, or virtual working) is not a new concept; the roots were found in early 1970s and have grown to achieve an extraordinary level today. Many individuals and organizations have adopted teleworking because of its many benefits such as improvement of office space, operational cost, absenteeism, turnover, work-related stress, commuting time (Kowalski and Sawson 2005); and also improving on job autonomy, work-family conflict, office technology, and environmental pollution (Ng 2010).Though technology has brought massive changes to our personal lives, in some workplaces it often seems like we are living a decade or more behind the time. While devices like smartphones and laptops have made communication much easier and accessible than before, many employees in the United Arab Emirates (UAE) still spend their days in big crowded office buildings, stuffed in tiny cubicles. Some business firms are on the fence about this new concept of teleworking as a strategic tool to compete in the global market. The overall aim of this research is to examine the status of telework implementation among private and public sectors in the United Arab Emirates, and to investigate the perception of employees and the employers about adopting teleworking culture.

2. Literature review on teleworking

The literature on teleworking is extensive; however summary of some major published studies by recognized experts in the field is reviewed. As per survey and research conducted in the US and UK, telecommuting is being used more and more as a mechanism to increase business efficiency and continuity because it increased productivity by eliminating commuting time and work distractions (Carr 2006). Information and Communication Technology now permits variety of remote working forms which lead to subsequent shifting of spatial and temporal boundaries between home, office and city (Cole *et al*. 2014). Advances in technology have also changed the work environment into one that will be at least partially virtual for most workers or completely virtual for others. The relationship between personality and attitudes towards telecommuting also matters where personality-attitude relationship maybe complex and contextually influenced (Clark *et al*. 2012). Individual and organizational factors influence the productivity of teleworkers. Job security is a key determinant of teleworking including role of satisfaction, commitment, work flexibility and management support (Aboelmaged and El Subbaugh 2012). An empirical study of teleworking in UAE was done based on their influencing factors, facilitators, and inhibitors. The research revealed that gender, nationality, marital status, place of residence, and work profession are relevant, whereas age, years of experience, educational level, use of internet, number of children, are irrelevant influencing factors for choosing teleworking. The research also identifies six facilitators and seven inhibitors. The importance of facilitators and inhibitors to choosing teleworking is almost similar among respondents except in association between choice of teleworking mode, individual freedom, travel overload, cost reduction, and union resistance (Aboelmaged and Elamin 2009). Research on differences between home-based working and teleworking behavior with respect to genders, age groups, household status, car access location inside city and distances of travel concluded that gender, professional status, age are influencing factors of teleworking (Theriault *et al*. 2005).

Furthermore, research on gender differences and teleworking among Spanish employees resulted that women have lower mobility than men (Carnicer *et al*. 2003). Similarly, individual's choice of teleworking in relation to demographic, travel, work, and attitudinal factors which showed that most important variables for choosing teleworking from home were the presence of small children at home, number of people at home, gender, number of vehicles, and family orientation (Mannering and Mokhtarian 1995). Empirical teleworking research suggested that some demographic variables have influence on teleworking productivity. With regard to gender, research showed that women with children prefer to be part-time teleworkers highlighting the fact that they are caretakers of children and family (Yeraguntla and Bhatt 2005). Similarly, male teleworkers experienced increase in productivity than females due to which there was improvement in the quality of life (Teo and Lim 1998). Regarding age and teleworking, studies have revealed that young adults (less than 25 years) are more likely to prefer part-time employment than older ones (Bagley and Mokhtarian 1997). Studies are also done on implications of job experience on the set of performance measures and found that teleworking requires training and specific experience in order to succeed (Torten *et al*. 2016) while another research result indicated that teleworking will be successful by training and communication (O'Brien and Hayden 2008).

3. Research design

Teleworking is a fascinating phenomenon which has resulted due to technology. From this research the authors have attempted to study both private and public sector Information and Communication Technology (ICT) organizations in the United Arab Emirates (UAE) and their prominence of teleworking.

The objectives of this research are: to examine the status of teleworking among private and public sectors in United Arab Emirates, to analyze the perception of employees and employers about teleworking culture, to identify the variables influencing the organization to practice telework.

Research methodology:

A survey was conducted by distributing 600 questionnaires among Information Technology professionals like software developers, network administrators, programmers, database administrators, working in the Dubai Internet City (DIC). Out of 600 questionnaires distributed, 500 were returned, with a response rate of 83.33%.

Descriptive and quantitative statistics was measured by using a 5 point Likert scale and responses were coded with the help of SPSS software. Quantitative and qualitative analysis was done by extracting frequencies, percentage, mean, standard deviation, Chi square test, and ANOVA.

Demographic description and analysis

Table 1. Profile of respondents (n=500)

Telework	Number of respondents (n)	Percentage (%)	Mean	Standard Deviation
Yes	350	70	1.30	0.462
No	150	30		
Organization type			1.74	0.443
Public	370	74		
Private	130	26		
Gender			1.44	0.501
Male	280	56		
Female	220	44		
Age			2.04	0.637
Less than 25 years	90	18		
25 to 34 years	300	60		
More than 35 years	110	22		
Education			1.94	0.651
High school	120	24		
Graduate	290	58		
Post graduate	90	18		
Organizational Level			2.40	0.571
First	20	4		
Middle	260	52		
Top	220	44		
Experience			1.76	0.686
Less than 5 years	190	38		
5 to 9 years	240	48		
More than 10 years	70	14		

The descriptive statistics shows that out of 500 respondents, 350 (70%) agree that they telework for one or more days per week, while 150 (30%) do not agree to work for one or more days a week. 370 respondents (74%) work in public organization while 130 (26%) work in private organization. 56% of the respondents are male and 44% of the respondents are female. 60% of the respondents fall in the age category of 25 to 34 years, 18% fall in the age group of less than 25 years and the remaining 22% are more than 35 years of age. The education level reported by respondents showed that 24% have passed high school degree, 58% have graduated and 18% have got post graduate degree. According to experience, 190 respondents (38%) have less than 5 years of experience, 240 (48%) have 5 to 9 years of experience, and 70 (14%) have more than 10 years of experience.

It is observed that, majority of male respondents of age between 25 to 34 years, after graduation, prefer to telework in public organizations.

Qualitative analysis - demographics

Chi square test analysis was done to assess the relation between teleworking in public and private organizations and the demographic variables such as gender, age, education, organization level, and experience

Hypothesis1: There is no significant relationship among employees teleworking in public / private organizations and demographic variables.

Result and analysis

Table 2. Chi Square analysis of demographics

Telework	Public	Private	Number of respondents	Percentage	Chi Square	P value
Yes	270(77.1%)	80(22.9%)	350	70	0.599	0.439
No	100(66.7%)	50(33.3%)	150	30		
TOTAL	370	130	500	100		
Gender						
Male	190(67.9%)	90(32.1%)	280	56	1.248	0.264
Female	180(81.8%)	40(18.2%)	220	44		
TOTAL	370	130	500	100		
Age						
Less than 25 years	80(88.9%)	10(11.1%)	90	18	1.296	0.523
25 to 34 years	210(70.0%)	90(30.0%)	300	60		
More than 35 years	80(72.7%)	30(27.3%)	110	22		
TOTAL	370	130	500	100		
Education						
High school	120(100.0%)	0(0.0%)	120	24	12.004	0.002
Graduate	220(75.9%)	70(24.1%)	290	58		
Post graduate	30(33.3%)	60(66.7%)	90	18		
TOTAL	370	130	500	100		
Organizational Level						
First	0(0.0%)	20(100.0%)	20	4	6.403	0.041
Middle	190(73.1%)	70(26.9%)	260	52		
Top	180(81.8%)	40(18.2%)	220	44		
TOTAL	370	130	500	100		
Experience						
Less than 5 years	140(73.7%)	50(26.3%)	190	38	0.038	0.981
5 to 9 years	180(75.0%)	60(25.0%)	240	48		
More than 10 years	50(71.4%)	20(28.6%)	70	14		
TOTAL	370	130	500	100		

Table 2 indicates that there is significant difference in the teleworking employees in public and private organizations where 270 (77.1%) agree to telework in public organizations while 80 (22.9%) agree to telework in private organizations. The Chi square analysis indicates that there is no significant relationship between those who agree to telework in public and those who agree to telework in private organizations, since (X^2 = 0.599, p>0.05) and the variables are independent of each other.

There is significant difference in the teleworking employees in public and private organizations based on their gender (X^2 = 1.248, p>0.05). It is clear from cross tabulation that males constitute majority of employees (56%) who selected to telework than female employees (44%). At the same time there is a difference that 67.9% males chose in public teleworking compared to 32.1% in private teleworking organizations. In case of females, 81.8% chose teleworking in public and 18.2% in private teleworking. The Chi square analysis indicates that there is no association between gender and teleworking. Therefore, majority of males and females prefer the choice of teleworking in public organizations as compared to private organizations.

Majority of employees between the age of 25 to 34 telework in public organizations constitutes approximately 70% (21); and 90 (30%) employees telework in private organizations. Eighty employees, (88.9%) of age less than 25 years prefer to telework in public and only 11% prefer to telework in private organizations. At the same time, 72.7% employees of age more than 35 years prefer to telework in public organizations than27.3% employees.

There is significant difference in the teleworking employees in public and private organizations based on age difference (X^2 = 1.296, p>0.05). It is clear from cross tabulation that the difference is not significant and there is no evidence of relationship between age and teleworking in public and private organizations. Therefore, majority of employees of all ages prefer the choice of teleworking in public organizations as compared to private organizations

Educational level and cross tabulation of teleworking in public and private organizations shows that a total of 290 out of 500 were graduates. 220 (75.9%) graduate employees preferred to telework in public organizations and 70 (24.1%) preferred to telework in private organizations as compared to total of 120 high school graduates and 90 post graduates. Chi square analysis between education level and teleworking preferences showed: (X^2 = 12.004, p<0.05) showing a significant relationship. Therefore, majority of high school passed employees and the graduates preferred to telework in public firms compared to private firms, among the postgraduates, 66.7% preferred to telework in private firms while, 33.3% preferred to telework in public firms.

The analysis shows that majority of employees telework in middle level as compared to first level and top level. Out of 370 employees at public, 190 (73.1%) constitute to telework at middle level in public organizations; 180 (81.8%) at top level and none at first level. 70 (26.9%) employees telework in private organizations, 20 in first level and 40(18.2%) in top level organizations. Chi square analysis indicates (X^2 = 6.403, p<0.05) showing a significant relationship between the levels and choice of teleworking. Therefore, majority of first level employees prefer to telework in private firms as compared to the middle level and top level. But the majority of middle level and top level employees prefer to telework in public organizations.

Relationship between employees' teleworking choice and their years of experience is not significant (X^2 = 0.038, p>0.05) where 180 (75%) employees who have 5 to 9 years' experience represent the majority with choice of teleworking in public organizations and 60 (25%) employees teleworking in private organizations. Also 140 employees (73.7%) represent those teleworking with less than 5 years' experience in public organizations and 50 (26.3%) teleworking in private organizations. Among those employees who have more than 10 years' experience, 50 (71.4%) chose to telework in public organizations and 20 (28.6%) chose to telework in private organizations.

Chi square analysis shows that there is significant association between public and private teleworking choice with education and organization level. While there is no significant association between public and private teleworking choice between genders, age, and experience. Therefore, hypothesis H1 is partially supported.

Qualitative analysis - motivation of teleworking

Variables chosen for motivation of teleworking are: management support, job security, work flexibility, attitude, job satisfaction, organizational commitment, ease of use, usefulness and intention to telework.

Hypothesis 2: There is no difference among employees teleworking in private and public organizations based on the motivation of work.

Result and analysis

Table 3. ANOVA of motivation variables

Item	Description	Mean	Mean	Std. dev	Std. dev
Management support (α=0.896)		Private	Public	Private	Public
M1	My manager considers teleworking is a good strategy	3.1538	3.3243	0.98710	1.05552
M2	My manager encourages employees to telework	3.0769	3.5405	1.03775	1.06965
M3	My manager provides resources to support teleworking	3.3077	3.3243	1.18213	0.97337
M4	My manager is keen to see employees telework	3.4615	3.4595	1.05003	0.98867
Job security(α=0.789)					
J1	There is no changes at my workplace	3.1538	3.4595	0.98710	0.98867
J2	I feel secure about the future of my job	3.6923	3.6757	0.75107	1.05552
J3	My work environment is stable	3.5385	3.7027	0.87706	0.90875
J4	I am not worried about leaving my job	3.6154	4.0270	0.65044	0.89711

Item	Description	Mean	Mean	Std. dev	Std. dev
Work flexibility(α=0.797)					
W1	I can organize my own working time	3.3846	3.7027	1.19293	0.84541
W2	I have full control over my work load	3.5385	3.3514	1.19829	1.13569
W3	My work- family relationship is balanced	3.4615	3.2703	0.96742	0.96173
W4	I can work offsite during the working day	2.9231	3.3784	1.18754	0.95310
W5	My work environment is flexible	3.2308	3.4595	1.09193	0.93079
Attitude(α=0.913)					
A1	Teleworking is a good idea	3.7692	3.5405	1.01274	1.12038
A2	Teleworking is wise idea	3.5385	3.4595	0.96742	1.04335
A3	Teleworking is pleasant	3.6154	3.6216	1.04391	0.95310
A4	It is desirable to telework	3.4615	3.7297	0.96742	0.96173
Job satisfaction(α=0.900)					
J1	I am satisfied with my work	3.7692	3.8108	1.01274	0.99549
J2	My co-workers support me in my work	4.0000	3.8919	0.81650	0.96563
J3	My supervisor supports me in my work	3.8462	3.7838	0.80064	0.97568
J4	I feel like I belong to the office team in my work	3.6154	3.6486	1.04391	1.22964
Organizational commitment(α=0.943)					
OC1	I feel emotionally attached to this organization	3.4615	3.6486	1.26592	1.11096
OC2	This organization has a great personal meaning for me	3.6154	3.5135	1.26085	1.04407
OC3	I feel like part of family at my organization	3.3846	3.6757	1.19293	1.02886
OC4	This organization is like my second home	3.3846	3.8378	1.19293	1.06754
OC5	I respect my organization's vision	3.8462	3.8108	1.21423	1.02301
OC6	I feel a strong sense of belonging to my organization	3.5385	3.7568	1.12660	1.06472
OC7	I feel as if this org. problems are my own	3.4615	3.8378	1.19829	1.04119
Ease of use(α=0.845)					
E1	Learning to telework would be easy for me	3.6923	3.6486	0.85485	1.00599
E2	Teleworking does not require a lot of effort	3.5385	3.6757	0.77625	0.97337
E3	It is easy to use teleworking	3.3846	3.7568	0.76795	0.89460
Usefulness(α=0.280)					
U1	Teleworking would enable me to accomplish my tasks	3.8462	3.5405	0.89872	1.09531
U2	Teleworking would make my tasks easier	3.8462	3.4865	0.89872	0.96095
U3	Teleworking is useful	3.8462	3.7838	0.89872	0.78652
U4	Using teleworking is advantageous	3.7692	5.1622	1.09193	8.47386
Intention(α=0.897)					
I1	I would telework for in the future	3.2308	3.6757	1.01274	1.13172
I2	Teleworking is something I would do	3.3846	3.6486	1.26085	1.05978
I3	I would see myself as a teleworker	3.2308	3.8108	1.23517	1.04981

In the ANOVA test analysis shown in Table 3, employees find managerial support is more in public organizations than in private organizations. There is significant difference in the standard deviation of both private and public organizations. *Management support* reliability test shows α=0.896, and mean scores for public organizations is higher than that of private organizations. Overall employees in public organizations agree that management supports teleworking. Regarding *job security*, reliability test shows α=0.789, and mean scores for public organizations is higher than that of private organizations. Employees in public organizations support job security in teleworking. Employees in the public organizations feel that there is *work flexibility* in teleworking with respect to stability and security but private organizations have more work- family relationship balanced. Reliability test shows α=0.797 and the mean scores have a low range of 2.92 in private organization for offsite working flexibility to as high as 3.70 in public organization for organizing own work. Looking into the *attitude* towards

teleworking, 69.1% employees in the private organizations have opined that teleworking is a good idea, while only 54% in public organizations have the same opinion.

Therefore, of the four variables two are supported by public organizations and two are supported by private organization, therefore equally rated. Reliability test alpha coefficient is 0.913 and the mean sores range from 3.53, and 3.76 in private organizations; 3.62, and 3.72 in public organizations. Regarding *job satisfaction*, 64.8% employees in public organizations are satisfied with teleworking while only 53.7% are satisfied in private organizations. Out of the four job satisfaction variables, two variables are supported by public organizations and two by private organizations. The highest mean value of 4.00 is observed in private firms where the co-workers extend their support while it is 3.89 in public firms. Alpha coefficient value for job satisfaction is 0.900. Out of seven variables in *organizational commitment*, five variables are supported by public organizations and two variables are supported by private organizations. Mean scores for public organizations are higher than that of private organizations and alpha coefficient α=0.943. Respondents in public firms were more supportive with *easiness* in teleworking; alpha coefficient being 0.845 with mean scores of 3.67, and 3.75; while it is 3.69 in private firms. *Usefulness* of teleworking is greatly supported by private organizations with mean value for three variables being 3.84; while mean value for one variable is 5.16 in public organizations. The alpha coefficient is 0.280. Regarding the *intention* of teleworking, more than 70% respondents in public organizations intend to telework as compared to private firms. Alpha coefficient for the intention variables is 0.897 with mean values ranging from 3.64, 3.67, and 3.81 in public organizations and lesser in private firms.

The Cronbach alpha coefficient analysis has been done to study the reliability of variables. As shown in Table 3, the alpha reliabilities range from as high as 0.943 to 0.280, the latter being less than 0.6 is not acceptable and needs further refinement. Therefore, H2 is rejected since it is observed that there is significant difference among employees teleworking in private and public organizations based on the motivation of work.

Conclusion

The survey revealed significant association between public and private teleworking choice with education and organization level but there is no significant association between genders, age, and experience. The adoption pattern of public sectors differs from that of private sectors with respect to motivation of work. Teleworking, an alternate work option, has yet to gain widespread recognition in the business environment in UAE. Despite the relatively low number of teleworkers in Emirates, the change of attitude remains increasingly optimistic about the future of flexible work arrangements which would play a very crucial role for greater penetration of teleworking in UAE.

Further research can be conducted on the types of jobs or businesses adopted by teleworkers, to find out how long each organization has been practicing telework, whether there is development after adoption, and so on. To fully understand telework, research need to expand to include all parties who might be affected when an individual teleworks.

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Monetary Factors that Affect Price Formation in Real Estate: A Nonlinear Approach

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Abstract

This paper is aimed at examining the relationship between monetary policy and price formation in the mortgage industry. We use the coefficient of mutual information as a measure of "association" to capture such a relationship as a whole, and not necessarily as the addition of contributions of statistical moments and, more important, it is not confined to linear structures or to the linear transformation as turns out to be in econometrics analysis. It is verified the effectiveness of the proposed measure of association according to Renyi's (1959) properties regarding a functional measure of dependency. The obtained results provide empirical evidence of the existence of an "association" between monetary instruments and the formation of prices in the sector under study.

Keywords: Real estate; monetary policy; mathematical methods; dependence measures; nonlinear models; entropy

JEL Classification: R31; E52; C02; C14

1. Introduction

The economic crisis in the US in 2008 was caused, essentially, from the bursting of a speculative bubble gestated in real estate. Due to the strong economic consequences of this event, recent research has focused on analyzing the importance of price formation in that sector. Studies from Assenmacher-Wesche *et al*. (2010) and Hirata *et al*. (2013) agree that the expenses related to real estate represent a significant percentage of the GDP in the United States. Also the evolution of prices in this sector plays an important role in the real and financial sectors, affecting macroeconomic fundamentals as wealth of families, their expenses and borrowing, as well as consumption and investment decisions. Another factor that, undoubtedly, has increased the significance of the real estate sector is the globalization of financial markets, which has encouraged the innovation of investment instruments related to real estate. For this reason, since the 1990s, real estate markets have played a major role as part of international long-term investments (Patterson 2008). Several investigations as those conducted by Aoki (2001, 2004), Ahearne (2005), Taylor (2007), Mishkin (2007), Dokko (2009), Xiaoqing (2012), and Hirata (2013), among others, agree in indicating an important link between monetary policy and changes in real estate prices. In this regard, Asenmacher-Wesche *et al*. (2010) report that over the past thirty years housing prices in most industrialized economies have been characterized by periods of sharp increases, followed by severe crashes. These increases have, generally, occurred in a context of low real interest rates in the long term, high liquidity and stable economic growth. Other studies, as those from Ahearne *et al*. (2005), Aoki *et al.* (2004), Calza *et al*. (2009), and Dokko *et al.* (2009), among many others, based mainly on econometric models, have examined the impact of monetary policy on the evolution in real estate prices.

However, most of the empirical results lead to contrasting conclusions. It is for this reason that the present research proposes the use of an alternative methodology, which is effective to capture the relationship between

monetary policy and housing prices as a complete stochastic system without the classical assumption made when dealing with linear systems. In this regard, works from Darbellaya and Wuertzc (2000) and Dionisio *et al*. (2004) propose the use of the concepts of entropy, joint entropy, conditional entropy, and mutual information coefficient. The latter is seen as a more general measure of dependence, which has the ability to capture a stochastic relationship as a whole, and not necessarily as the addition of the contribution of each statistical moment. The calculation of this indicator requires no assumptions about linearity, normality, stationarity, or homoscedasticity. In this paper, the coefficient of mutual information is used to study the relationship between the formation of housing prices and monetary policy variables such as: money supply, short-term interest rates, and total loans by commercial banks. We also describe the economic and financial importance of the real estate sector, and discuss about monetary and non-monetary factors that influence price formation in real estate.

This paper is organized as follows. Section 2 emphasizes the advantages of the concepts of entropy and mutual information as measures of association between two stochastic processes, and verifies that these indicators satisfy desirable characteristics stated by Renyi (1959) for having a functional measure of dependence. Section 3 shows the empirical results of the mutual information in studying the relationship between monetary policy variables (real M1, interest rates, total industrial and commercial loans granted by commercial banks) and the Shiller index which represents the evolution of prices in the US real state. The study period starts in 1987, when the calculation of Shiller Index starts, and finishes in July 2014. Finally, section 4 provides the conclusions, and acknowledges the limitations of this research.

2. Relative Importance of the real estate sector in the economy

The development in real estate prices plays an important role in real and financial fluctuations in the economy. The activities related to this sector represent a significant percentage of production, investment and expenditure; see, for instance, Dokko (2009). During 1974-2002, residential investment in the United States reached 4.5% of GDP; by the end of 2005 the increase was 6.25%. In addition, variations in real estate prices affect fundamental macroeconomic variables such as wealth of individuals, their borrowing capacity and investment decisions (Hirata *et al*. 2013).

Bjørnland and Henning (2009) also emphasize the importance of the housing market, and suggest that unlike other assets houses have a dual function as a store of wealth and as a durable good consumption. Consequently, a shock in real estate prices can affect the heritage of their owners. As indicated by Hirata *et al*. (2013), Assenmacher-Wesche *et al*. (2010), and Ahearne, Ammer *et al*. (2005), when the wealth of individuals is modified also its decisions of consumption and investment are modified.

Moreover, Bernanke (2007) describes the importance of real estate when houses are used as collateral to negotiate a loan. In general, the availability of guarantees reduces information problems inherent in the credit market, and reduces the risk taken by lenders. This can increase the loan supply at lower costs; see, in this regard, Mishkin (2007). Notice also that an increase in the value of collateral, makes easy the expansion of credit; however, when home prices decline, borrowers lose solvency, causing the weakening of the financial system. In this regard, Aoki (2004) suggests that housing prices play an important role in the transmission of monetary policy because this type of durable goods is used as collateral to reduce the agency costs associated with lending which are used to finance investment and consumption. In the past, major declines in house prices have often been associated with economic downturns, and sometimes have contributed to financial distress (Ahearne *et al*., 2005).

Furthermore, Ahearne *et al*. (2005) suggests that fluctuations in housing prices cause significant effects on the financial system. In the US, mortgage lending is an important activity for a large number of foreign and local banks. Loans of this type represent a substantial proportion of the banks' assets, and in most situations exceed both the amount of capitalization stock and the net book value of the bank. To compensate for this risk, mortgage lenders turn to be a significant portion of loans. Finally, it is worth mentioning that fluctuations in real estate prices may be a key channel of transmission of monetary policy.

In the next section, we describe some non-monetary and monetary mechanisms that can influence price formation in real estate. The main determinants identified by various researchers can be grouped into the following

categories: demographic changes, productivity shocks, market expectations, financial deregulation, and monetary variables. All these categories will be briefly explicated in what follows.

2.1 Demographic changes

The housing prices tend to rise in cities where demographic growth has resulted in higher population density. Additionally, a sudden increase in population also affects the real estate industry modifying savings rates. Moreover, there is an increase in savings rates, which tends to push down long-term interest rates; with lower capital cost housing, demand increases and the prices rise. The change in productivity levels can distort relative prices between different productive activities. The increase in productivity tends to be relatively lower in the construction sector compared to other activities. Consequently, prices in the real estate industry are relatively higher than in other sectors; see, Ahearne *et al*. (2005).

Economies with more "flexible" financial markets, as pointed out by Assenmacher-Wesche *et al*. (2010), respond strongly to monetary stimulus. Since late 1980, financial deregulation has produced fewer restrictions for consumer indebtedness. Deregulation also translates into a greater or lesser degree of government intervention in the housing market. This is a decisive factor in price changes modifying key variables such as tax structure or legal formalities.

Patterson (2008) considers that the continuous search for innovative investment instruments to improve the performance of portfolios has lead to the inclusion of investment instruments in real estate. It is for this reason that, since the 90's, the real estate markets have has played a significant role as part of the international long-term investments. In this context, an investor can buy a house with the intention of making a profit on the price of future sale or future income from leasing, which is expected to increase in the long run. According to Assenmacher-Wesche *et al*. (2010) and Ahearne *et al*. (2005), expectations also plays an important role, since the beliefs of agents can lead to behaviors that may cause to the market a self-fulfilling prophecy. An optimistic view of the public causes an increase in demand for houses pushing prices upwards. Unfortunately, when expectations change to adverse, homes purchased as an investment, return more easily to the market for resale, which generates excess supply and rapid decline in prices.

Bjørnland and Henning (2009) emphasize that asset prices can be an important source of macroeconomic fluctuations, due to their role as stores of wealth, they could also be important transmitters of shocks since they react quickly to news (including monetary policy announcements). Understanding the role of asset prices in the transmission mechanism of monetary policy may, therefore, be a useful prerequisite for the implementation of an efficient monetary policy strategy.

Several investigations as those conducted by Aoki (2001), Aoki (2004), Ahearne (2005), Taylor (2007), Mishkin (2007), Dokko (2009), Xiaoqing (2012), and Hirata (2013), among others, agree in indicating an important link between monetary policy and changes in the prices of real estate. Asenmacher-Wesche *et al*. (2010) report that over the past decades, house prices in most industrialized economies have had episodes of sharp increases, followed by harsh crashes. The increases have been characterized by occurring in a context of low real interest rates in the long term, ample liquidity, and stable economic growth. Ahearne (2005) and Xiaoqing (2012) have shown that expansionary monetary policy tends to accelerate the growth of housing prices. These results suggest that monetary policy actions are some of the driving forces behind the change in real estate prices. Thus, the evolution of prices in this sector is a key channel of transmission of monetary policy. Mishkin (2007) describes six transmission mechanisms by which variations in interest rates affect directly or indirectly the real estate market and the whole economy that are explained as follows:

Now then, following Mishkin (2007, 5) the cost of capital in the neoclassical orthodoxy framework is an important determinant of the demand of residential capital. The capital cost, *CC*, normalized by relative purchase price of new houses, *NH*, is defined through three separate components

$$\frac{CC}{NH} = A - B + D$$

where $A = (1 - t)i - p^e$ stands for the after tax real mortgage rate, $B = p_h^e - p^e$ is the differential between expected housing appreciation and expected inflation, and *D* denotes the depreciation rate for housing. Here, i stands for the mortgage rate, p_h^e represents the expected rate of appreciation of housing prices, π^e is the expected inflation rate, and t is the tax rate on mortgage.

Notice that even if the actual mortgage rate and the expectation of appreciation in home prices are determined in the long term when short-term interest rates increase, then long-term rates also augment so that the cost of capital increases and the demand for real estate falls.

Also, Mishkin (2007, 6) also states that the term considering *B* provides another way in which central bank actions could affect housing activity. An increase in interest rates in the short term generates expectations of an increase in the cost of long-term capital. In response families are reluctant to buy new homes so their demand decreases and expectations of housing prices fall since a higher cost of capital causes that the demand for these durable goods decreases. In the case of housing supply, an increase in short-term rates causes the rise in costs of production in all sectors, including construction. Therefore, in the context of increasing interest rates, the supply of real estate tends to decrease.

An increase in wealth from stocks, real estate, or other assets, has a positive effect on household consumption. A decrease in interest rates will result in an increase in demand for houses, so the expected future price of this asset will be adjusted upward. The result of this process will be reflected as a higher level of wealth for owners of real estate, thereby stimulating consumption and aggregate demand.

In credit markets, there is usually a problem of asymmetric information, whereby lenders have to take the risk that the borrower does not have sufficient resources to pay the loan granted. The collateral, as in this case, is the residential property, which reduces risk for lenders. Therefore, the appreciation in housing prices, results in a greater potential to get loans, even at lower costs. In other words, the increase in the value of collateral reduces the risk premium required by banks, which allows increasing the supply of credit to lower interest rates. Finally, changes in interest rates affect cash flows families, for example, when interest rates increase in the short term, the cost of mortgages also increases. This will affect the cash flow of families that see increased their expenditures. In this case, with a higher mortgage cost, housing demand decreases.

It is clear that the prices formation in the housing market plays an important role in the monetary transmission mechanism. The housing sector has the potential to create instability in the financial system. This Instability could magnify problems for the overall economy (Mishkin 2007). A shock to house prices may affect real growth, which makes housing prices an important variable that the monetary policymaker may want to monitor.

Finally, Bjørnland and Henning (2009) claim that the common procedure for analyzing the effect of monetary policy on economic variables has usually been the structural VAR A major challenge when incorporating asset prices like house prices into a VAR model is how to identify the system as both the interest rate and asset prices may respond simultaneously to news. In this sense, it is important to have a methodology to measure the dependence between real state and monetary variables, overcoming problems such as timing, the lack of normality and linearity in the variables. For this reason, this research proposes the coefficient mutual information as an effective indicator to measure the association between variables with the ability to capture the relation as a whole. The following section describes the features and advantages of the proposed methodology.

3. Mutual information and other measures of dependence

The analysis of dependency between two stochastic processes is a central problem in most disciplines. Granger *et al*. (2002) mention that the correlation coefficient is the statistic most commonly used to assess the linear relationship between continuous random variables or Gaussian processes. Lu (2011) explains that the reason for the popularity of this statistic is its easy estimation and its low computational cost. But despite these advantages, the correlation coefficient has serious deficiencies, one of which is that correlation is not equivalent to dependence;

two variables that are uncorrelated are not necessarily independent. Other disadvantages are related to the fact that this measure depends on the linear structures or the linear transformations of the variables and it is inefficient when variables are not discrete or may not follow a Gaussian process[7].

Research from Darbellaya and Wuertzc (2000) propose alternative methodologies of association based on the concept of entropy, such as the coefficient of mutual information, which can be used to measure the statistical dependence. The advantage of this measure is the fact that it has the ability to capture a stochastic relationship as a whole, and not necessarily like the sum of the contribution of each statistical moment. Dionisio *et al*. (2004) propose the concept of entropy, joint entropy, conditional entropy and mutual information coefficient as a measure of more general dependence than traditional methods, which do not require classical assumptions on the distribution of errors.

The concept of entropy was introduced by Shannon (1948) proposing the theory of information, and stating the pillars of ergodinamic theory. Entropy can be understood as the average of information that is poured through one source; however, this concept has different connotations that identify entropy with randomness, uncertainty, and shock or surprise. In the financial area, the research linking entropy with the concept of efficient market is very common. The entropy *H*(*X*) is a measure of information or uncertainty (Shannon 1948). The entropy can be defined as follows. Let X be a discrete random variable taking values x with probability *p*(*x*), then entropy is defined by (the continuous case is directly extended):

$$H(X) = -\sum_{x} p(x)\ln\big(p(x)\big).$$

This information indicator has the following properties:

- $H = 0$, that is, if the system only generates a single event with probability 1, then there is no uncertainty, and the value of the entropy is zero
- H reaches its maximum value when all $p(x)$ are the same.
- $H \geq 0$, that is, entropy is always positive, which means that there no loss of information.

In this research, we shall be using the coefficient of mutual information as a measure capable of capturing the statistical dependence between two random variables. When there are two discrete random variables whose behavior is conditioned on a reciprocal basis, then between these two variables exists a structure of mutual information. Mutual entropy for one pair of discrete random variables$X$ and $Y, I(X,Y)$, is defined as:

$$I(X;Y) = H(X) - H(X|Y) = \sum_{x.\ y} p(x,y)\log\frac{p(x,y)}{p(x)p(y)}$$

The expression $I(X;Y)$ defines a measure of dependence between two random variables. Dionisio *et al*. (2004) define the coefficient of mutual information as an indicator that reduces uncertainty in the variable X given the knowledge of Y. If this occurs is said to be that Y provides information to X. The coefficient of mutual information has the following properties:

$a)$ $I(X,Y) \geq 0$. The measure is always positive.

$b)$ $I(X,Y) = 0$. The measure takes a zero value when variables are mutually independent.

$c)$ $I(X,Y) = H(X)$ or $I(X,Y) = H(Y)$. When a variable depends entirely on the other variable, the coefficient of mutual information is equal to the entropy of either.

$d)$ $I(X,Y) = I(Y,X)$.

The coefficient of mutual information is a symmetric function regarding the variables. The parameter is proper to point causality between variables but does not specify the direction. To understand the advantages of the

[7] See, for instance, Green (2003).

above information coefficient as a measure of dependence is important to describe the desirable properties stated by Renyi (1959), Granger *et al*. (2002), and Fuller *et al*. (2012). A measure of dependence $\delta(X,Y)$ between two random variables (Y,X) has to satisfy following desirable features:

1) $\delta(X,Y)$ is defined for any two random variables, discrete or continuous.

2) $\delta(X,Y) = \delta(Y,X)$, *i.e*., is symmetric,

3) $0 \leq \delta(X,Y) \leq 1$,

4) $\delta(X,Y) = 0$. It has a zero value if X and Y are independent,

5) $\delta(X,Y)$ takes the value 1 when there is a strict dependence between variables,

6) If the joint distribution of X and Y is normal, then $\delta(X,Y) = |R(X,Y)|$, where $|R(X,Y)|$ is the correlation coefficient between X and Y,

7) $\delta(X,Y)$ is a metric, *i.e*., is a measure of distance, not just of divergence,

8) $\delta(X,Y)$ is an invariant measure under strictly increasing transformations.

It can be shown that the coefficient of mutual information satisfies the above criteria except properties third and sixth. Importantly, compared with the coefficient of mutual information, the absolute value of the correlation coefficient, which is the most commonly used measure of association, satisfies only properties two, three and six.

There are important similarities between the concept of entropy and statistical methods such as regression (Dionisio *et al*., 2004):

1) the expression, $I(X;Y)$ has its equivalent in the sum of squared errors obtained through a linear regression, $SSE = \beta^2 \sum(X_i - \bar{X})^2$. In this case, both measures reveal the variation in the dependent variable that is explained by the independent variable.
2) the term $H(Y)$ is equivalent to the variance of the dependent variable, $SST = \sum(Y_i - \bar{Y})^2$, both measures explain the total dispersion in the dependent variable.

Among the disadvantages when applying this methodology, Darbellaya and Wuertzc (2000) comment that the difficulty in calculating the mutual information lies in the fact that the probability density function is unknown.

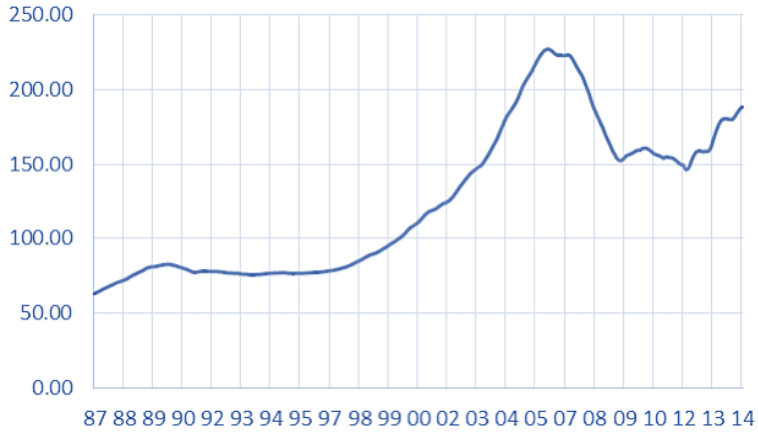
4. Empirical results

According to Ahearne *et al*. (2005), real housing prices in most industrialized cities have exhibited prolonged increases and drastic drops in the past decades. Price booms were characterized, generally, by loose monetary policies. Another feature in housing markets is that prices have increased relatively more than income, thus it is possible to argue the presence of a growing speculative activity: see, in this regard, Assenmacher-Wesche *et al*. (2010)

In relation to the US housing market, Bernanke (2010) describes that after some years of slow growth, prices in the US began to rise faster in late 1990. The price variation reached an annual rate of 7% to 8% in 1998 and 1999, respectively, and grew from 9% to 11% in 2000-2003. However, the most rapid increase occurs, according to Bernanke (2010), in 2004 and 2005, when the annual rate of price appreciation of the houses was between 15% and 17%. Table 1 shows the evolution of the S&P/Case-Shiller Index 10.[8]

[8] The S&P/Case-Shiller Index 10 represents the value of residential real estate in 10 major metropolitan areas in the US. This statistic developed by Robert J. Shiller and Karl E. Case, is regarded as the leading indicator of residential real estate prices in the US. The index measures changes in market prices of houses assuming a constant quality.

Figure 1. Evolution of Shiller Index



Source: Author's own elaboration with S&P data.

The empirical results obtained for the coefficient of information between monetary policy and the appreciation of housing are discussed in the next section.

4.1 Coefficient of mutual information

This section presents the empirical results of the coefficient of mutual information. Variables used are: (M1) real money supply, three-month Treasury Bill interest rate (*r*), and total industrial and commercial loans provided by commercial banks (*L*). To observe the evolution of prices in the US mortgage industry we used the S&P/Case-Shiller Index 10. With comparison purposes, we calculate covariance and correlation coefficient, which, as discussed above, can be considered as a leading indicator of association between variables, so it is important to compare its effectiveness against the indicator proposed here.

Table 1. Correlation coefficient and covariance

	Correlation coefficient	Covariance
	Shiller index	Shiller index
M1	.060224	6.428395
T-bill	-.084370	-2.139109
Loans	-.091267	-.070950

Source: Author's own elaboration with data from the Federal Reserve Bank of San Luis.

As it can be seen, the correlation coefficient does not allow postulate an association between these variables because its values are less than 1%. Likewise, it is expected that the sign obtained between the Shiller index and the loans is positive. Hence, in this case, the obtained result does not have the expected sign. Nonetheless, after applying more rigorous testing, we found that the assumptions of normality, autocorrelation and homoscedasticity are not satisfied, which are basic OLS model assumptions, even if the correlation coefficient has filed a high value. Its veracity would be conditional on compliance with these characteristics. Table 2 shows the results obtained for the coefficient of mutual information.

Table 2. Coefficient of mutual information

Coeficiente de información mutua			
Año	Prestamos	T-bill	M1
1987	1.2608	0.7459	1.4733
1988	1.2861	1.1171	1.5651
1989	0.8523	1.1890	1.5552
1990	0.9381	1.2904	0.8861
1991	1.4833	1.5847	1.7242
1992	1.2762	0.6452	1.6185
1993	1.7285	1.1269	1.2861
1994	0.7607	1.3580	0.8043
1995	0.8042	1.1367	0.5297
1996	1.0452	1.2762	0.9776
1997	1.2861	1.4975	1.6566
1998	0.6310	0.8621	0.6212
1999	1.0692	1.5607	1.1607
2000	1.3678	1.2185	1.1945
2001	1.0692	1.6185	0.8861
2002	1.1945	0.6409	1.1030
2003	1.4975	0.9438	1.4157
2004	1.0157	1.0594	1.5214
2005	1.5847	0.6310	1.2523
2006	1.3242	1.7482	1.2087
2007	1.1749	1.2326	1.1269
2008	1.2621	1.1607	0.8762
2009	0.8073	0.2986	1.2523
2010	1.0790	1.5651	1.4256
2011	1.3482	0.4479	1.3383
2012	1.0114	0.2280	0.9536
2013	1.1367	0.7945	1.2621
2014	0.4817	0.7020	0.9990

Source: Author's own elaboration with data from the Federal Reserve Bank of San Luis.

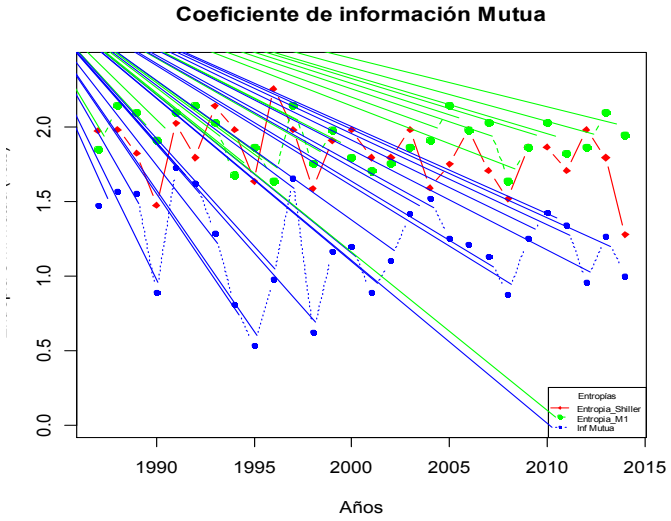
It can be seen that the coefficient of information is different from zero in all cases, thus it is possible to suggest the existence of association between monetary variables and price formation in the real estate sector. The results show that variations in the rate of the information coeficient are synchronized with the easing of monetary policy. According to Greenspan (2004), the crisis of 1987 forced the US government to loosen monetary policy in order to overcome the recessionary environment. From 1987-1988 is evident the increase in the information coefficient for all monetary variables analyzed, but is remarkable, the behavior of the interest rate, which increases from 0.75 to 1.12 nats, which represents an increase of 50 %.

Inflationary pressures force to contract money supply again. The rate of federal funds reached 10% in 1989. In this context the contraction of economic activity increases and in 1990 the government begins with the gradual easing of monetary policy. The interest rate reaches, its lowest level in more than three decades after falling to 2.87% in April 1993. Again the information ratio responds to changes in monetary policy declining in periods of

restriction as in 1989 and grows in periods of accommodative monetary policy like 1990. For 1993, the interest rate reaches its lowest value and the coefficient information jumps around 75%.

In early 1994, thanks to low interest rates, profitability and capitalization of banks was restored beginning the credit expansion. As shown information coefficient for variable loans increases markedly from 1994-1997. Also as it can be seen in the figures presented below there is a strong synchronization in the evolution of the entropies of each monetary instrument and Shiller index.

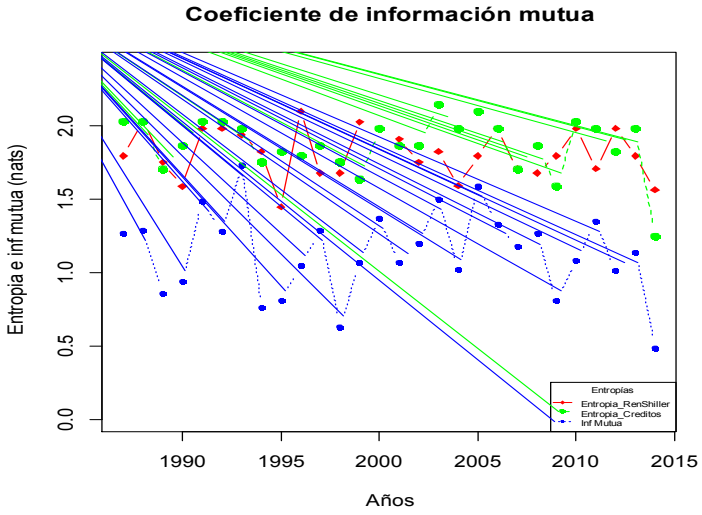
Graph 1. Coefficient of mutual information. (Shiller Index and M1)



Source: Author's own elaboration with data from the Federal Reserve Bank of San Luis.

The results allow us to observe a relationship between variables that increases steadily during periods of monetary expansion which comprise of 1987-1989 and from 2001 to 2004. In accordance with Bernanke (2010), the implementation of an aggressive monetary policy, beginning in 2002 and the falls sustained 1991-1995 and 2005-2008 resulted in the increase speculative activity in the real estate sector.

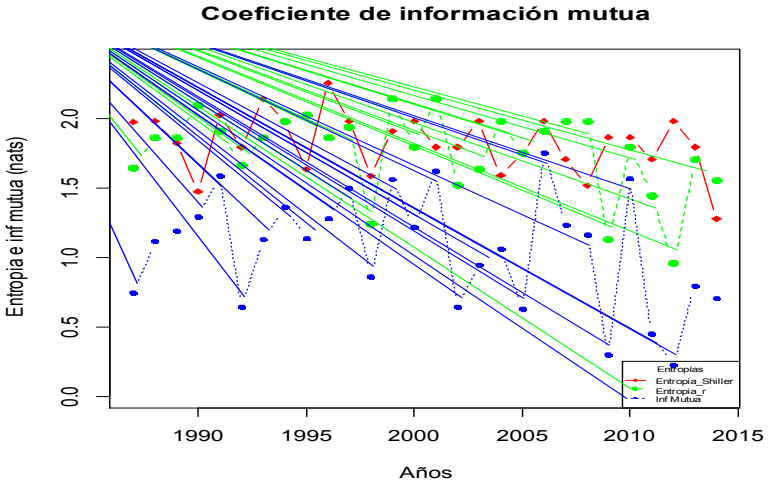
Graph 2. Coefficient of mutual information. (Shiller Index and loans)



Source: Author's own elaboration with data from the Federal Reserve Bank of San Luis.

The empirical results allow us to observe that the relationship between variables increases steadily during periods of monetary expansion which comprise 1990-1994 and 2001-2003.

Graph 3. Coefficient of mutual information. (Shiller index and interest rate)



Source: Author's own elaboration with data from the Federal Reserve Bank of San Luis.

Regarding the association between interest rates and housing prices, it can be seen that this ratio increases steadily from 1987-1991, a period characterized by a marked decrease in interest rates, which was aimed to overcome the recessionary environment after the financial crisis of 1987. It is also remarkable that the information ratio started decreasing from 2010. The lowest degree of association between these variables can be explained by the exceptionally low interest rates, which have reached lower levels around 0.1%. In this context, the dissociation between variables is understandable because the interest rate has ceased to provide information to the market. The very low levels of interest rates induce the economy to a liquidity tramp, leading to an infinitely elastic money demand. Based on the obtained empirical results, it is possible to establish the existence of an association between monetary variables and price formation in real estate. This association increases steadily during periods of relaxation of monetary policy and decreases when monetary policy becomes contractionary.

The results of this study are consistent with those from Xiaoquing (2012). His research shows that decreasing interest rates, rises money supply, and the expansion of mortgage loans accelerate growth in housing prices, while the increase in interest rates, slower expansion in money supply. Finally, the tightening of mortgage loans slows further growth in housing prices. Other research as that from Ahearne *et al*. (2005) cannot conclude that monetary policy has contributed to the increase and decrease of housing prices. However, the results with respect to interest rates coincide in indicating a correspondence between the real growth in house prices and declining nominal interest rates.

In contrast to the obtained results in this research, Bernanke (2010) observes that, based on historical relationships, only a small part of the increase in property prices in the early 90s can be attributed to the stance of monetary policy. Dokko (2009) provides a conclusion in this regard to notice that the policy was not the primary factor that contributed to the extraordinary appreciation in housing markets. According to this author, the relationship between interest rates and the real estate prices is simply not strong enough to explain the increase in investment or residential prices. Although attributed something of importance the low interest rates and monetary accommodation that followed the 2001 recession, the momentum of monetary policy in housing markets was a small factor at that time.

Conclusions

The obtained empirical results showed that the coefficient of mutual information provides an appropriate approach to examine the relationship of money supply, short-term interest rates, and banks' loans with the price formation in the real estate sector. It is worthwhile pointing out that, unfortunately, this coefficient does not allow us to determine the causal direction between these variables, that is, it is not possible to elucidate whether monetary policy affects price formation in real estate or *vice versa*.

We have seen that the association among the studied variables becomes stronger during periods of relaxation of monetary policy. In this sense, we may say that monetary variables provide more information on real estate market when monetary policy is accommodative. On the other hand, the decrease in the coefficient of information can be explained by the increase in speculative activity. In the specific case of interest rates, it is important to notice that this monetary instrument has ceased to provide information to the performance of the housing sector since the Federal Reserve has handle extraordinarily low interest rates.

Finally, it was clear that the formation of prices in the housing market plays an important role in the monetary transmission mechanism and this sector has the potential to affect real growth and to create instability in the financial system. Needless to say real estate prices should be an important variable that monetary policy designers should consider when designing economic policy.

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Vertical Fiscal Imbalance as an Integral Part of the Local Public Sector Financing: Its Determinants in the Case of New and Old European Union Member

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Abstract:

Fiscal decentralization brings certain economic benefits, but also meets certain inconveniences. If the process of decentralization is realized in the mode, that the decentralization of expenditure and decentralization of revenue are divided, the success of its implementation is endangered. Excessive expenditure decentralization without adequate decentralization of revenues creates a gap, which is under the soft-budget constraints conditions completed by intergovernmental transfers. Intergovernmental transfers present a move of public financial resources from central level of government to local levels of government creating vertical fiscal imbalance. The theory is not clear about the eligibility of soft-budget constraints and vertical fiscal imbalance. The economic reality supports their existence and considers them as an integral part of local resources. In this paper vertical fiscal imbalances in the EU countries are analyzed. Using the panel regression with time effects for a sample of new and old EU member states, determinants of vertical fiscal imbalance are identified. Significant negative effect of public deficit and revenue decentralization is observed in all two samples. The impact of time effects differs according to the sample. This paper is published within the project VEGA no.1/0559/16.

Keywords: fiscal federalism; fiscal decentralization; vertical fiscal imbalance local budget; budget constraint; panel model

JEL Classification: H77

Introduction

Vertical fiscal imbalance is a term to express a part of sub - central (sub-national) expenditure, which is financed through transfers from the central level of government or a part of sub – central expenditure, which is not financed through sub – central own revenues. It is directly connected with the Theory of Fiscal Federalism introduced by Oates (1972) as a part of the Public Finance Theory elaborated by Musgrave (1959) and revisited by Musgrave and Musgrave (1984). Here the fiscal decentralization plays a key role. According to Bodman et al. (2009) the fiscal decentralization is an amount of independent decision-making power involved tin sub-national provision of public services, expenditure and revenue decisions in an economy. In general, it represents a shift of responsibilities and powers from central government to lower levels of government. Shift of responsibilities is understood as expenditure decentralization and shift of power presents revenue decentralization (Horváthová 2009). Ebel and Yilmaz (2002) or Rodríguez-Pose and Gill (2003) emphasize the simultaneous implementation of the expenditure and revenue decentralization. However, the asymmetry in expenditure and revenue decentralization creates a space for distortions and requires additional financial resources to finance this gap. Under the conditions of hard budget constraints, the problem may be solved also through sub-national borrowing. Under the soft-budget constraint is this gap solved through intergovernmental grants creating vertical fiscal imbalance. Boadway, Roberts and Shah (2000) mention, that the situation corresponding to vertical fiscal balance could be expressed as situation, when decentralized local governments have on their disposal sufficient sources of revenue to finance their expenditure. The basic condition of vertical fiscal balance is compliance of expenditure responsibilities and fiscal resources on decentralized level of government (or lower level of government). Usually, the scope of revenue decentralization does not rise accurately to the scope of expenditure decentralization. The reason is concerning on the lack of own

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revenue resources of lower levels of governments. Intergovernmental transfer system of financing local needs becomes a rule as a rule becomes an insufficient own revenue source. There are several origins of vertical fiscal imbalance. First, incentives of expenditure decentralization are stronger than incentives of revenue decentralization (decentralization of tax powers). Lower levels of government react more flexible on preferences and needs of corresponding (local) citizens. This is the main reason of the expenditure decentralization. Decentralization of tax powers may lead to inefficiency and inequality among lower levels of government. Additionally, centrally administrated taxation is less expensive in comparison of decentralized units of tax administration and provides unified tax system and tax policy. Second, the shift of sources from central government to lower government levels may play the role of a central government instrument to achieve social welfare goals. Winer and Hettich (2010, 6) define vertical balance as situation that involves an efficient allocation of resources among government levels and between the public and private sector. To complete the idea of vertical fiscal balance, Bird and Tarasov (2004, 78) mention that vertical fiscal balance requires that each level of government separate and independent revenue resources sufficient to finance all expenditure assigned to that level of government.

Correctly set intergovernmental transfer system works as mean of equalization among jurisdictions. They naturally differ because of the unevenly distributed taxable base. According to Boadway, Roberts and Shah (2000) the optimal degree of vertical fiscal imbalance is not set. Similarly, to findings of Sorens (2016), they warn against the negative aspects of vertical fiscal imbalance. Relax of the budget constraint may lead to reduction of spending accountability of local authorities and the loss of motivation to acquire own resources. The importance of vertical fiscal imbalance resists in increasing the efficiency of the entire economy. It allows the tax system harmonization, internalization of the externalities, influencing the lower government levels´ behaviour (through transfers) and to set the redistribution by the central government as mentions Jílek (2008).

The problem of soft-budget constrain was originally elaborated by Kornai (1979, 1980). He deliberated about state - owned enterprises of socialist economies. Their chronic financial losses were compensated by financial aids from central (state) budget. According to Kornai, Maskin and Roland (2003) this problem was later generalized to all economic subjects, which have expected a financial aid from a “sponsor” organisation to solve their deficits. Oates (2005) mentions, that nowadays certain regions and localities behave in this way, whereby the sponsor is in this case is still the central government - state.

Important is an aspect of expectation of lower levels of government. Soft – budget constraints allow financial aids in period of “financial crisis” even in the case when the crisis is individual – bearing on an individual jurisdiction. If the expectation broke out into a convention, it demotivates lower levels of government to behave responsibly and to economize, to create a surplus and to exploit the public resources effectively.

Problem of soft- budget constrains was theoretically elaborated also in the Game Theory. Under the information asymmetry conditions, the central government launches threats to local governments, that in case of local financial problems it will not provide an aid (Innman 2003, Rodden 2003). Local governments have to decide whether they will behave as under the hard – budget constraints or they will still expect an aid from the central government. Consequently, the central government have to make a decision about the provision of financial aid.

The related literature body in not compact about the economic eligibility of vertical fiscal imbalance. Sorens (2016) distinguishes among two main approaches to vertical fiscal imbalance (gap). First, the public finance theory approach, second, the political economy approach. Public finance theory sees the equalization as the main reason of creating vertical fiscal imbalances. The absence of equalization encourages the negative impact of tax competition on tax rates (in sense of the race-to-the-bottom hypothesis). Equalization also serves to solve the distortions caused by the existence of interjurisdictional externalities. Political economy approach is sceptic about the importance of intergovernmental transfers programs that create vertical fiscal gaps. Excessive revenues from transfers and shared taxes reduce incentives of sub-central governments to behave competitively, undermine the fiscal discipline and lead to waste of financial resources. Despite of this, fiscal decentralization is still promoted for its economic benefits (Jha 2015); even some authors mention its potential menaces (Tanzi 2000).

The aim of the paper is to examine the presence of the vertical fiscal imbalance in the system of sub – national financing in the EU and to identify its determinants in the cease of two samples - new and old EU member states. The paper is organized in a following way. Introduction is followed by the literature review. Next chapter

expresses the methods and date used in the research. After it, the results and discussion are provided. Conclusion and References are situated at the end of the paper.

1. Literature review

Vertical fiscal imbalance is an object of many researches, which contain its origin or nature, its determinants or its relationship with other macroeconomic categories. Shah (2006) declares that intergovernmental transfers are a dominant (and so important) feature of subnational finance in most countries. Sorens (2016) provides a theoretical review and an empirical meta-analysis of the vertical fiscal imbalances (gaps) and economic performance on a sample of USA. According to him, vertical fiscal imbalance is created as a difference between the expenditure decentralization and autonomous revenue decentralization. Expenditure decentralization is here defined traditionally as the share of sub-central spending on central plus sub-central expenditure. Autonomous revenue decentralization is defined as share of sub-central own revenue on central plus sub-central revenue. He mentions that in cross-national and cross-state studies of the US the fly-paper effect is observed. For the tax burden the results of studies are less consistent. Income per capita is reduced by the increase of sub-central government dependence in the US states. Aldasoro and Sieferling (2014) investigate the relationship between vertical fiscal imbalance and government indebtedness. They mention that expenditure decentralization occurs more frequently as revenue decentralization what causes vertical fiscal imbalances. According to them, the vertical fiscal imbalance attempts to measure how the sub-central government spending is financed through sub-central own revenues including the incurrence of subnational debt liabilities (Aldasoro and Sieferling 2014). Using the Fixed-effect models with time dummies with sample of 47 world countries they revealed significant positive impact of vertical fiscal imbalance on general government gross debt, and significant negative impact of expenditure decentralization.

Eyraud and Lusinyan (2013) define vertical fiscal imbalance as the share of subnational own spending not financed through own revenues. They estimated the influence of vertical fiscal imbalance on general government primary balance at the sample of OECD countries using the fixed-effect estimations. Their research is set on an assumption that vertical fiscal imbalance relaxes fiscal discipline. The significant negative influence is obtained what means that the fiscal discipline is fortified with decreasing transfer dependence and borrowing of the subnational level of government. The impact of expenditure decentralization is significant and positive. Karpowitz (2012) provides case studies of narrowing vertical fiscal imbalance in Belgium, Italy, Norway and Spain. These countries had to face the asymmetry in expenditure and revenue decentralization what led to creating vertical fiscal imbalances. Trying to reduce them, certain reforming steps were introduced in these countries. The undesirable situation with high vertical fiscal imbalances was in Belgium, Italy and Spain solved by the revenue decentralization (devolution, as the strongest of expression of the decentralization). Only in Norway reforms tended to centralization. Karpowitz (2012, 17) mentions some obstacles in the revenue devolution; loss of cheap resources, inadequate tax base, weak administration and tax competition.

Bordignon, Gamalerio and Turati (2013) stressed the vertical fiscal imbalance inconveniences in Italian municipalities. According to them, the process of decentralization in the ´90s caused differences among tax base what led to vertical fiscal imbalance. Municipalities in northern part of the country were more financial autonomous and they were able to finance approximately 70% of their expenditures. The situation in the south of the country differed. Municipalities were considered as poor and were granted by the central government. Bordignon, Gamalerio and Turati (2013) introduce a career-concern model of politics based on the Game Theory. After using to OLS with panel correction standard error, they study effect of a decentralization reform on consumers´ welfare and political candidacy in Italian municipalities with a different tax base. Winer and Hettich (2010) treat with vertical fiscal imbalance in Canada. They are attached with the definition of vertical fiscal imbalance built on the mismatch between revenue sources and expenditure responsibilities. To reduce the vertical fiscal imbalances, they suggest the reduction of federal taxes in favor of provinces, to provide them with additionally own resources. Here the electoral competition plays a key role in the achieving the efficiency. Boadway and Tremblay (2006) investigate the principle of sequential decision – making by different government levels and problems of commitment, which could increase a vertical fiscal imbalance in federations. Transfers are considered as undesired, because they cause derogations from the vertical gap optimum. Under the conditions of decentralized federation, the problem of vertical

externalities is examined. They admit the relevance of vertical fiscal imbalance as the response of the federal government to coordination failure between regional governments (Boadway and Tremblay 2006, 40). Bird and Tarasov (2004) stress both vertical and horizontal fiscal imbalances and intergovernmental transfers in countries as Australia, Austria, Belgium, Canada, Germany, Spain, Switzerland, and the United States (federal states). According to them there does not exist a universal guide how to implement recommendations of the Theory of Fiscal Federalism or how to design an intergovernmental transfer system. Aversion of central government to shift the power of revenue seeking on lower levels of government and simultaneous aversion of lower levels to be responsible for all decision make a system inefficient. They mention that there is not economic reason for equalization and intergovernmental transfers and the decision about their provision is political.

2. Methods and data

Data are collected on annual base covering the period from 2000 to 2015 (balanced panel). The source of data is the Eurostat Database (2016). Data are of the nature of longitudinal or panel data (combining cross-section and time-series data). The sample of EU member countries is divided into two sub – samples referring to the EU accession; sub – samples contain or new EU member states or old EU member states. Consequently, two panel models are estimated. Vertical fiscal imbalance represents the dependent variable. Explanatory variable is fiscal decentralization indicator. Control variables involved to estimations are reflecting the related literature. To capture the specific time coefficients focusing on the period heterogeneity, time effects were introduced to estimations.

Basic assumptions about the relationship between fiscal decentralization indicator and vertical fiscal imbalance should distinguish the concept of the fiscal decentralization quantification. According to Stegarescu (2005), Blume and Voigt (2008) Bodman *et al.* (2009) or Afonso and Hauptmeier (2009) there are several modes of fiscal decentralization measurement. Frequently used indicators are expenditure and revenue decentralization. In connection with vertical fiscal imbalance these two indicators may have contradictory effects. As the revenue decentralization indicator shows the source of sub - national revenues, in this paper the revenue decentralization indicator serves to determine the vertical fiscal imbalance.

Certain control variables were involved to the estimation. The negative positive relation between the population variable and vertical fiscal imbalance is expected. Vertical fiscal imbalance is also influenced by the public sector expenditure. The imbalance between resources and needs creates the surplus or deficit (in prevalent part of countries creates the deficit), so the public deficit variable is here considered. Its negative impact on vertical fiscal imbalance is expected reflecting the fact, that the main source of public deficit is created on central level of government.

Vertical fiscal imbalance measurement is may be expressed using several constructions. In the mode used by Boadway, Roberts and Shah (2000), Martinez-Vazquez and Boex (2001) or Blume and Voigt (2008) the vertical fiscal imbalance indicator is constructed as share of transfers from central level of government on sub - national government expenditure. They present a following formula:

$$VFI = \frac{\sum transfers\ \ from\ \ central\ \ level}{\sum sub - national\ \ \ exp endtiure} * 100\% \quad (1)$$

According to Sorens (2016) the alternative interpretation is given. The vertical fiscal gap is created as a difference between the expenditure decentralization and autonomous revenue decentralization as shows the Figure 1.

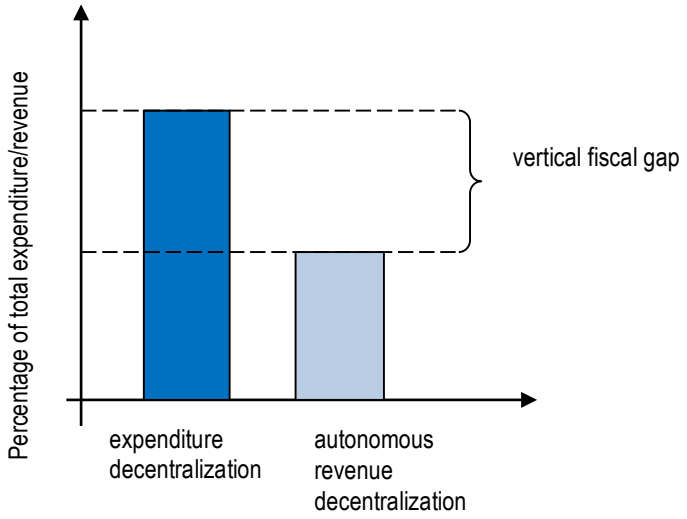
Eyraud and Lusinyan (2013) or Aldasore and Sieferling (2014, 7) mention a modified measure of vertical imbalances. It is established on transfer dependency incorporating subnational government borrowing (r^{own} and s^{own} are subnational government own revenue and subnational own spending):

$$VFI = 1 - \frac{r^{own}}{s^{own}} \quad (2)$$

Sub - national own spending is expressed as the difference between total sub – national spending and transfers paid by the sub – national government. The inconvenient of this indicator is that the sub – national control

over resources of revenues is measured imperfectly. It is caused by the incorrect recording of revenues from shared taxes as tax revenues instead of received transfers (Eyraud and Lusinyan 2013, 8). On the spending side the existence of regulation from the central level of government is not excluded and covers also earmarked expenditure.

Figure 1. Vertical fiscal gap

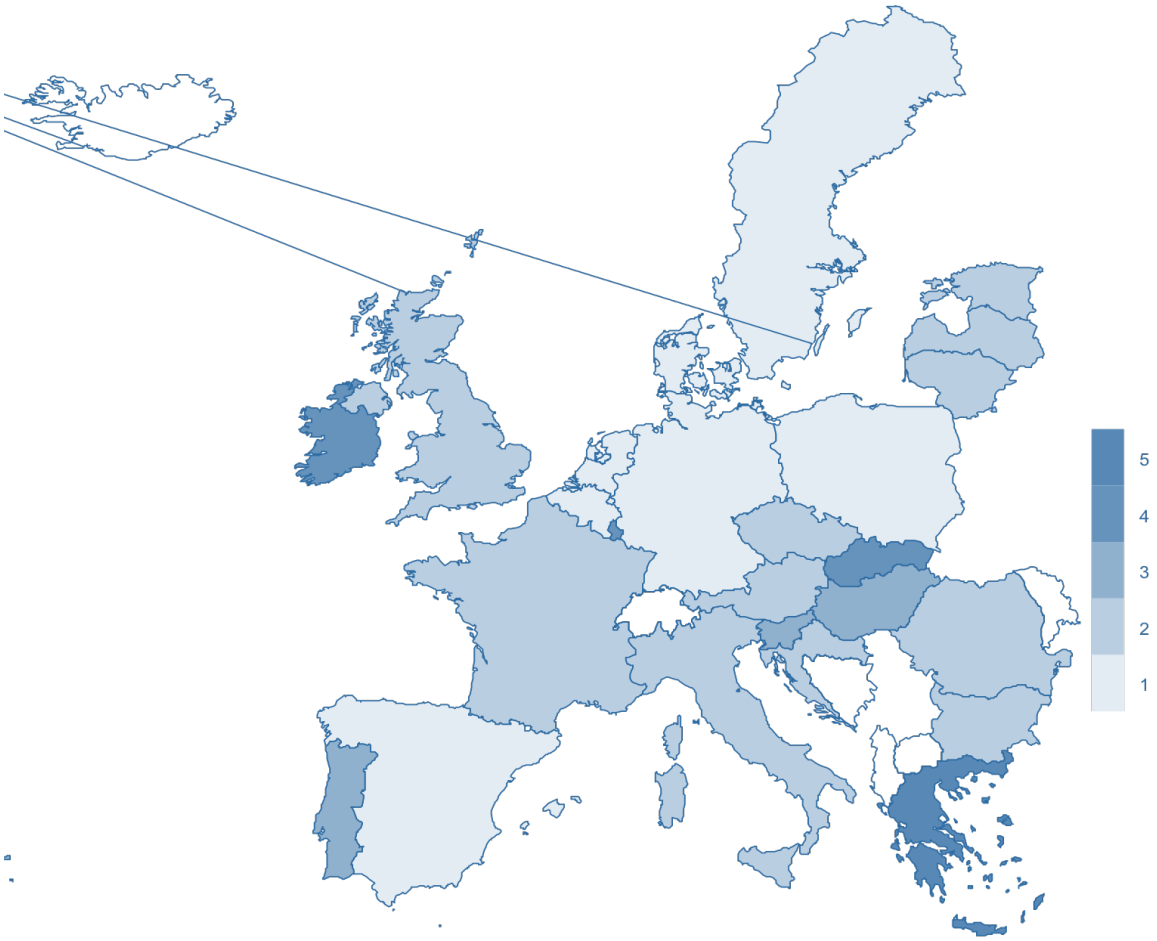


Source: According to Sorens (2016, 4).

For the paper purpose the indicator promoted by Boadway, Roberts and Shah (2000), Martinez-Vazquez and Boex (2001) or Blume and Voigt (2008) is used, see Eq.(1). Figure 2 shows the vertical fiscal imbalances average values of EU countries in period of 2000 – 2015.

The prevalent part of EU countries has the average vertical fiscal imbalance values in the lower part of the predefined scale (see the Legend of the Figure 2). In the middle of the scale are Hungary, Portugal and Slovenia. In the case of Slovakia, Luxembourg and Ireland, the scale shows the fourth degree of the range. In these countries transfers create approximately 75% of sub-central spending. As Horváthová (2009) mentions, in Slovakia lower levels of governments are highly dependent on central level and main part of their revenues is obtained in the form of transfers. Additionally, the main sub – national tax revenue is from the shared tax. In Ireland the financial crisis in 2010 influenced the public expenditure structure (Fitzgerald 2014). In Luxembourg, the sub – national spending is financed using mainly the transfer payments from central level of government, Municipalities taxable base consists on real estates used for commercial purpose (Široký 2009). The darkest shadow of the colour palette is achieved by Greece and Malta (territorially too small to be displayed on map). In these countries are spending of lower levels of governments are financed exclusively through transfers. In Malta the absence of local taxes is observed (*e.g.* Široký 2009, does not mention local taxes in his survey of EU countries tax systems). In Greece, massive transfer was shifted to local governments in 2012 and 2013 accompanied by the economic growth decrease and unemployment increase (Karafolas and Alexandrakis 2015).

Figure 2. Vertical fiscal imbalance average values (2000 – 2015) in EU countries



Legend: countries are displayed in shadows of grey according to the rate of VFI, 1 (the lightest shadow of grey) denominates countries with VFI in interval from 0 to 20%; 2 – 20% - 40%; 3 – 40% - 60%; 4 – 60% - 80% and 5 (the darkest shadow of grey) denominates countries with VFI more than 80%.

Source: own according to data from Eurostat

3. Vertical fiscal imbalance determinants – results and discussion

According to panel diagnostic (Arellano and Bond 1991), the basic OLS panel regression (pooling model) was tested against the adequacy of FEM or REM. In case of FEM or REM adequacy the final model was estimated according to Hausmann test (Hausmann 1978). For both samples of new and old EU member states the FEM model with time effect seems to be the most appropriated following the procedure mentioned hereinbefore. In both case the Robust (HAC) standard errors is used to avoid problems with heteroskedasticity and autocorrelation. Results of the FEM estimations with time effects for new and old EU member states separately are presented in Table 1. Classification criterion is the accession date (in parentheses). New EU members are Bulgaria (2007), Cyprus (2004), Croatia (2013), Czech Republic (2004), Estonia (2004), Hungary (2004), Latvia (2004), Lithuania (2004), Malta (2004), Poland (2004), Romania (2007), Slovenia (2004), Slovakia (2004). Old EU members are Austria (1995), Belgium (1958), Germany (1958), Denmark (1973), Finland (1995), France (1958), Greece (1981), Ireland (1973), Italy (1958), Luxembourg (1958), Netherlands (1958), Portugal (1986), Spain (1986), Sweden (1995), United Kingdom (1973).

Table 1. Estimations of vertical fiscal imbalance for new and old EU member states

	New EU member states			Old EU member states		
	Dependent variable: Vertical fiscal imbalance FEM 13x16, Time effects Robust (HAC) standard errors			Dependent variable: Vertical fiscal imbalance FEM 15x16, Time effects Robust (HAC) standard errors		
	coefficient	*p-value*	*Significance*	*coefficient*	*p-value*	*significance*
const	−2.1867	<0.0001	***	2.2635	0.0014	***
popdensity	0.0245	<0.0001	***	−0.0088	0.0735	*
PubDefGDP	−0.1104	0.0014	***	−0.0665	0.0012	***
RevDec	−7.8689	0.0124	**	−2.2171	0.0086	***
dt_2007				−0.2612	0.0576	*
dt_2009	0.1798	0.0371	**			
dt_2015	0.3110	0.0124	**			
Within R^2	0.32			0.41		
Hausmann test	p-value<0.05			p-value <0.05		
Legend: *** denotes significance at 0.01 level, ** at 0.05 level and * at 0.1 level.						

Source: own calculations

The results of estimations for new EU member states show significant negative effect between vertical fiscal imbalance and revenue decentralization. The increase of revenue decentralization causes the reduction of the vertical fiscal imbalance, what supports given assumptions. The raise of subnational part of public revenue indicates the fortification of the regional and local government position in source seeking.

Additionally, if the vertical fiscal imbalance is defined as the difference between the expenditure decentralization and revenue decentralization (see Sorens 2016), increase of revenue decentralization reduces the gap, and consequently the vertical fiscal imbalance is reduced, too. This result represents a match with the findings of Karpowitz (2012), where problems induced by existing vertical fiscal imbalance were solved by enhancing the revenue decentralization. It also corresponds to the results of Eyraud and Lusinyan (2013). Here the relationship between vertical fiscal imbalance and expenditure decentralization is significant and positive. The increase of expenditure decentralization causes an increase of vertical fiscal imbalance.

Relationship between public deficit and vertical fiscal imbalance is significant and negative. Increase of public deficit leads to a decrease of vertical fiscal imbalance. In the situation of increasing public deficit, certain actions taken by central government are indispensable. Despite the fact, that in such a case a centralized decision making is promoted in expense of fiscal decentralization (according to normative conclusions of Theory of Fiscal Federalism the macroeconomic stabilization is provided centrally, Oates 2005), public expenditures are often revisited and reduced. This is accompanied by the diminution of transfer payments of central government. Here the findings of Aldasoro and Sieferling (2014) seem to be opposite (they revealed significant positive impact of vertical fiscal imbalance on general government gross debt), but taking into account the adverse estimation of this relationship, our results are not in conflict with these of Aldasoro and Sieferling (2014).

The positive impact of population density on vertical fiscal imbalance indicates an increasing demand for public goods. In general, the augmentation of the population (or the population density) creates a pressure on public expenditure. The case of increasing demand for local public goods (provided by lower levels of government) creates the need of raise of local expenditures. Without the flexible reaction on the revenue side (because of the legislatively assigned powers or because of the time factor) the required need for public resources is satisfied by transfers from the central government budget. Increase of the share of transfers on subnational expenditure presents an increase of vertical fiscal imbalance (as mentions *e.g.* Veiga and Veiga 2014). Of course, in the terms of hard-budget constraints the sub-national borrowing comes on disposal. Using this instrument, the total public deficit and total public debt is influenced. That is why the central government does not remain on the preservation of golden rule of balanced budget (mentioned *e.g.* in Dafflon 2002) at the sub-national level using own effort (the borrowing facilities) and accedes to transfer payments.

In the case of the new EU member states certain time dummies are significant. In the year 2009 the vertical fiscal imbalance in new EU member states increased. This year is often labelled as the year of financial crisis that fastened almost all European countries (Šuliková *et al.* 2015), although Fidrmuc and Lind (2016) dates its beginning to period of 2007-2008. In the period of financial crisis countries had to face financial problems at each government level. Dropouts in sub - national revenues fortified the transfer dependency of sub- national governments on central level. They increased the vertical fiscal gap and thus increased the vertical fiscal imbalance. The period of financial crisis influenced the evaluation of the fiscal decentralization implementation and proofs of its success became ambiguous and unclear. As Maličká (2012) mentions, countries in transition implemented the fiscal decentralization with certain time delay in comparison with Western Europe or Canada and USA. Delayed fiscal decentralization implementation (in the 2000´s) was additionally disturbed by the division of the expenditure and revenue decentralization and by the financial crisis. The main goal of fiscal decentralization to fortify the sub-national fiscal autonomy was in the period of fiscal crisis not achieved and sub-national level remained strongly dependent on sources of central government. In certain countries as Czech Republic and Hungary the process of fiscal decentralization was inhibited also by the fragmented territorial structure (Boex, Martinez-Vazquez, Timofeev 2004). Time dummy for year 2015 indicates also an increase of vertical fiscal imbalance in the new EU member states. It may be caused by the economic recovery in the period of 2013 - 2014, when the central government in conditions of increasing revenues shifts more sources on lower levels of governments. Nota bene, reasons may be diverse. *E.g*. in Hungary, central government financed the sub-national debt after the 2013 from central level budget (Reuters 2012).

Results of the estimations for old EU member states do not essentially differ from those of new EU member states. The final FEM estimation with time effects reveals significant negative relationship between revenue decentralization and vertical fiscal imbalance. The relationship between public deficit and vertical fiscal imbalance is similarly to the case of new EU member states significant and negative. Differences are observed in the effect of population density. In the case of old EU member states, the relationship between the population density and vertical fiscal imbalance is negative. This result may be explained by the lower fertility rate in developed countries (as mentions Šuliková *et al.* 2015, 950). Decrease of population density presents a diminution of a taxable base, and missing resources have to be completed by transfer payments. In the FEM estimation for old EU member states the time dummy of the year 2007 is significant and the sign of its coefficient is negative. As it was mentioned hereinbefore, according to Fidrmuc and Lind (2016) and also according to Aldasoro and Sieferling (2014) the financial crisis hurt the economies of many countries in the EU in 2007-2008. Aldasoro and Sieferling (2014, 10) observed the notable increase in the average vertical fiscal imbalance (what is also the case of new EU member states). In the case of old EU member states contrary, the decrease of vertical fiscal imbalance is observed. This situation may be explained by the construction of the used vertical fiscal imbalance indicator. In time of crisis, central level may decrease transfer payments to sub – national government. The freeze of sources on central level of government serves to create funds necessary to realization of the centrally provided macroeconomic stabilization and redistribution (Oates 2005). Decrease of transfers and unchanged sub – national expenditure causes decrease of the vertical fiscal imbalance indicator.

Conclusion

The aim of the paper is to explain the presence of vertical fiscal imbalance in the sub – national finance and to analyze vertical fiscal imbalance determinants using the regression models for panel data. EU countries divided into two sub – samples were analyzed estimating the FEM with time effects to capture the period (2000 – 2015) heterogeneity. The results of estimation for new and old EU member states do not differ essentially, although certain derogations are observed. In both estimations the negative significant relationship between revenue decentralization and vertical fiscal imbalance is observed. Strengthening the financial autonomy of sub – national government the transfer dependency is reduced. Both models reveal significant negative influence of public deficit on vertical fiscal imbalance. Increase of public deficit (created mostly on the central level of government) initiates reduction of transfer payments in aim to realize the centrally provided macroeconomic stabilization. Results about the impact of population characteristics on vertical fiscal imbalances differ regarding the sample. In the case of new

EU member states, the relationship between population density and vertical fiscal imbalance is significant and positive. It signalizes increasing demand for public goods financed through transfer payments. In the case of old EU member states, the situation differs. The relationship between population density and vertical fiscal imbalance is significant and negative. Lower fertility in developed countries causes a decrease of the population density. It causes the diminution of a taxable base, and missing resources have to be completed by transfer payments. In both estimations certain time effects are significant. The period of financial crisis affected positively vertical fiscal imbalance of new EU member states in 2009. Dropouts in sub - national revenues fortified the transfer dependency of sub- national governments on central level. Significant positive effect of time dummy for year 2015 may be explained by the restoration of transfer flows from central level of government induced by the economic recovery. In case of old EU member states, the time dummy of 2007 is significant. Its negative effect on vertical fiscal imbalance may indicate the reduction of transfer payments in these countries following the purpose of creating sources to realize the centrally provided stabilization and redistribution functions of the public finance.

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Analysis of Factors of Investment Activity in Russia through the Construction of Econometric Model

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Abstract:

Investment policy - is one of organic components of the economic policy. Implementation of effective investment policy in many respects depends on a strategy correctness and tactics of general economic reforms at the macro- as well as at the micro-level.

Key words: investment policy; investment climate; Russian Federation; regional policy; econometric model; econometric modeling; identifying the main factors of investment activity

JEL Classification: C5, E22.

Introduction

Forming effective investment policy aimed at changing the investment climate requires assessment of available improvement opportunities, and finding the most effective directions for applying the efforts of regional authorities.

To this end, the main, most important components of the investment climate can be divided into two large groups: stable and changeable. Stable factors are characterized by low susceptibility to deliberate action in the short term. Their change requires long time and results in a significant shift in the region's economy. Thus, ownership type change at production facilities, such as replacement of government ownership with private, leads to a completely different form of interaction between the authorities and the productive sector. The change of stable characteristics in the management is either difficult (such as spatial and climatic factors), or associated with the radical change in the nature of management.

Changeable components include factors that are susceptible to the effects of management at the regional level. Investment attraction policy is basically carried out through the change of these factors. Thus, the creation of an appropriate model is one of the basic tasks of government.

The following factors, roughly classified as stable, can be distinguished at the regional level. First of all, it is, as already mentioned, the territorial factor, climatic conditions, security in the region by various types of natural resources. As a stable factor we can also name the demographic factor, due to the complexity of the changes in the short term, its characteristics such as overcrowding or under-population (labor surplus) in the region, the proportion of the economically active population, the proportion of people of retirement age, the ratio of urban and rural population, etc.

Components of investment climate can be characterized by very close mutual influence and large interdependence. In addition to stable components of investment climate it is possible to allocate some factors that are largely a consequence of its other factors.

One of these factors is the degree of interregional relations. Tightness of interregional relations in a given region is largely determined by its production structure and the financial condition of its manufacturing sector. Export opportunities in the region are determined by the level of competitiveness of goods produced at enterprises located on the regions territory, as well as by the degree of product differentiation. The structure of imports in the region also depends on how highly specialized the area is, the extent of the regions ability to provide itself with productive

resources and consumer goods. It is clear that the ratio of imports and exports is a direct consequence of these factors.

Another such factor is the degree of public trust to the regional government, the degree of polarization of political sympathies, relationship between regional authorities and federal center. It is largely determined by the kind of policy carried out by regional power bodies, the degree of effectiveness of this policy. This factor is also strongly influenced by the level of socio-economic development of the region, both in itself and in comparison with neighboring regions.

Another factor essentially determined by the other components of the regional investment climate, is the level of social tension and crime in the region. We know that crime and social tensions tend to increase in proportion to the deterioration of the material conditions of the population, *i.e.*, reduction in real income of most of the population, increase in unemployment, a decrease in the availability of premises, etc.

The degree of financial security in the region can also be attributed to the group of factors conditioned by other components of investment climate in the region. Securing regional government expenses with income depends on:

- size and structure of these expenses, *i.e.* the regional policy (for example, presence and magnitude of regional marketing costs, qualitative assessment of repayment of loans provided to enterprises by the regional administration), social situation in the region (volume of social benefits and other expenses to reduce social tension in the region), demographic structure of the population;
- income value and structure in the constituent entity of the Federation, ie development of manufacturing and other sectors of economy (tax revenue), regional policy (tax incentives), specialization and structure of economy in the region (depth of recession during reformation years, degree of favorable economic conjuncture for certain sectors).

Thus, we can conclude that the main components of investment climate may be subject to deliberate action by a regional investment policy. Further, by means of building an econometric model we will try to identify the main factors that need additional incentives in order to create a favorable regional investment climate. After consideration of the major factors affecting the attraction of foreign investments, we construct a model using econometric methods, including all the factors described above into the model.

Since one of the main sources of investment financing is the profit of the enterprise, the ability of the region's economy to increasing the volume of investment is determined by the profitability of existing enterprises on its territory. Thus, the factor of development of infrastructure, which is crucial for a strategic investor in organizing a new production on any territory or in creating a joint venture, to some extent, takes a back seat. A favorable investment climate largely determines the ability of the existing conditions in the region to ensure the restoration and development of existing businesses, increase their profitability and, consequently, increase foreign investment.

The choice of a criteria and prognostic evaluation of its effectiveness, as a rule, are largely subjective. An approach used in this work is based on the following:

- objective analysis of the investment sphere functioning in the regions, which itself implies taking into account peculiarities of the transition period and the characteristics of investment processes in Russia
- use of economic and mathematical modeling for the analysis and forecasting of investment processes
- taking into account the specifics of investment sphere in a particular region, as opposed to the use of standardized development criteria

One method of regional forecasting is building econometric models (Magnus, Katishev, Peresetsky 2014). Econometrics – the science that, using mathematical and statistical methods, allows to reveal quantitative relationship between the studied parameters and influencing factors. The main tool of econometrics is the econometric model, *i.e.,* economic and mathematical model of factor analysis, the parameters of which are estimated by means of mathematical statistics. This model serves as a tool for analysis and forecasting of specific economic processes based on actual statistics. According to traditional econometrics, econometric modeling of economic processes is carried out in several stages:

- building of the economic model (choice of the basic economic criteria, selection of explanatory factors, building a system of connections between the criterion (the result obtained) and selected factors);
- data collection (statistics materials);
- choice of estimation method (least squares method, Gauss method, the weighted least squares method, and others);
- evaluation of the model using the selected method;
- control of the quality of the econometric model.

For the purposes of this study it would be particularly interesting to build a model that would allow to influence the inflow of investments in the region through the previously defined (available for the impact of the regional administration) factors of the investment climate and to forecast the effect of the use of certain measures, such as introduction of new facilities, benefits and guarantees.

The coefficients estimated in the course of solving the system of equations are essentially weights reflecting the importance of the relevant factors for the investment climate in the region, *i.e*., the degree and nature of its influence on investment processes.

Thus, the regression equation is not the sum of factors that dissimilar in their nature, the nature of the impact on the investment climate and units. It is a weighting function, by detecting the correlation between the factors and the resulting process (investment activity in the region), reflecting the approximate dynamics of investment activity in case of the explanatory factors change in its terms of quantity per unit. Units of the explanatory variables are taken, in accordance with accepted in official statistics used in the ranking, etc.

The test of the hypotheses presented in this work will be carried out using regression analysis techniques and, in particular, by building and evaluating the multiple linear regression models. It should be noted that regression models were used earlier by a number of Russian and foreign authors for investigating investment attractiveness. Thus, regression model was also used in the study of E. Kolomak (2000) to analyze the economic impact of attracting investments to the regions. Also, the issue was raised in the work of the Institute of Economy in Transition.

The work is dedicated to econometric analysis of the factors determining the investment processes in the Russian regions. In particular, there has been conducted a study of interdependencies of variable sets that characterize some aspects of investment processes in the Russian regions, and many economic variables that reflect the economic situation in the region and having a potential impact on the volume and structure of investment in the region. The analysis is based on regional data published by the Federal State Statistics Service. It has considered 16 indicators characterizing the investment activities in the region. These indicators can be divided into 7 groups: 1) the overall level of investment activity; 2) the distribution of investments by form of ownership; 3) the distribution of investments by investment objects; 4) public investment; 5) investment from its own funds; 6) investments of borrowed funds; 7) foreign investment.

This work studies the impact of the individual indicators on a number of characteristics of the investment on the regional level which reflects various aspects of the economic situation in the region. Multiple regression model enables to include quite a number of factors in this study. On later stages it would be possible to identify the most important and on this basis to draw conclusions on the following aspects:

- *firstly*, define the impact of various factors on attraction of foreign investment;
- *secondly*, suggest methods for attracting foreign investment based on the comparison of the obtained results.

The least squares method was used to estimate the parameters of the regression equations *(i.e.* the coefficients of the variables). The coefficient of determination R^2 and the adjusted coefficient of determination R^2 reflect the correlation between studied phenomena. The values of these coefficients stay in the range [0, 1]. The closer the estimated value of coefficients to 1, the stronger the correlation between variables.

In general quality equations testing was performed using the F-statistic, and the test of the regression coefficients - using t-statistics at a certain level of significance.

Critical value of t - statistics were determined from the table of the Student distribution for testing the hypothesis of a coefficient being equal to zero in the regression. The specified level of significance was determined by the number of degrees of freedom which equals N (m-1). The random variable tj is subject to this distribution, if the true value of the corresponding coefficient is zero.

The critical values of t - statistics were given for the level of significance α = 0,05. Required critical t - statistics was derived from the table given the value of the degrees of freedom v. If the value of tj exceeds the value of tcr from the table for v = N * (m-1), then it can't be said that the coefficient bj = 0 because the probability of such event is not more than 0.05. In this case the coefficient bj is significant. If tj <tcr, then the coefficient bj is insignificant.

After the test of the significance of the estimated coefficients of the linear model, the program calculates the estimates of two-factor interactions of coefficients and their corresponding values of t - statistics.

Calculation of estimates of two-factor interactions of coefficients is carried out according to the formula:

$$bjk = \Sigma yi*xij * xik/N$$

where: bjk - estimates of regression coefficients during product of factors xj and xk, $j \neq k$.

The level of significance is the probability of rejecting a correct hypothesis. The lower the value, the more likely the equation and its coefficients are statistically significant. Correlation between the variables considered statistically significant if the significance level is less than 0.1. This means that the confidence level at which the coefficients in the regression equation we determined should be not less than 90%.

Durbin-Watson test is also performed to evaluate the quality of the model. The model is considered to be reliable, and can be used for the forecast if the value of this criteria exceeds 1.4 (Eliseeva 2013).

Statement of hypothesis

The study is based on a number of hypotheses. Hypotheses are a set of cause-and-affect relationships and reflect the dependence of the volume of investments in the region on influencing factors - the components of the investment climate in the region.

Thus, hypotheses qualitatively explain the correlation between the degree of investment activity in the region and the processes and objects on the regional level, which also influence this correlation.

Hypothesis 1: The volume of investments attracted to the region primarily depends on the existing level of social and economic development in the region.

Hypothesis 2: The policy pursued by the regional administration also has a significant influence on the volume of investments attracted to the region. Among the most important instruments of regional investment policy there are budget allocated for development, guarantees to investors, and the marketing of the region.

Hypothesis 3: The volume of investments attracted to the region is affected by fiscal policy, especially in terms of tax incentives for priority sectors of the region and investment tax benefits to investors, provided during the payback period of the investment project.

All of these hypotheses are represented as a regression equation. The regression equation with the parameters for evaluation is:

$$y = a0 + a1x1 + a2x2 + \ldots + a_m x_m + e$$

where: y – resulting factor; x – describing factors; a – regression coefficients; e – error.

Econometric model is described by the nine unknown coefficients:

$$Inv\_Come = c1 + c2 * VMP + c3 * SP + c4 * ACT + c5 * ST + c6 * LAW + C7 * PR + c8 * MARKET + c9 * PROG + c10 * POL$$

where: Inv_Come - the volume of investments attracted to the region, minus budgetary investments; VMP - the volume of industrial production in the region for the year in th. Rub; SP - type of specialization of the region defined as the major industry in terms of rubles in the regional structure of industrial production (eg. machine manufacturing-0), etc; ACT- level of the economically active population; ST- educated population, defined as the number of students in higher and secondary special educational institutions; LAW-the presence or absence of the law "On investments"; PR- size of benefits for income tax (%), granted by law in the region; MARKET- number of references of the region on foreign internet sites; PROG-presence (1) or absence (0) of development programs in the region; POL - political regime (1 stable, 2 relatively stable, 3 unstable, 4 uncertainty) in the region.

Variables are tested for multicollinearity after being defined. This is done by regressing each IV (independent variable) to all other IV. For example, we want to test the equation:

$$Y' = a + b1X1 + b2X2 + b3X3 + e$$

through such equations:

$$X1 = a + b2X2 + b3X3;$$

$$X2 = a + b1X1 + b3X3;$$

$$X3 = a + b1X1 + b2X2.$$

If R^2 for any of these equations will be higher than, 75%, we can conclude that there is a significant Multicollinearity.

Table 1. Multicollinearity calculation

Variables	R^2
VMP	67%
SP	23%
ACT	46%
ST	43%
LAW	16%
PR	59%
PROG	40%
POL	53%
Market	72%

Source: compiled by the author.

It may be noted that R^2 in each case less than 75%, therefore, we can use all the variables in the analysis. We can also use the logarithmic form of equation:

LOG(INV)=C(1)+C(2)*LOG(VMP)+C(3)*LOG(PR)+C(4)*LOG(MARKET) +C(5)*LOG(POL)

The next step is to evaluate the statistical significance of each coefficient of the system of equations. The resulting equations are solved with the least square method. Least square method was chosen because this method is common for evaluating of regression models.

Interpretation of the results

The data for evaluating the model is taken from the official statistics by region in the work "Regions of Russia". As a result, we obtain the evaluated econometric investment-factor reliability model. The resulting model can be widely used. The model can be used to analyze the relationship between the influx of investments in the region and its determining factors: the dependence of the degree of influence of one or another factor.

Assessing the impact of the explanatory factor to the outcome variable is carried out by calculating t-statistics.

Table 2. Assessment results of the multiple regression model at the regional level (9 independent variables) dependent variable: Foreign investment inflow in the regions (I_r)

INV=C(1)+C(2)*VMP+C(3)*SP+C(4)*ACT+C(5)*ST+C(6)*LAW+C(7)*PR+C(8)*MARKET+C(9)*PROG+C(10)*POL				
Parameter	Value	Standard Error	T-Statistics	Significance Level
C(1)	40 907	15340,46	2,666609	0,0110
C(2)	-88,4396	124,6316	-0,70960	0,0821
C(3)	-6801,57	6610,619	-1,02888	0,3097
C(4)	45787,25	11547,23	3,965214	0,0003
C(5)	-1396,02	474,0217	-2,94506	0,0054
C(6)	-559,892	8786,832	-0,06372	0,9495
C(7)	-1658,03	1030,488	-1,60898	0,1155
C(8)	4,63456	1,973970	2,347841	0,0239
C(9)	-3258,18	5862,754	-0,55574	0,5815
C(10)	-8686,59	2559,858	-3,39338	0,0016
R^2 (determination coefficient)	0,660370	Mean dependent var		16019,04
Adjusted R-squared	0,583954	S.D. dependent var		17250,01
S.E. of regression	11126,54	Akaike info criterion		21,64891
Sum squared resid	4,95E+09	Schwarz criterion		22,03132
Log likelihood	-531,2228	Durbin-Watson stat		0,924279

Source: compiled by the author

Determination coefficient R^2 = 66,03%. This means that there is a strong relation between the dependent and explanatory variables in the equation. Indicators can be arranged in order of significance: ACT, POL, ST, MARKET, VMP, PR, SP, PROG, LAW. Next let us consider which variables are the most significant in the equation, which, in fact, reflects the most important factors for attracting investments to the regions. Let us consider the results of a logarithmic model.

Table 3. Results of logarythmic model calculations

LOG(INV)=C(1)+C(2)*LOG(VMP)+C(3)*LOG(PR)+C(4)*LOG(MARKET) +C(5)*LOG(POL)				
Parameter	Value	Standard Error	T-Statistics	Significance Level
C(1)	6,6194	3,638612	1,819210	0,0755
C(2)	0,1905	0,334380	0,56988	0,5716
C(3)	-0,7429	0,692831	-1,07229	0,2893
C(4)	0,5096	0,489915	1,04023	0,3038
C(5)	-0,5905	0,332919	-1,773700	0,0829
R2 (determination coefficient)	0,1800	Mean dependent var		9,252878
Adjusted R-squared	0,1072	S.D. dependent var		0,927191
S.E. of regression	0,8761	Akaike info criterion		2,667975
Sum squared resid	34,5400	Schwarz criterion		2,859177
Log likelihood	-61,6990	Durbin-Watson stat		0,870054

Source: compiled by the author

Determination coefficient R^2 = 18%. This means that there is a weak relation between the dependent and explanatory variables in the equation. Next let us consider which variables are the most significant in the equation, which, in fact, reflects the most important factors for attracting investments to the regions.

Development of industry, volume of industrial production (VMP parameter)

Expansion of industrial production, the conquest of new markets and access to the world level is currently associated with the level of technology in the sector, region or country as a whole. Production technology in the world today is one of the key factors in economic development. However, the Russian technological factor is one of the constraints. Thus, the depreciation of fixed assets in the industry is over 50%, and the share of obsolete

equipment reached almost one third of fund assets. In such a situation, the production is ineffective (reduced product quality, increasing costs, etc.), the enterprises are unprofitable, and therefore investment, the main source of which - own funds (including the share of profits the most significant), are minimal.

Thus, the lack of investment at present, delays the possible investment in the future, and becomes a critical factor of the development process.

Marketing efficiency in the region (MARKET parameter)

Effectiveness of regional investment marketing has not yet been investigated; however, this component of the policy has a significant weight in the structure of investment expenditures of the regional budgets. Investment marketing includes quite a wide range of different activities. It includes organization of exhibitions for products manufactured in the region, publication and distribution of a variety of promotional and informational pamphlets and booklets, placing of information about the region in press and worldwide network, conduct and participate in seminars and conferences on investment, establishment of direct contacts with foreign companies, financial-industrial groups, credit unions. The active marketing policy often involves investment in the local printing industry, which significantly increases the total budgetary cost of marketing.

After the first period of reforms in Russia, investment marketing has become the subject of considerable controversy among politicians and economists. The focus of the investment policy (regional in particular) largely on marketing and infrastructure was heavily criticized, as the use of budgetary funds for these purposes was not effective because of the low investment attractiveness of the Russian enterprises. The majority of Russian enterprises were unprofitable, had physically and morally obsolete technical equipment, were not able to provide liquid collateral for funds credited to them. Thus, according to the magazine "Expert", repayment of loans issued under the guarantee of the government, was only 16%. Indeed, the priorities of the regional authorities are the financial recovery of enterprises and increasing the economic potential of the territory by reducing the tax burden and the pre-investment preparation, industry and investment tax benefits, raising the educational level of the population, etc.

At the same time, Western economists value the information resource. The fundamental work about the growing role of information in the investment processes published by Kenichi Ohmae (2000). Our researchers confirm that, despite the difficult socio-economic situation in Russia and the lack of budget funds, the construction of a competent marketing system in the region is necessary, and insufficient attention to the problems of information may reduce the effectiveness of public policy as well as it reduces the quality of business decisions.

Support of investors: Tax benefits, garantees (PR parameter)

Support of enterprises conducting investment activities through budgetary sources is now the primary means of regional investment policy. Partial funding for major regional projects from the budget (so-called "development budget"), "frefusal" of the authorities from obtaining a share of tax revenues (investment tax credits), and assistance in obtaining loans guaranteed by the regional administration and absorb most of the budget allocated to the investment policy. The results of our empirical analysis showed the highest value of such policy tool of investors' support as development budget.

Specialisation of the region (SP parameter)

Industry charachteristics of attracting investment have been recognized by several Russian authors. Thus, N. Frolov (2003) found out in his work that the ability to attract direct foreign investment from the locally-oriented regions (with no export potential) and export-oriented differ significantly.

Significance of specialization and diversification of the regions is indicated by foreign authors. For example, the study on the development of cities in both developed and developing countries suggests that the level of specialization/diversification of the economy in the region has a significant impact on the concentration of economic activity in them or, on the contrary, its outflow to other regions. And the less economically developed a country is, the greater differentiation in the level of business activity inside it is caused by these factors. Moreover, even the development of the country may take the form of increasing differentiation of regions on economic indicators, rather

than convergence, as is often assumed. The authors (Bevan and Estrin 2000) also argue that the differentiation of the regions is also contributed by localization of political power in certain cities (*i.e.*, non-uniform distribution of it), which is taken into account in our clusterization.

The assessments obtained as a result of our econometric analisys confirm the importance of industry factor.

Number of students (level of education in the region) (ST parameter)

The quality of the labor force has traditionally been seen as one of the key factors of economic growth and investment climate. Low labor capacity is often significantly hindering economic growth. Systematic investment in education in the form of grants and capital construction of buildings of educational institutions are able to significantly improve the quality of the workforce and as a consequence, to stabilize the investment process.

Conclusion:

The results we received in our investigation also depict high importance of this factor for investment and, in particular, for regional investment in Russia. One of the economic policy priorities in Russia is to attract Russian and foreign investments in the real sector of economy. The role of foreign investment in the region is primarily in the fact that their involvement should contribute not to exhausting resource potential, but to recovery of all sectors of the economy in the new scientific and technological base, technological breakthroughs, creating new and modern industrial products, development of production infrastructure.

Econometric modeling of economic processes takes the following steps: building the economic model (choice of the basic economic criteria, selection of explanatory factors, building a system of connections between the criterion (the result obtained) and selected factors); data collection (statistics materials); choice of estimation method (least square method, Gauss method, the weighted least square method, and others), evaluation of the model using the selected method, control of the quality of the econometric model. The constructed econometric model revealed the following most important factors of investment attraction: industry development, investment marketing, support of investors: tax benefits, garantees, development budget, specialisation of the region, number of students (education level in the region).

In general, the volume of foreign investment in most regions does not correspond with their investment potential, and well-constructed investment policy, especially of the regional and federal authorities, will encourage inflow of foreign capital, next larger than the current inflow of foreign funds (Pozdnyakov 2015).

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On the Science and Research Efficiency of Czech Universities: A Data Envelopment Analysis

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Abstract:

The quality of higher education depends on the quality of scientific research of their employees. University scientific research and education are inseparable. Rating of their level is currently the subject of many scientific and expert discussions. At the present time, there is a prevailing pressure to create a categorization of universities on the basis of their scientific performance, which should translate also in the process of distribution of state subsidies for universities. In order to stop the process of stagnation in the quality of higher education it is necessary to identify the barriers to its growth as soon as possible and propose solutions for their elimination. For this reason, questions of objective and independent evaluation of the quality through multidimensional economic analysis are nowadays being brought more and more into focus. It was the ambition of our research.

We aimed to evaluate the effectiveness of science and research at universities in the Czech Republic to find out the real state as well as the suitability of the applied method chosen for the evaluation process. We run Data Envelopment Analysis on data on faculty level. Our findings suggest, that efficiency level of faculties in global view is fair enough, but place for improvement still exists. Our analysis shows that 53% of the faculties in the Czech Republic operate on efficient way in term of Science and Research. Most equilibrated groups in term of efficiency is group of Engineering, followed by group of Architecture, group of Psychology and group of Informatics. Least equilibrated groups are group of Economics, group of Sociology and group of Law.

Key words: data envelopment analysis; Czech Republic; universities; faculties; efficiency

JEL Classification: C67; I21

1. Introduction

Higher education is often seen as a public good that is accessible to everyone. On the majority of markets with education, private and public colleges and universities coexist. Private colleges finance their activities by their own sources, while public universities are dependent on public funds. In both cases, the majority of financial resources is coming out from enrolled students. This fact is the topic of debate of nowadays, because universities can directly influence their budgets by a number of admitted students. This matter of fact implies question about the quality of education.

Various non-scientific approaches exist to measure out the quality of universities. On the international level, we can find about twenty more or less established and accepted ranking. Among them, one of the most accepted

is Times Higher Education World Reputation Rankings which define top 100 most powerful global university brands by using 13 performance indicators, which are grouped into 5 areas: Teaching: the learning environment what is 30% of the overall ranking score; Research: volume, income and reputation which are worth 30%; Citations: research influence that's worth 30%; Industry income: innovation, which make an impact by 2.5%; and International outlook: staff, students and research that worth 7.5% of the overall ranking score. Another well-established ranking is done by QS World University Rankings® which provides individual ranking positions for top 400 universities in a global dimension. QS World University Rankings work with 6 parameters. These are: Academic reputation (40%), Employer reputation (10%), Faculty/Student ratio (20%), Citations per faculty (20%), International student ratio (5%), and International staff ratio (5%). The following is The Academic Ranking of World Universities which yearly ranks top 500 universities all over the world. This ranking works with four criteria divided into six indicators. Criteria have following weights: Quality of Education: (10%); Quality of Faculty (40%); Research Output (40%); Per Capita Performance (10%).

Naturally, alongside with global universities ranking exist also national university rankings. These are often based on global universities rankings parameters. For instance, in the Slovak Republic, the Academic Ranking and Rating Agency, which is an independent Slovak civil association exists, and yearly ranks universities in accordance with parameters used by the above mentioned agencies. These parameters are following: Education, Attractiveness of study, Doctoral studies, Research, Grants. This ranking is done separately for individual fields of study, which are: Technical Sciences, Natural Sciences, Medical Sciences, Agricultural Sciences, Economic Sciences, Other Social Sciences, Philosophical Sciences, Law Sciences, Pedagogical Sciences, Theological Sciences and Arts.

In the Czech Republic, ranking is done by the influential journal Economic Newspaper, which is the member of the European Business Press Federation. Parameters are: International school involvement, Teaching staff, Interest in the study, Survey of graduates, Science and research. Czech ranking distinguishes seven main fields of study: Architecture, Economics, Informatics, Law, Psychology, Sociology and Engineering.

The aim of this study is to measure the efficiency of Czech faculties with respect to field of study. Dividing faculties into a particular field of study is done with the purpose to have a homogenous group of units. In total, 59 faculties in 7 fields of study entered our analysis. To perform our analysis, we are using Data Envelopment Analysis (hereafter DEA).

The paper is organized as follows: in next part the Literature review is proposed. Then, Materials and Methods are precisely described. Afterwards the Description of Variables is done. Analysis and Results are in chapter four. Final part of the paper is devoted to the discussion and Conclusion.

2. Literature review

DEA is often times used to settle technical efficiency of entities. Abbott and Doucouliagos (Abbott and Doucouliagos 2003) found that regardless of the output-input mix, Australian universities as a whole recorded high level of efficiency relative to each other. Another study from Australia (Avkiran 2001) shows also that Australian universities have in average fair efficiency. Nazarko, Komuda and Szubzda (2008) use subsidies as the input and the number of students and scientific grants are treated as the output. Authors showed that the majority of the universities in Poland possesses reserves in technical and allocative efficiency. Bayraktar, Tatoglu and Zaim (2013) run DEA to measure the relative efficiency of quality management practices in Turkish public and private universities.

Authors showed that private universities with higher levels of quality management efficiency on stakeholder-focus indicators achieved better performance in terms of fulfilling the expectations of their stakeholders. Sav (2013) run analysis on a dataset consisting of 331 US public universities. Author indicate that tuition dependency promotes inefficiency while increased government funding yields efficiency gains. Another finding of the study is that investment income appears to have a slight negative effect, albeit statistically weak. Results of the study reveal that public universities efficiencies have improved over time.

Agasisti and Dal Bianco (2006) run DEA on 58 Italian public universities. Authors found that the majority of universities perform well for various input and output specifications. Afonso and Santos (2008) run DEA on Portuguese Public Universities. In this study inputs are the number of teachers and universities' spending while the

outputs are the undergraduate success rate and the number of doctoral dissertations. Authors identified well performing universities and those which does not perform well. Agasisti and Johnes (2009) use DEA to compute the technical efficiency of Italian and English higher education institutions. Authors' results show that institutions in England are more efficient than those in Italy when comparing jointly their performances. Authors also look at the evolution of the technical efficiency scores over a four-year period, and find that Italian universities are improving their technical efficiency while English universities are obtaining stable scores. Agasisti and Pérez-Esparrells (2010) employ DEA to analyze efficiency of Italian and Spanish universities. Authors found that Italian universities are relatively more efficient than those in Spain. Afonso and Aubyn (2005) showed on a dataset consisting of OECD countries, that efficiency in education is in some cases linked to the efficiency in the health sector. Breu and Raab (1994) measure relative efficiency of the top 25 universities in the United States. Authors find that the most prestigious universities always generate the highest level of satisfaction among students. Authors suggest that university expenditures should be aimed more at increasing levels of efficiency, rather than to improve the perceived quality. McMillan and Datta (1998) run DEA on a dataset of 45 Canadian universities to assess their relative efficiency. They used nine different specifications of inputs and outputs. Authors showed that the relative efficiencies of Canadian universities are quite consistent. Flegg, Allen, Field and Thurlow (2003) examined technical efficiency of 45 universities in UK between 1998 and 1993. Authors revealed a rise of 51.5% in total factor productivity over the study period. This growth in total factor productivity was brought predominantly by a marked outward shift in the efficiency frontier rather than by enhanced technical efficiency. Kempkes and Pohl (2007) run an analysis of German universities dated within the period 1998-2003. Authors found that East German universities have performed better compared to those in West Germany. García-Aracil and Palomares-Montero (2008) examined the productivity of the Spanish public universities from 1994 to 2004 using four different specification models. Results of Spain study indicate that annual productivity growth was largely attributable to technological progress rather than efficiency improvements. Partial analyses of teaching-only, research-only and industry-only productivity suggest that most productivity growth was associated with improvements in research rather than teaching and knowledge transfer. Jeck and Sudzina (2009) run DEA on dataset consisting of 96 faculties in Slovak Republic. Authors use teaching staff as input variable and number of graduates, publication in Current Contents Connect® and number of patents as output variables. Authors found that one half of faculties in the Slovak Republic are effective. Authors found no differences in efficiency caused by location of faculties. Authors also argue that 21 faculties do not reach economies of scale, thus are too big. Kubák, Bačík, Szabo and Bartko (2014) shoved that efficiency of universities in the Slovak Republic is diverse and results depend on input-output mix. Kuncová, Bíza Bisová and Mulač (2015) performed DEA analysis on dataset consisting information about Czech universities. Authors used several models with various inputs and outputs and showed that the efficiency of Czech universities and colleges is not bad.

3. Materials and methods

The aim of this study is to study technical efficiency of Czech universities at the faculty level. Following on from Chapter 2, which evaluates potential methods of DEA in evaluating the efficiency of the processes, we decided to apply this method to meet our research objectives. DEA method uses traditional principles embodied efficiency as the ratio of output the unit produces to input the unit consumes during the operation. The set of allowable effective solutions is determined by the efficient frontier consisted of efficient units. A unit which would achieve the same output while using fewer inputs, or the one which would achieve higher production output using the same number of inputs is considered to be an efficient unit. In principle, the basis of the DEA method is a generalization of the proportional ratio to the ratio of the weighted sum of outputs and the weighted sum of inputs.

Let consider n production units $U_1, U_2, \ldots, U_n$. We have r outputs and m inputs to analyze their efficiency. Let the matrix of inputs to have this form $\mathbf{X} = \{x_{ij}, i = 1, 2, \ldots, m, j = 1, 2, \ldots n\}$ and the matrix of outputs this form $\mathbf{Y} = \{y_{ij}, i = 1, 2, \ldots, r, j = 1, 2, \ldots n\}$. The rate of efficiency of the unit U_q will be then expressed as a ratio:

$$\frac{\sum_{i=1}^{r} u_i y_{iq}}{\sum_{j=1}^{m} v_j x_{jq}}, \quad (1)$$

where the weights are assigned to *j* inputs and *i* outputs.

DEA model is based on the existence of a set of acceptable options created by all possible combinations of inputs and outputs. For the comparison of efficiencies of each unit an efficient frontier is search, due to which the units are relatively related to. When using DEA models, the weights can be different for each production unit and are not identified other subjective methods (such as expert estimates), but only from data. It is assumed, that each unit is trying to manage its position in space of inputs and outputs, so that the efficiency rate given by formula (1) was the maximal. For calculation of optimal values of inputs or outputs the linear combination of several units is usually being used (Jablonský and Dlouhý 2004). We are using homogenous groups of datasets, thus, faculties are separated according to the field of study.

The need of separation of universities within homogenous groups was shown in (Mikušová 2015), where on the dataset from Czech Republic the effect of specialization of the universities on results on DEA is demonstrated. We are doing so, because of the fact, that analysis on the level of universities does not absorb differences in tuition, research, budgeting, etc. We are making use of data from Ranking of Czech universities provided by Economic Newspaper. We do it so, because of the fact, that these data are in the form of composite indicator and thus have some advantages. Among many, the most important convenience of data on this form is the fact, that they reduce the size of the sample, include more information and summarize complex issues in a simplest way. Moreover, DEA, which is used in this study is highly sensitive to the number of inputs and therefore, the more inputs one use, the more efficient units one can find in a model. In our model, we consider 3 inputs and one output. Inputs are *International School Involvment, Interest in Study, Teaching Staff.* Output is *Science and Reseach*.

4. Description of variables

In this subchapter, we briefly describe variables that we use and the reason why we use them. We excluded one variable that can be found in Ranking of Czech universities provided by Economic Newspaper. This variable is the *Survey of Graduates*, because we do not see any impact of this variable on *Science and Research, and* we find this variable to be very subjective one. Moreover, this variable aquires value 1 if survey is done and value 0 if not and therefore this dichotomy would nasty our analysis.

Our variables set up was inspired by Flegg *et al.* (2003). Authors use the number of staff, the number of undergraduate students, the number of postgraduate students, aggregate departmental expenditure as input variables and income from research and consultancy, the number of undergraduate degrees awarded and the number of postgraduate degrees awarded as some output variables. For familiarization with widely used input and output variables, see Rosenmayer (2014, 45).

4.1 Input variables

International School involvment

This indicator tells us how many percent of the total number of students spent at least a semester at the universities abroad. The higher the percentage of outgoing students is, the better score school has. Indicator also contains the number of foreign students who have spent at least one semester at given faculty (this number takes into account the total number of students at the faculty). The higher the percentage of incoming students is, the better school is ranked. The indicator also monitors the number of foreigners who are studying entire study program at school. This number is given as the ratio to the total number of students. The higher the percentage of foreign students are, the better position of the school is. Indicator contains also the percentage of theses defended in a foreign language. The higher the percentage, the better for faculty.

We consider this variable as an input, because we believe, that diversity is helpful in the research process. This is also the reason, why international study stays and internships exist.

Interest in the study

This indicator detects the chance of admission for faculty, thus the ratio of applicants and admitted students. The lower the percentage of applied to enrolled students is, the better score faculty receives. The indicator also monitors the ratio of admitted and actually enrolled students. The higher the percentage of students enrolled, the better score school has. Further indicator documents the interest in doctoral studies on the faculty - a number of PhD students to total students. The higher the percentage of doctoral students, the better score school has. Indocator also tracks the percentage of doctoral students who received a second degree at another school. The higher the percentage, the better score school has.

We consider this variable to be an input, because we assume, that if students see school as a good one, they are willing to study in given school and do not take it only as a second option in case, when they have been admitted to several schools. Thus, if the school has good students, they can be helpful in research process when completing their thesis for instance. Moreover, regarding PhD students, we believe, that these ones have the strongest stimuli for research.

Last but not least, the income side of universities´ budgets is above all determined by number of students.

Teaching staff

This indicator detects, how many teachers completed in the past academic year at least a three-day continuous stay at a foreign university, research facility or conference. This number takes into account the total number of teachers at given faculty. The higher proportion of teachers comes out during the year, the better score school has. Indicator also monitors a long-term experience of teachers abroad. Indicator checks the number of academics and scientists who have ever lived in the past more than a year at a foreign university or research facility. The higher percentage of the total teaching staff satisfies this condition; the better score school has. Indicator also evaluates and individual approach: the fewer students per teacher, the better score school has.

This variable is treated as an input, because it is a logical consequence of fact. More researchers are able to do more research. But this input also reflects the quality of academic employees and, therefore, we capture the matter of well-informed individuals.

4.2 Output variable

Science and research

Indicator assesses faculties according to the results of the research in 2013 as collected by the Council for Research, Development and Innovation. The total number of obtained points is recalculated to the number of academic staff who work at the faculty as researchers and teaching staff.

This variable is considered as an output, because nowadays the quality of universities is measured mainly by its ability to do research. Also Tomkins and Green (1988) suggest that research reflects the market value of universities, thus can be used as output variable. Moreover, higher education has a nature of public service and public services are influenced by public policy. Science and Research cannot be influenced by public policy to such an extent as can be influenced number of students, or teaching staff.

5. Analysis and results

As mentioned above, this study aims to assess efficiency of faculties in Czech Republic. We distinguish seven fields of study, which are: Architecture, Economics, Informatics, Law, Psychology, Sociology and Engineering. We are not able to measure efficiency of medical faculties, because these refused to participate in the ranking, from which we use the data.

In our analysis, we use Data Envelopment Analysis, which is the method that basic idea consists in enveloping positions of the monitored entities with a line called efficiency frontier. All entities not present at this line are considered as inefficient. This method does work under the condition that at least two entities, also known as

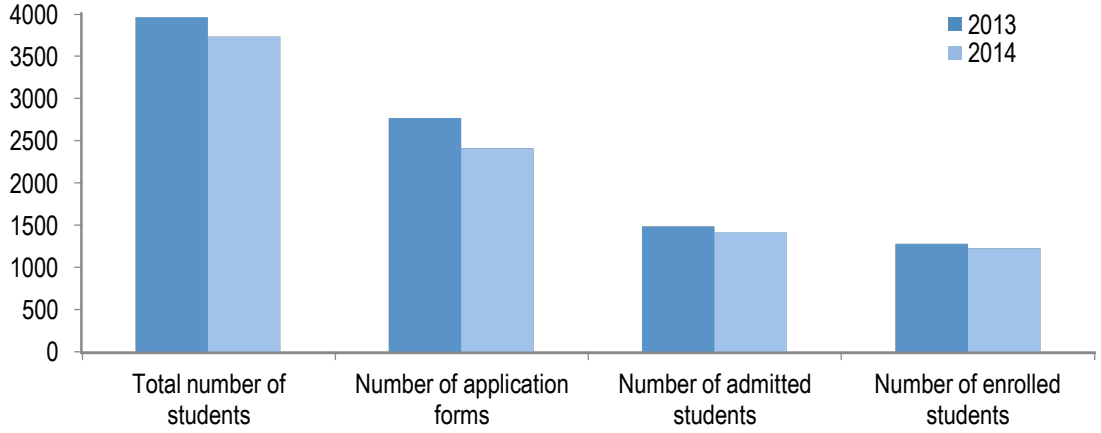
Decision Making Units, must be compared and at least one of them is always effective. Effective one lies on the efficiency frontier. Others may be inefficient and inefficiency is then measured as the distance from the efficient frontier. DEA assigns score 1 to units which are efficient and score inferior to 1 to those, which are inefficient. The minimum obtainable score is 0. We consider variable returns on scale in our DEA (Banker, Charnes and Cooper 1984). Our analysis is dedicated to output oriented DEA what means that we are interested in maximizing the weighted sum of outputs, whereas keeping fixed the weighted sum of inputs.

In following seven subchapters, results of our analysis are presented. In every table, faculties are in the order they finished in the Ranking of Czech universities (Economic Newspaper 2015).

5.1 Architecture

The basic evolution within the architectural field of study is shown in Figure 1. One can see a mine drop in the number of students and associated indicators between 2013-2014.

Figure 1. Architecture



Source: Economic Newspaper (2015)

Within a group of architecture, the Faculty of Civil Engineering - Czech Technical University in Prague is ranked in the first place. This was due to fact that a big number of teachers and students visited foreign universities. Additionally, the school has a good ratio of students per teacher. Last but not least, school has also the best scientific results from all schools assessed in this field. Table 1 depicts the results of DEA. It indicates, that 60% of faculties within this group operate in an efficient way in terms of Science and Research output. Major deficiencies within this group have two faculties, Department of Architecture - Academy of Arts, Architecture and Design in Prague and Faculty of Architecture - Czech Technical University in Prague. First named should improve research activities by 76%, second one by 45% with given resources.

Table 1. DEA output model – Architecture

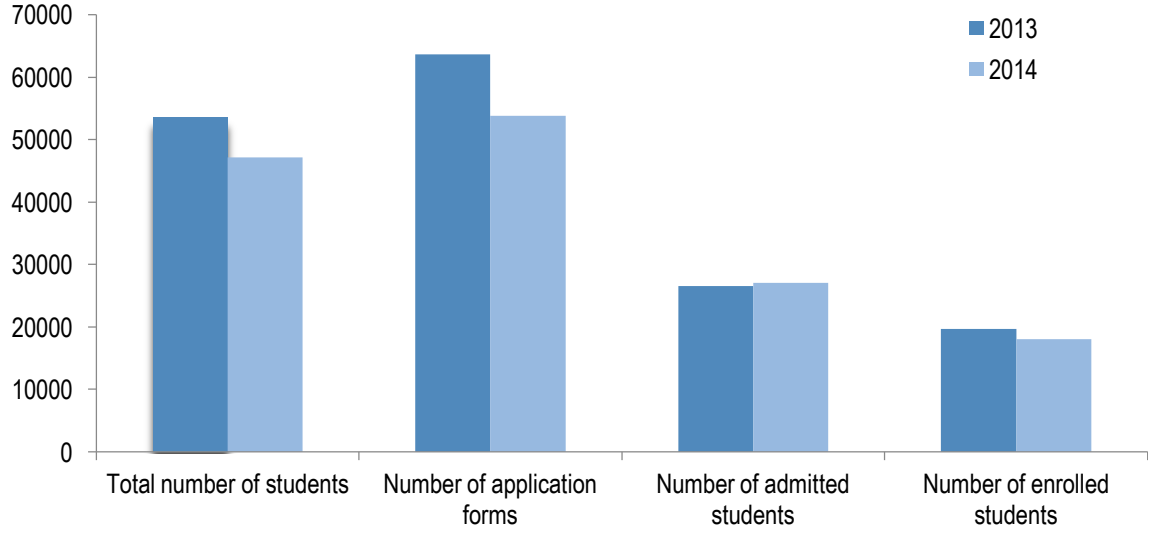
Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Civil Engineering - Czech Technical University in Prague	1.3	3.6	2.8	5	1
Faculty of Civil Engineering - Brno University of Technology	3.1	2.8	1.2	4	1
Department of Architecture - Academy of Arts. Architecture and Design in Prague	3.8	2.6	4.2	1	0.238095
Faculty of Architecture - Czech Technical University in Prague	3	1.9	3.2	2	0.549451
Faculty of Civil Engineering - VSB - Technical University of Ostrava	2	1.1	2.4	3	1

Source: own processing of data provided by Economic Newspaper (2015)

5.2 Economics

Group of Economics is a biggest stakeholder on the market of education. Economics schools in the Czech Republic have in charge 49% of the total number of students in the country. The basic characteristics of the field of economy are on the Figure 2. It is evident that unfavorable demographic changes influenced faculties in the group of Economics. Controversial is rise of number of admitted students' despite of fact, that number of application forms drastically declined in 2014 compared to 2013.

Figure 2. Economics



Source: Economic Newspaper (2015)

Group of Economics consists of 21 faculties. First in the line ranked Institute of Economic Studies - Faculty of Social Sciences - Charles University in Prague. This faculty recognizably outperform others faculties mainly due to the fact, that students write a thesis in a foreign language. Moreover, 13% of students' study abroad at least one semester. Not the least, faculty have the best performance in research activities. Results of DEA are in Table 2.

Table 2. DEA output model – Economics

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Institute of Economic Studies - Faculty of Social Sciences - Charles University in Prague	21	14.7	18	21	1
Faculty of Economics - University of Economics, Prague	13.5	11.8	19.9	17	0.842776
Faculty of Business and Economics - Mendel University in Brno	16.8	12.7	11	16	0.785063
Faculty of Management and Economics - Tomas Bata University in Zlin	10	14.9	10.8	19	0.962025
Faculty of Informatics and Statistics - University of Economics, Prague	5.8	15.2	14	18	1
Faculty of Informatics and Management - University of Hradec Kralove	14.8	15.6	9.6	12	0.592398
Faculty of Economics and Administration - Masaryk University	13.6	9.6	14.1	14	0.759574

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Economics and Administration - University of Pardubice	10.6	11.2	6.7	20	1
Faculty of Economics and Management - Czech University of Life Sciences	17.7	12.9	9.7	8	0.39476
Faculty of Finance and Accounting - University of Economics, Prague	9	6.1	15	15	1
Faculty of Business and Management - Brno University of Technology	9.5	10.9	14.6	10	0.533201
Faculty of International Relations - University of Economics, Prague	17.7	10.1	13.8	3	0.158549
Faculty of Economics - Technical University of Liberec	9.9	8.5	11.6	11	0.633898
Faculty of Economics - University of West Bohemia	9.5	13.1	13.4	4	0.204691
Faculty of Business Administration - University of Economics, Prague	15.5	9	9.7	6	0.344187
Faculty of Economics - VSB - Technical University of Ostrava	9.2	14.1	6.1	9	0.502793
Faculty of Economics - University of South Bohemia in Ceske Budejovice	4.9	8.8	4.7	13	1
School of Business Administration in Karvina - Silesian University in Opava	3	11.7	7.5	7	0.998521
University of Finance and Administration, Prague	6.2	5	8.5	1	0.12416
Faculty of Management - University of Economics, Prague	2.4	3.8	7.8	5	1
Faculty of Social and Economic Studies - Jan Evangelista Purkyne University in Usti nad Labem	3.5	5	3.3	2	1

Source: own processing of data provided by the Economic Newspaper (2015)

First of all, we can state, that one third of faculties in this group work in an efficient way. These faculties are faculties with DEA score equal to 1. One can say that also the faculties with DEA score superior to 0.9 are good performers. These are Faculty of Management and Economics - Tomas Bata University in Zlin and School of Business Administration in Karvina - Silesian University in Opava. Then we can define moderate performers, which DEA score above 0.5. Finally, we can list weak performers with DEA score inferior to 0.5. These faculties are Faculty of Economics and Management - Czech University of Life Sciences, Faculty of International Relations - University of Economics – Prague, Faculty of Economics - University of West Bohemia, Faculty of Business Administration - University of Economics – Prague, University of Finance and Administration – Prague. These faculties should raise their output, thus Science and Research activities in a significant way, or reduce inputs, thus resources.

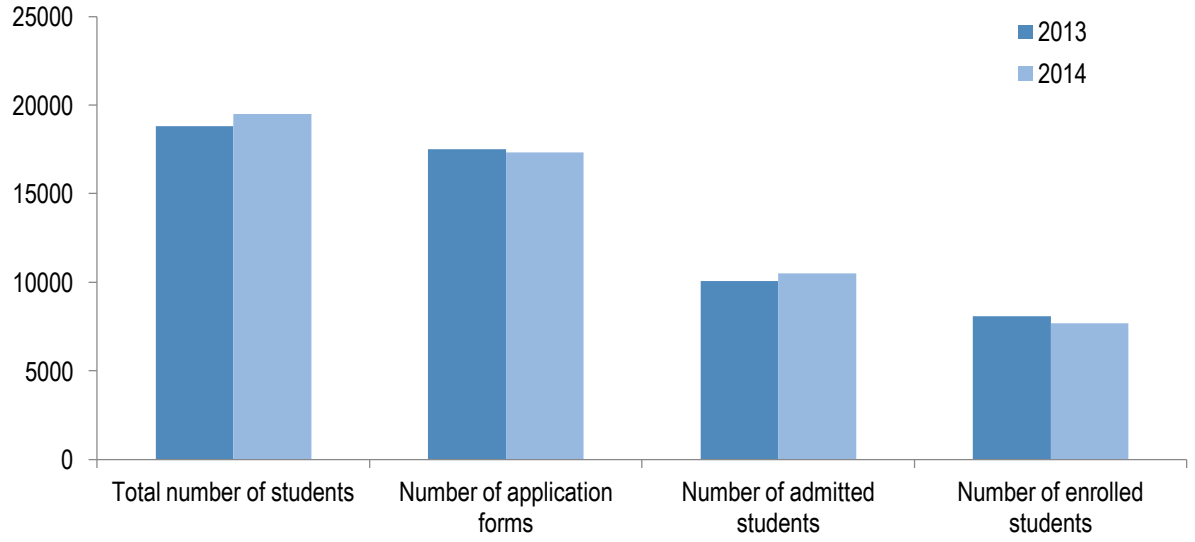
5.3 Informatics

Group of informatics is the second biggest stakeholder on the market of education in the Czech Republic. Over 20% of all students in the country study informatics. Figure 3 indicates the situation in the group of Informatics. Among all fields of study, group of Informatics is only one in which total number of students raised from year to year. Moreover, the decline in numbers of application forms was no as sharp as in other groups.

In group of Informatics the Faculty of Electrical Engineering - Czech Technical University in Prague ranked first. This was due to the fact, that a lot of people from abroad is willing to spend a semester at the faculty. Many

students of this faculty write a thesis in a foreign language. The faculty has also a big number of PhD students. The faculty is also performing well in Science and Research.

Figure 3. Informatics



Source: Economic Newspaper (2015)

Concerning DEA results it can be said, that 58% of faculties operate in an efficient way (see Table 3). These are the ones which DEA score equals to 1. Among all faculties, only two are weak performers: Faculty of Economics and Management - Czech University of Life Sciences, Prague and Faculty of Information Technology - Czech Technical University in Prague. First one should improve Science and Research domain by 82% and the second one by 86%. Worth mentioning is the act, that faculty which ranked first in ranking, Faculty of Electrical Engineering - Czech Technical University in Prague, should improve their Science and Research activities by 14% to become efficient in terms of output efficiency.

Table 3. DEA output model – Informatics

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Electrical Engineering - Czech Technical University in Prague	8.6	9	7	10	0.862385
Faculty of Mathematics and Physics - Charles University in Prague	6.2	10.9	4.8	12	1
Faculty of Mechatronics, Informatics and Interdisciplinary Studies - Technical University of Liberec	9.6	5.9	8.3	7	0.676471
Faculty of Informatics - Masaryk University	7	6.2	6.2	11	1
Faculty of Information Technology - Brno University of Technology	6.4	6.6	6.8	8	0.747705
Faculty of Applied Sciences - University of West Bohemia	3.5	7.8	6.6	9	1
Faculty of Economics and Management - Czech University of Life Sciences, Prague	11.1	6.1	7.2	2	0.185484
Faculty of informatics and Management - University of Hradec Kralove	9.2	5.9	3	3	1

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Applied Informatics - Tomas Bata University in Zlin	2	3.9	8.8	6	1
Faculty of Electrical Engineering and Informatics - University of Pardubice	3.7	7.4	5.2	5	1
Faculty of Information Technology - Czech Technical University in Prague	6.5	4.6	7.4	1	0.140604
Faculty of Informatics and Statistics - University of Economics, Prague	2.7	3.7	6.7	4	1

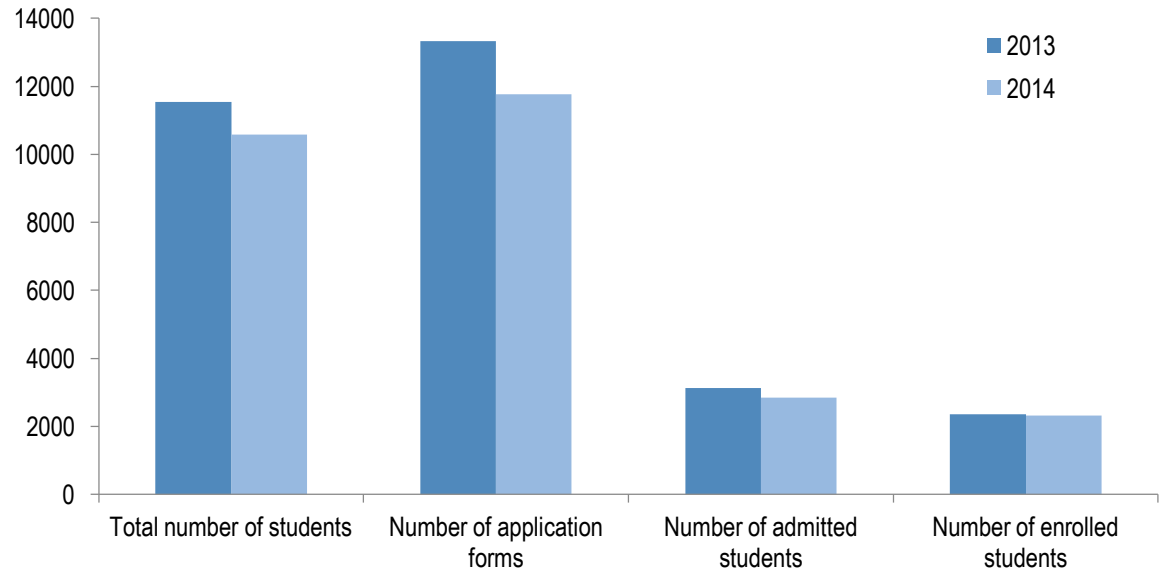
Source: own processing of data provided by the Economic Newspaper (2015)

5.4 Law

Group of Law is the smallest group in our analysis. The situation in the group concerning demand for the study of law is shown in Figure 4. We observe the analogous situation as in other fields of study, which is inducted by unfavorable demographic trends. We observe a considerable drop in total number of students, number of application forms, but no drop in enrolled students. Here we must make a point, that the refusal rate of students by law schools is one of the highest within all groups.

In group of Law, Faculty of Law - Charles University in Prague ranked first. Students of this faculty go often study abroad and only one person out of five is admitted to study at this school. The main weakness of this faculty is domain of Science and Research.

Figure 4. Law



Source: Economic Newspaper (2015)

Results of DEA for group of Law are presented in Table 4. It can be stated, that group of Law is well equilibrated in term of efficiency. There is no very weak school in this group, but striking fact is, that efficient faculties are those which finished in ranking at final places. This is due to the fact, that Faculty of Law - Charles University in Prague and Faculty of Law - Palacky University Olomouc are weak in Science and Research. These two faculty should raise research activities by 50%.

Table 4. DEA output model – Law

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Law, Charles University in Prague	3.9	2.6	2.9	2	0.5
Faculty of Law, Palacky University Olomouc	2.1	3.4	2.8	2	0.5
Faculty of Law, Masaryk University	1.8	1.9	2.4	4	1
Faculty of Law, University of West Bohemia	0.7	2.1	1.9	3	1

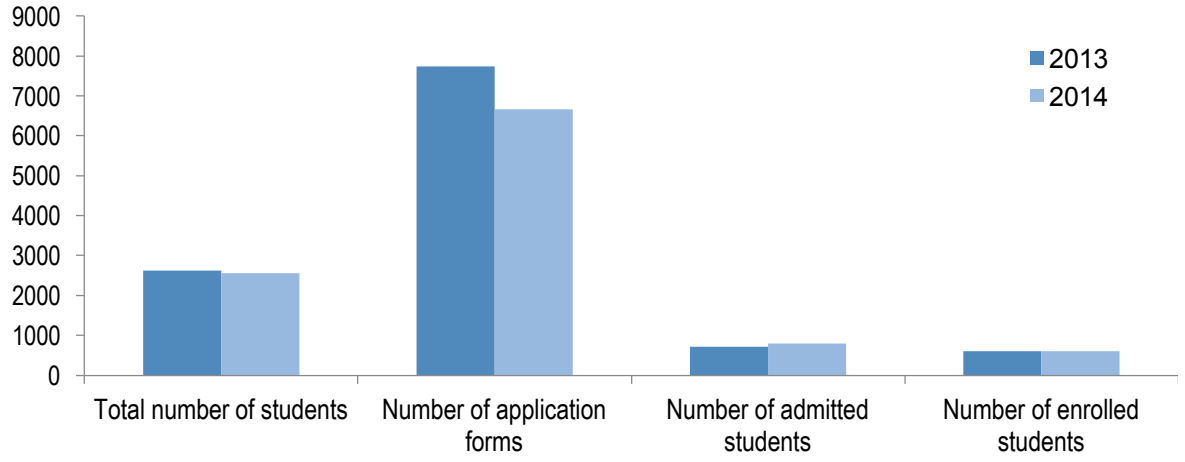
Source: own processing of data provided by the Economic Newspaper (2015)

5.5 Psychology

Figure 5 proposes a quick overview of the situation within the group of Psychology. Group face the drop in number of applications. Excluding the above, the group is stabilized and do not meet any other large changes.

Faculty of Social Studies - Masaryk University scored the first place in the ranking. It was possible thanks to its excellent Science and Research activities and fact, that faculty keeps fair ratio of students to teachers. Faculty admits only 11% of students, which apply for studies.

Figure 5. Psychology



Source: Economic Newspaper (2015)

Concerning DEA analysis, 60% of the faculties are efficient in terms of Science and Research. Results of analysis are presented in Table 5. Within the group, we identified one moderate performer Faculty of Arts - Palacky University Olomouc. This faculty should increase research activities by 40%. The mind-bending situation is on Faculty of Education - Charles University in Prague, which research activities are below the average of the group, even if this faculty ranked second in the ranking. Named faculty should progress in research activities by 79%.

Table 5. DEA output model – Psychology

Faculty	International School Involvment	Teachin g Staff	Interest in Study	Science and Research	DEA output model
Faculty of Social Studies - Masaryk University	3.6	3.1	2.8	5	1
Faculty of Education - Charles University Prague	3.1	4.4	5	1	0.216667
Faculty of Arts - Palacky University Olomouc	3.7	3.4	3.3	3	0.6
Faculty of Arts - Masaryk University	2.3	2.3	1	4	1
Faculty of Arts - Charles University in Prague	1.7	1.8	2.9	2	1

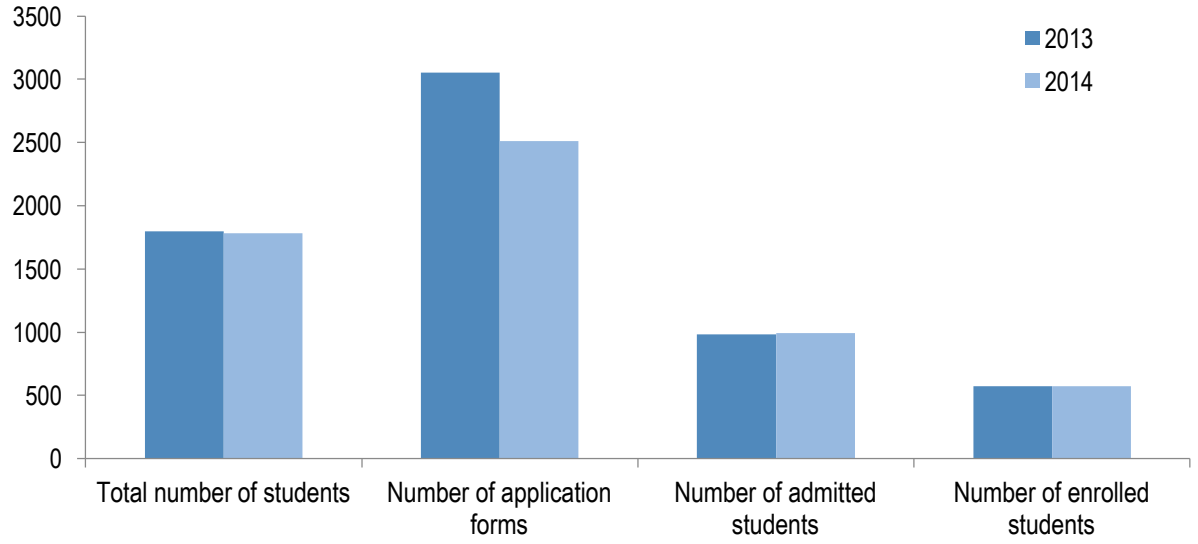
Source: own processing of data provided by the Economic Newspaper (2015)

5.6 Sociology

A quick overview of the situation in the group of Sociology gives Figure 5. One can see that group is well stabilized except the number of applications. Drop in number of applications seems to be the inevitable part of an academic life in Czech Republic.

In the ranking, Faculty of Social Studies - Masaryk University finished at the first place. This was mainly due to the fact, that faculty raised a number of PhD students and faculty out perform other faculties in research activities.

Figure 6. Sociology



Source: Economic Newspaper (2015)

In terms of results of DEA we state, that two thirds of faculties within the group of Sociology are efficient in term of Science and Research. We identified one moderate performer, Faculty of Social Sciences - Charles University, which should improve research activities by 26% and one poor performer, Faculty of Arts - Charles University, which should ameliorate research activities by 83%, because its research activities face the obvious gap compared to other faculties in the group.

Table 6. DEA output model – Sociology

Faculty	International School Involvment	Teaching Staff	Interest in the Study	Science and Research	DEA output model
Faculty of Social Studies - Masaryk University	4.6	3.7	4.1	6	1
Faculty of Social Sciences - Charles University	4.2	3.7	3.4	4	0.745282
Faculty of Arts - Charles University	3.8	4.5	6	1	0.173077
Faculty of Arts - Palacky University, Olomouc	1	2.9	3.9	5	1
Faculty of Philosophy and Arts - University of West Bohemia	1.1	4.5	1.8	2	1
Philosophical Faculty - University of Hradec Kralove	3.3	1.7	0.6	3	1

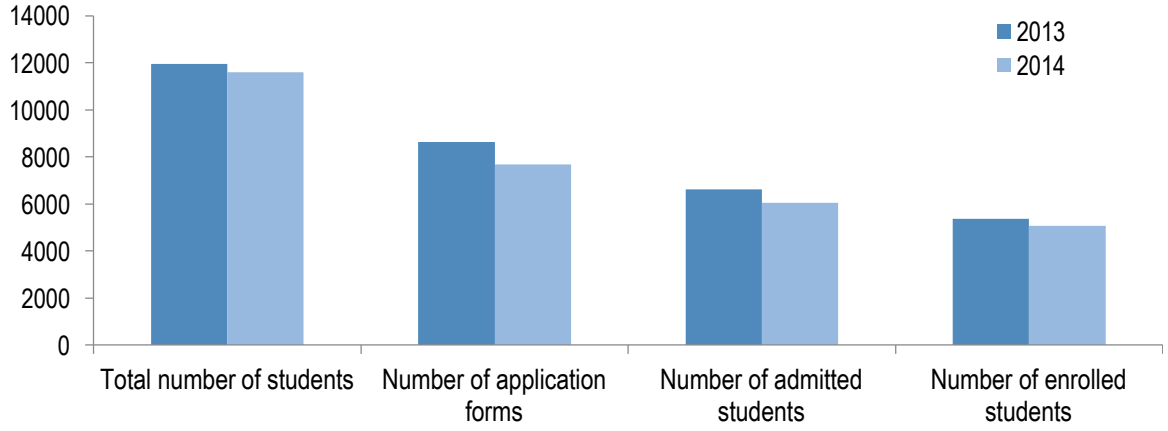
Source: own processing of data provided by the Economic Newspaper (2015)

5.7 Engineering

Figure 7 brings insight to the situation within the group of Engineering. Every twelfth student in Czech Republic studies in the field of engineering. As seen in the Figure 7, field of Engineering faces the same problems as others fields. In this field, we observe the gradual, systematic reduction in every monitored dimension.

Faculty of Mechanical Engineering - Technical University of Liberec ranked first in the rating. It was due to the fact, that students and academic employees go often to foreign universities for a short or medium-term stay. Moreover, faculty´s research activities are on the good level.

Figure 7. Engineering



Source: Economic Newspaper (2015)

Concerning DEA analysis, we can conclude, that 83% of the faculties are efficient in term of Science and Research activities. Only one faculty, Faculty of Mechanical Engineering - Czech Technical University in Prague, is a moderate performer and should improve its research activities by 50%. From a global point of view, group of Engineering is most eqilibred in terms of Science and Research efficiency.

Table 6. DEA output model – Engineering

Faculty	International School Involvment	Teaching Staff	Interest in Study	Science and Research	DEA output model
Faculty of Mechanical Engineering - Technical University of Liberec	4.9	5.2	1.7	5	1
Faculty of Mechanical Engineering - Brno University of Technology	3.7	3.9	3	6	1
Faculty of Mechanical Engineering - Czech Technical University in Prague	4	4.8	3.9	3	0.5
Faculty of Mechanical Engineering - University of West Bohemia	2.7	2.9	4.9	4	1
Faculty of Mechanical Engineering - VSB - Technical University of Ostrava	2.4	2.9	5.3	2	1
Faculty of production Technology and Management - Jan Evangelista Purkyne University in Usti nad Labem	3.3	1.3	2.2	1	1

Source: own processing of data provided by the Economic Newspaper (2015)

Discussion

Higher education in the Czech Republic faces the demographic changes. Detailed information about demographic decline can be found in Kuncová *et al.* (2015). Mentioned study also confirmed, that efficiency of universities is not influenced by its size, but rather by its scope. According to the mentioned study, universities in the Czech Republic reach a good level of efficiency. Authors advise to reduce the number of academic staff and financial resources. On the other hand, the authors suggest to improve research activities.

These findings are in line with our analysis. Our study suggests that 53% of Czech universities perform on well in Science and Research activities. The biggest heterogeneity in term of output efficiency in Science and Research are within the two groups, which are the most abundant in term of number of faculties, and also most populous in term of number of students. These groups are the group of Economics, and group of Informatics. Special attention should be given to the efficiency of these two groups, because they are in charge of more than 70% of the total number of students. The most balanced groups in terms of Science and Research efficiency are group of Engineering, group of Psychology and Group of Architecture. We find here interesting the group of Engineering, which is globally the most efficient group. This group is third biggest group within the analysis and 80% of faculties achieve the efficient frontier. Thus, we cannot attribute the high level of inefficiency to the scope of the group how could we suppose on the basis of group of Economics and group of Informatics. The results of our study are not in line with big number of researches. For example, (Abbott and Doucouliagos 2003, Avkiran 2001) Australian universities recorded as a whole high level of efficiency. Also in Italy the majority of universities perform well for various input and output specifications (Agasisti and Dal Bianco 2006). McMillan and Datta (1998) shoved that the relative efficiencies of Canadian universities are quite consistent, what is not a case of the Czech Republic. Big disparities in group of Economics were found also in case of the Slovak Republic (Kubák, Bačík, Szabo and Bartko 2014).

Conclusions

University research should form the core of the research potential of each country. In many countries, there are clear pressures to rise substantial funding for higher education with the ambition to achieve at least an average level of OECD countries or EU.

In the process of allocating funds for higher education an issue of rational consideration of the criteria of science, research and employment of graduates in practice is getting into focus. For this reason, there are more discussions about the possibilities for evaluating the effectiveness of science and research at universities necessary for the efficient allocation of resources, as well as creating a platform for national and international benchmarking. In this process multidimensional analysis are increasingly important, which would allow to evaluate the quality of higher education in various aspects and detect endogenous and exogenous causes of its lack of progress, resp. stagnation. These facts have been our main motivation in implementing the evaluation of effectiveness of selected Czech universities. We run Data Envelopment Analysis with variable returns to scale on the dataset consisting of 59 faculties in the Czech Republic. We use an output oriented model to measure efficiency in Science and Research. We use data on faculty level. Data have a nature of composite indicators with the intention to reduce the size of the sample and include more information, by keeping the number of variables low. Faculties are divided into seven distinctive groups, with purpose to capture differences in budgeting, tuition and different conditions for research. We distinguish groups of Architecture, Economics, Informatics, Law, Psychology, Sociology and Engineering.

Our findings suggest, that efficiency level of faculties in global view is fair enough, but place for improvement still exists. Our analysis shows that 53% of the faculties in the Czech Republic operate on efficient way in term of Science and Research. Most equilibrated groups in term of efficiency is group of Engineering, followed by group of Architecture, group of Psychology and group of Informatics. Least equilibrated groups are group of Economics, group of Sociology and group of Law. The findings mentioned above are important for the creators of several policies, strategic plans in the process of development of science and research at universities, as well as greater activation of the research potential in the country. Finally, it can encourage the adoption of new measures to

revitalize the growth of quality in higher education from extensive to intensive, from quantity to quality. It is also necessary to adopt a number of crucial decisions in the educational policy of the country.

Aknowledgement

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Current Instability in the Monetary and Credit System of Russia

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Abstract:

The current geopolitical and international economic situations are changing at a high speed and leading to multi-faceted changes of individual economies. Russia is now experiencing isolation in political and economic spheres, which has led to the assertion of its political position on the international arena. The dead-end relationship between Russia and the West has led to the sanction wars that negatively influence the state and development of the monetary system and the banking sector of the Russian Federation. This work is devoted to the analysis and evaluation of the impact of the sanctions approved by the Western countries against Russia on its monetary and banking systems.

Keywords: sanctions; banks; restrictions; inflation; currency markets; decline

JEL Classification: E22; E31; E44; E5; F51; F62; G00

Introduction

Economy is the continuation of politics. Modern globalization and extension of inter-national links lead to diffusion of certain boundaries among countries: cultural, political, judicial, social and economic. Any change on the world political arena or in mega-economy can seriously influence different states' development. A spectacular example was a significant cooldown of relations between Russia and western countries as part of the recent events in Ukraine. The consequences of such cooldown were different external-economic and political limitations which left a negative imprint on the economic structure of the country under sanctions. The referendum of March 16, 2014 on inclusion of the Crimea into the RF became a critical point in the political and economic relations between Russia and western countries. On the next day, the USA and European Union, Australia, New Zealand and Canada put in force the first package of sanctions including freezing of bank accounts and visa limitations with reference to 21

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Russian and Ukrainian officials, as well as suspension of cooperation in a few spheres (The White House. Office of the Press Secretary 2014)

1. Research background

During a few months starting from the middle of March 2014, the political and economic sanctions against Russia were introduced by separate countries, international organizations and unions of states. The list of the international organizations that imposed limitations on economic and commercial relations with Russia is as follows: Organization for Economic Cooperation and Development, North Atlantic Treaty Organization, European Union, Council of Europe, European Organization on Aerial Navigation Safety, "Group of Eight", Financial Action Task Force (FATF), etc.

Among many different sanctions and limitations, it is necessary to specify the most significant ones for Russia from the economic point of view:

- On April 17, the South Stream gas pipeline project was frozen, the assessed cost of which was 16 bln euros, throughput capacity was estimated as 63 bln m3 of gas per year and the scheduled share in Russian gas deliveries to Europe would be 35% (RIANovosti 2012).
- In July 2014, the next package of sanctions followed: the first block included prohibition on supplies to Russia of high-tech equipment for production of oil in the Arctic Region and deep-sea shelf, as well as for production of tar; the second block included prohibition to credit five biggest Russian banks on the European financial market for a period exceeding 90 days. The banks list included: Sberbank, VTB, Rosselkhozbank, Gazprombank, Vnesheconombank; the third block presupposed embargo on arms import and export from Russia and a prohibition on supplies of power-generating equipment and technologies (Official Journal of the European Union 2014).
- The European Bank for Reconstruction and Development suspended projects in Russia the sum of which constituted 50 bln rubles in 2014 and 5 bln euros in 2015. The European Investment Bank stopped financing the RF projects for a sum of $ 600 mil-lion in 2014 (European Council 2014).
- In September, the next extension of sanctions followed including prohibition of debt financing of the biggest industrial companies of Russia: Rosneft, Transneft, Gazpromneft. The term of Russian banks' financing on the world financial market was also reduced to 30 days (Official Journal of the European Union 2014).

During the whole year of 2014, the list of sanctions was appended with new Russian and Ukrainian politicians, officials, public figures and organizations. Altogether, by the end of 2014, the list included more than 150 people and 41 organizations.

The complete list of sanctions against Russia is rather extensive, while the above items are the main ones from the point of view of economic threat and safety of Russia. Russia's response action in the beginning of August 2014 was a food embargo on import of agricultural products from the countries which applied the sanctions against Russia. The exclusion list contained supplies to Russia of meat, poultry, cheeses, milk and milk products, fish and seafood, vegetables, fruits and nuts (Edict of President of Russia 2014). The volume of these products import in the total amount of agricultural products in Russia constitutes 40% (more than 9 bln euros). Such measure was directed at ensuring of the RF safety in compliance with the Edict of the RF President.

The above listed events and economic limitations applied by the western countries, as well as an effort to increase the RF economic safety by introducing the embargo led to structural problems in the economy, its slowing down, and later – a decline. The damage to the economy from the imposed sanctions snowballed during the whole 2014-2015 period and caused uncertainty as to the future development of the RF economy in the near-term outlook.

Let us consider the further development of the Russian financial sector under the conditions of sanctions and analyze the severity of the country's economic damage and the con-sequences of the applied sanctions.

2. Methodology

Capital investments

The prohibition on debt financing of big Russian companies and banks caused a decrease in capital investments in 2014 by 70% in comparison with 2013, and in 2015 – by 78%, respectively. In 2014, the volume of investments, in the absolute value, was reduced by practically $50 bln. In 2015, the volume of direct investments dropped down to the minimum index since 2002 ($ 3.7 bln). This was a consequence of the sanctions applied against Russia and including suspension of investment projects' financing, prohibition on supplies of high-tech equipment and parts, which immediately affected the investment component of the Russian economy.

Figure 1. Dynamics of direct investments into Russian economy in 2011-2015

Source: according to Central Bank of Russia, Direct investments, (Central Bank of Russia n.d.)

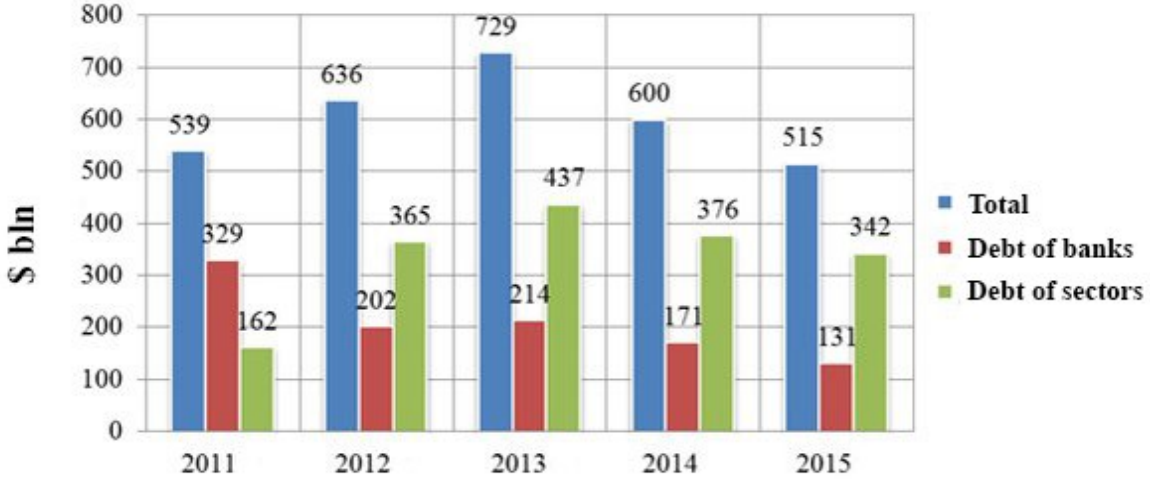
The net capital exports of the private sector in 2015 constituted $ 58.1 bln ($ 152.9 bln in 2014) (Central Bank of Russia n. d.). At that, as opposed to the previous years, the main component in the structure of the net capital export was liquidation of obligations. The reduction in banks' foreign liabilities was the most significant ($ 59.8 bln) and was realized not only at the expense of owned foreign assets, but also at the expense of assets accumulated through open account transactions. Stable surplus of the current account transactions made it possible for other sectors being under the conditions of limited foreign financing to not only reduce the debt to non-residents, but to accumulate foreign assets, mainly, in the form of direct investments, though in substantially smaller amounts than in the previous years.

It is worth noting that the share of foreign investments in strategically important Russian industries, such as raw materials industry, constitutes 21%, in processing industry – 14%. Therefore, the reduction of foreign investments into these industries can lead to deeper structural problems of the economy, such as reduction of productive capacities and production volumes, deterioration of products quality and growth rate deceleration.

Banking sector

In the banking sector of Russia, a special situation took place with the foreign loans of banks and industrial enterprises. The data on the structure and dynamics of the Russian external debt are presented below. The total value of the external debt decreased in 2014 by $ 129 bln, in 2015 – by $ 85 bln. This was ensured due to repayment of debts by banks and industrial companies. This dramatic repayment of external obligations is a result of the imposed sanctions which prohibited access of Russian companies and banks to the external financial loan market for a period exceeding 30 days.

Figure 2. Structure and dynamics of Russian foreign loans in 2011-2015.

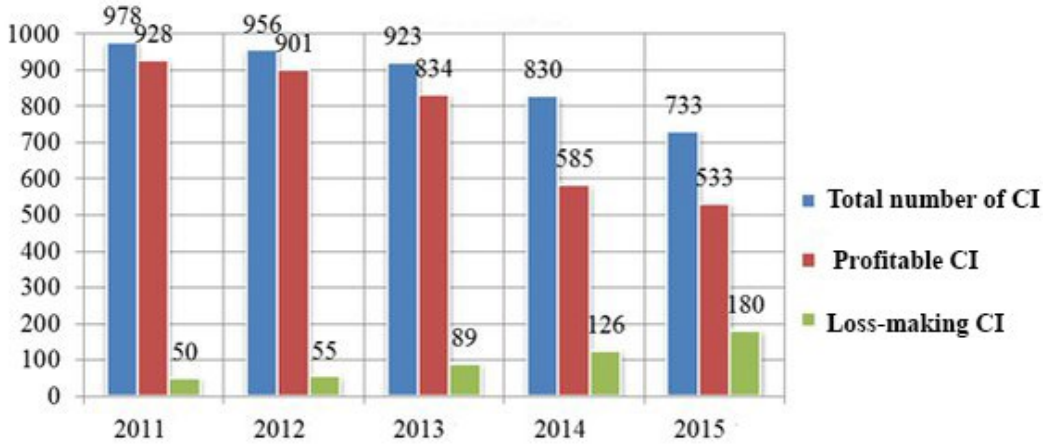


Source: according to Central Bank of Russia, Foreign debt, (Central Bank of Russia n.d.)

In the last 20 years, banks took loans on the external financial market obtaining credits at low interests. This was more profitable than being refinanced in rubles by the Bank of Russia, the refinance rate of which, in the beginning of 2014, constituted 8% and was the lowest in the history of modern Russia. There existed a possibility to continue to obtain foreign currency loans from western financial institutions at 2-4% yearly for repayment of current debts and financing operations while expanding liquidity. Such strategy is called "Carry trade". However, after imposing the sanctions with the prohibition of the biggest Russian banks' and companies' access to external funding markets, such practice stopped. Taking into consideration the prohibition on access to cheap credit resources on the external market, Russian residents have to repay their obligations using liquid ruble assets and converting them into currency (Tashtamirov and Vahaeva 2015). This circumstance has led to a considerable reduction of rubles circulating in the economy. Correspondingly, repaying external debts, banks and companies contributed to outflow of capital from the Russian economy, and this outflow constituted a total amount of $ 150 bln.

The second negative factor of the Russian banking sector weakening and absence of cheap credit sources was the Bank of Russia's increasing the key interest rate to 10.5% in the second half of 2014, and later – to 17% per year. This decision has led to an even bigger reduction of ruble liquidity in the bank system under the conditions of significant capital outflow. As a result, Russian banks found themselves between "a rock and a hard place" and had to repay their debts and to conduct operations without any access to cheap loans on the external currency market and internal ruble market. On an aggregate basis, due to the fast advancing inflation, fall of the ruble purchasing power and decline in earnings of the population and enterprises, the level of crediting and paying capacity of the current bank borrowers has reduced. This has led to a decrease in the banking sector interest margin and in net profit which has caused the deterioration of the Russian commercial banks' financial situation and their instability.

Figure 3. Number of credit institutions (CI) in RF and their financial situation in 2011-2015.



Source: according to Central Bank of Russia, Review of banking sector, (Central Bank of Russia n.d.)

This critical situation in the banking sector caused by the applied sanctions and increase in the key interest rate has led to growth of negative financial results of credit institutions' activity. In Figure 3, the dynamics from 2011 to 2013 shows a small yearly increase in the number of loss-making credit institutions and a simultaneous reduction of operating credit institutions. The negative tendency is present but has no critical dynamics. However, in 2014, there was a decrease in the number of operating credit institutions (CI) and a colossal increase in the general number of the loss-making organizations. In 2013, the share of loss-making CI constituted approximately 10% of all the operating ones; by the end of 2014 this index increased to 15%, and in 2015 – to 25%. In addition, in 2015, the number of loss-making CI grew by 43%. The total volume of profit shrank from 1 trillion rubles in the beginning of 2014 to 735 bln rubles in 2015. At that, the total volume of losses constituted 543 bln rubles.

A rapid reduction in the number of credit institutions and a proportional deterioration of their financial results is observed. In conditions of the tough monetary-credit policy of the Bank of Russia and nationwide social instability, growth of poverty and fall of real earnings, a still bigger decrease in the bank margin is possible. In 2015, the number of the poor in Russia increased by 3 million people and constituted, by the beginning of 2016, more than 20 million people (13.5% of the country population). The level of real earnings decreased by 4%, while actual wages, following the results of the year 2015, decreased by 11% (Tashtamirov and Ashaganov 2015). These two factors have become the worst in the last 10 years, and can cause significant problems for lending banks. By the beginning of 2016, 40 million Russian people had loans; at that, the banking system credit portfolio for individuals exceeded 10 trillion rubles. The share of defaulted debts constituted 900 bln rubles (9%) and grew more than twice in 2014-2015. On the basis of these data, it is possible to conclude that the structural crisis that caused a drop in the living standards of the population can lead to a growth of cash gaps in the banking sector; taking into account the decrease in the financial results, the deterioration of the banking business environment will continue.

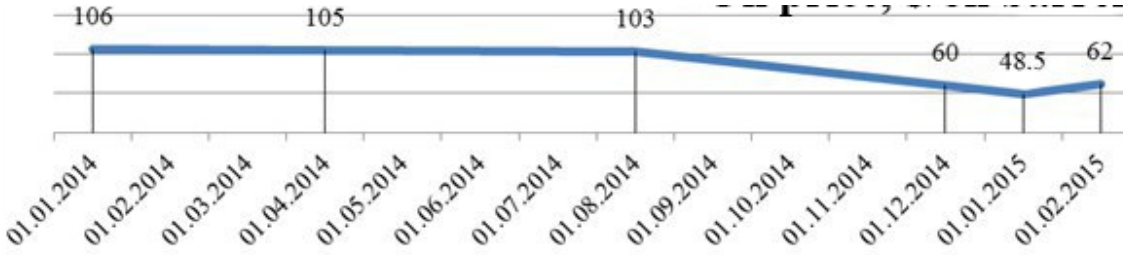
The aggravation of economic and political relations between Russia and western countries led to short-term negative consequences that affected the financial sector. Under the conditions of the financial sanctions, high key interest rate and tough prudential policy of the Bank of Russia, the banking sector is facing a deep system-wide collapse and a decline of financial stability.

National currency

High loan rates have inevitably led to a decrease in consumer crediting, which, in its turn, caused a decrease in consumer demand, while the latter has had an immediate impact on the decline in production and trade. At that, the retail industry decline constituted 11%, following the results of the year 2015, which became the lowest index during the period since 1998. The situation was aggravated by the decision of the Central Bank of Russia to "let the ruble float freely" in November 2014 and to abandon forcible regulation of its exchange rate to other foreign

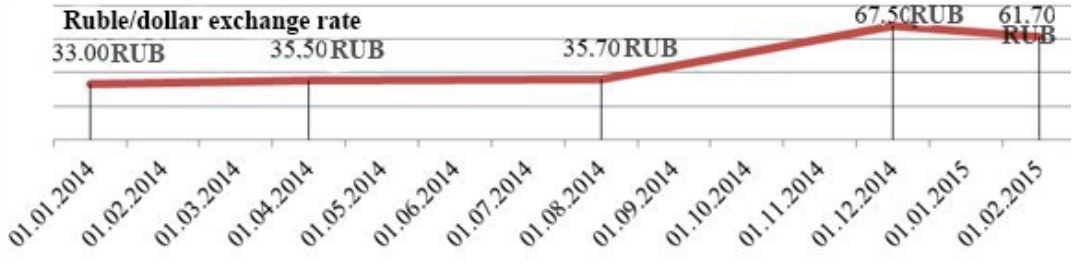
currencies. On the other hand, the ruble rate was strongly affected by the fall in crude hydrocarbon prices in the world economy. For Russia, it was the second economic blow after the sanctions. The intensity of the problems caused by the fall in oil prices is connected with Russia's budgeting. On average, 45% (52% in 2012) of the federal budget income comes from the sales of hydrocarbons and the dependence between oil price quotations and the exchange rate of ruble against dollar. This is vividly shown in Figures 4 and 5.

Figure 4. Cost of a barrel of oil on the world market.



Source: according to ProFinance Service, Oil price, (ProFinance Service. Online trading n. d.).

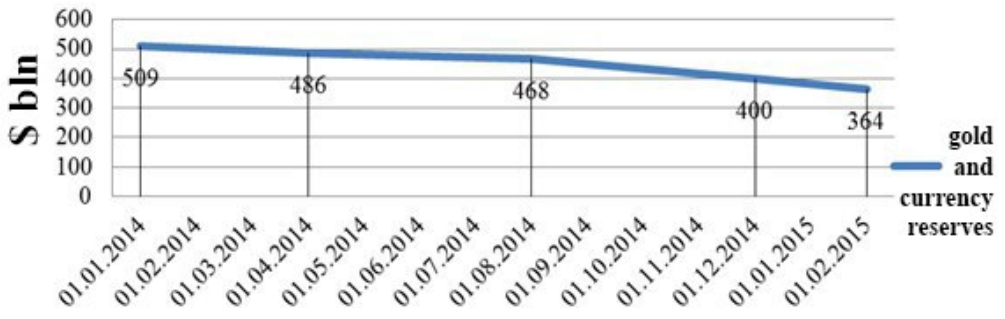
Figure 5. Exchange rate of dollar against ruble.



Source: according to ProFinance Service, Exchange rate, (ProFinance Service. Online trading n. d.).

Simultaneously, starting from the middle of 2014, changes have been happening in the oil market and the exchange rate of dollar against ruble. The 50% fall in raw hydrocarbon prices from $ 106/barrel at the beginning of 2014 to $ 49/barrel at the end of 2014 has caused a proportional growth of the dollar/ruble exchange rate from 33 rubles/dollar at the beginning of 2014 to 67 rubles/dollar by the end of 2014. Such dependence is clearly demonstrated by Figures 4 and 5. The ruble devaluation and reduction of its purchasing power by 60% became a consequence of this fall. In its turn, together with the capital outflow, this has led to the highest inflation index since 1998 – 13% in 2015.

Figure 6. Change in Bank of Russia gold and foreign currency reserves value from 2011 to 2015.



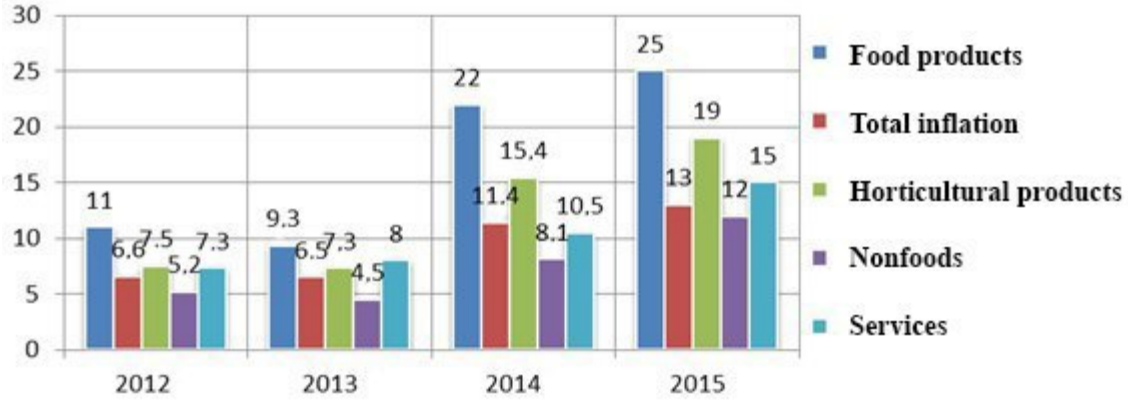
Source: according to Central Bank of Russia, International reserves, (Central Bank of Russia n. d.).

In order to stabilize the currency exchange rates, the Bank of Russia took a decision to increase the key interest rate to 17% and to conduct a tough monetary policy aimed at inflation control. Additionally, the Bank of Russia directed gold and foreign currency reserves for ruble support.

3. Case studies

Due to the ruble devaluation and decrease in its cost, the Bank of Russia gold and foreign currency reserves reduced from $ 510 bln in January 2014 to $ 376 bln in January 2015. To support the ruble rate, the Bank of Russia used $ 134 bln for currency interventions; however, significant results, such as inflation decrease and ruble price increase, were not achieved. Correspondingly, with the purpose to preserve the volumes of accumulated international reserves, a decision was made to waive the right to conduct currency interventions and use them only in case of necessity. Under the conditions of economic instability and big external debt, the preservation of reserves is very important. For example, in 1998 to finance the budget, government short-term bonds (debt bonds) were actively used. They were emitted and placed both in internal and external markets. However, after the financial crisis in Asian stock markets, there was a sudden fall in prices of such assets and their interest rates. The result was a technical default of Russia to external creditors. It was in this period that practically all gold and foreign currency reserves were used to pay the state debts. The modern external debt, certainly, has an absolutely different structure. Thus, the share of external debt of governmental authorities constituted 6% in the beginning of 2016 as compared to 74% in 1999. The main part of the external debt is placed in banks and big industrial companies of different economic sectors of the country. But, one should take into consideration the fact that practically all banks and companies having external loans are owned by the state. At that, it's these companies (Rosneft, Gazprom, NOVATEK) and banks (Sberbank, Rosselkhozbank, VTB, Vnesheconombank) that provide for the biggest part of the federal budget income and have the biggest share in the national economy sectors. Correspondingly, in case of a threat to their financial stability in servicing foreign loans, one should expect the use of gold and foreign currency reserves for repayment of the debts. For example, in 2015, 1.5 trillion rubles of the anti-recessionary funds (2.3 trillion rubles) were sent to the banks, in particular, to Vnesheconombank, in order to increase financial soundness and to repay current liabilities. The Rosneft company also received a trench in the amount of 1 trillion rubles from the National Wealth Fund for financing of current activity and repayment of liabilities. Notably, the NWF is included into the gold and foreign currency reserves.

Figure 7. Dynamics of inflation rates and its structure in 2012-2015.



Source: according to Federal Agency of State Statistics, Federal Agency of State Statistics. (n. d.).

As follows from Figure 7, the inflation rate accelerated in 2014, in comparison with the previous year, to 11.4%, and in 2015 – to 13%. The most critical increase was noted in consumer goods prices. As reported by Trading Economics (The White House. Office of the Press Secretary 2014), in 2013 Russia took the 40th place among 224 countries according to the level of inflation, while, by the beginning of 2015, it rose to the 8th place between Byelorussia and Argentina.

The colossal inflation run-up negatively influenced the living standard of disadvantaged population with low and average income. As the population of Russia spends around 50% of their income on food products, the rise of consumer prices by more than 20% in the last half year has already resulted in the fact that approximately 40% of the citizens cannot provide themselves with a minimal monthly set of products. Further growth of consumer prices

and inflation rate can cause a rise in social tension. Taking into consideration the current inflation rate and decrease in real earnings, one should expect a galloping inflation with transition to a mass unemployment wave due to the increase in expenditures of organizations and enterprises. Therefore, the tension and deterioration of the economic situation will only grow. The growth of unemployment can be caused by yet another reason – a 10% decrease in government expenditures in 2015-2016 and public servants lay-offs in different sectors: Ministry of Home Affairs, Federal Security Service, government employees.

The reduction of government expenditures is related, apart from the inflation, to a decrease in the Russian federal budget revenues from external economic activity, the main part of which consists of crude hydrocarbons sales income. The share of such income in the federal budget structure constitutes 45%. Correspondingly, the 50% fall in oil prices has resulted in the $150 bln decrease of oil and gas budget revenues.

Conclusions

The problems of the Russian banking and monetary sectors have been caused not so much by the sanctions imposed in 2014 or the key interest rate increase, as by the years-long policy pursued by the monetary regulator. The main vector of the monetary-credit regulation carried out by the Bank of Russia was maintaining the ruble purchasing power, its unjustifiable exchange rate against the American currency and control of inflation, which, as a result led to direct dependence of the national currency and state budget on the dollar inflows from the sales of crude hydrocarbons. The overstated refinance rate of 8% made it impossible for the Russian banks to obtain a sufficient amount of liquid and cheap resources; on the other hand, it led to high bank loan interest rates which in no way stimulated the development of the economy and production. Commercial banks and big companies re-orientated towards the European and American financial markets with affordable credit resources at low interest rates. The outcome was the dependence of the Russian banking sector on external loans.

The target of the policy pursued by the Bank of Russia was not developing the banking sector, financial markets, and the stability of the national currency, as required by the law, but keeping the inflation level at the lowest possible rate with the regulation of the currency band unjustifiably overstating the exchange rate of ruble against dollar. Correspondingly, the economic stagnation and the resulting crisis in the monetary system and banking sector became the consequences of the years-long “short-sighted” policy of the RF Central Bank, which dramatically manifested themselves after the imposed sanctions and even more inadequate decisions of the regulator to increase the key interest rate and “to let the ruble float freely”.

With due account for the presented data, one should note that the negative impact related to the deterioration of Russian foreign economic relations with its western partners is significant. The introduction of sanctions, the prohibition to enter the external funding markets, the response food embargo, the break-up of cooperation in the biggest investment projects, the slump in oil quotations have led to a deep fall in the banking sector of the country and deterioration of the monetary and credit system condition. It is premature to unambiguously speak of the sanctions as the primary reason for the deterioration of the economic situation in the country, as it is necessary to conduct a detailed research of the structure of the economy and economic development over the last decades. The main problem that has led to the existing difficulties in the economy and financial system is the model of raw material export dependence of the national economy. This, to a great extent, reflects the depth of the structural problems of the national economy. The sanctions as an external factor and a threat to economic safety of the country have become a catalyst accelerating both the onset of the crisis and its intensity.

One way or another, the introduced sanctions have significantly affected the financial sector and the state monetary system. In order to ease the damage caused by the external factors and to overcome the crisis in the mid-term, an expert and weighted policy of the Bank of Russia is required concerning the monetary system and the banking sector. The vexed problem that requires immediate solution is ruble liquidity shortage on the internal monetary market.

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