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Fuzzy Set Model of Project Portfolio Optimization Inclusive for Requirements of Stakeholders

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Abstract:

The paper suggests a fuzzy model for the formation of an optimal portfolio of investment projects of the company, which adheres to stakeholder management as a discrete institutional alternative. It considers companies whose main stakeholders are company personnel, founders and investors; society; structures and bodies of state administration. Each of the stakeholders has its own requests in relation to the company. Optimization of the portfolio is based on the proposed multiplicative utility function, which reflects the stakeholder importance of projects and includes, along with the indicator of economic efficiency, qualitative indicators characterizing social and state significance. Risk management is carried out within the framework of the portfolio investment theory of H. Markowitz using the scenario approach. To model the uncertainty of input parameters and the results of project implementation, a fuzzy set approach is used, in which verbal expert estimates of input parameters and results of projects are transformed into fuzzy sets with subsequent formulation and solution of fuzzy optimization problems. A fuzzy model is transformed into a clear quadratic programming problem, which is solved using standard numerical methods. An example of the formation of a portfolio of real projects of a construction company, a developer, operating in the market of the Primorsk Territory of the Russian Federation, is considered.

Keywords: project portfolio optimization; stakeholder approach; social significance; utility function; fuzzy model

JEL Classification: C61; O21

Introduction

This paper is a continuation of works of the authors devoted to the problem of formation of a portfolio of investment projects of the company on the basis of the project utility function, which allows to compare projects and programs and find the optimal solution using a certain principle of domination.

A stakeholder theory has become widespread in the works on project management optimization. In particular, articles Vayyavur (2015), Eskerod, Hamann and Ringhofer (2016) provide an overview of the principles of application of the stakeholder theory in the project activity. Various areas of application of the stakeholder theory can be met in the works on portfolio investment. For example, articles of Rojas and Liu (2015), Ang, Killen, and Sankaran (2015) note that the core goal of the project portfolio management is to maximize the strategic significance of tangible and intangible value of the portfolio for all stakeholders. Integrated decision-making models can help project practitioners in the design, planning, and achievement of objectives of many stakeholders in the

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framework of project portfolio management. Due to this, these articles also indicate the need for further research on the impact of choosing the most appropriate environment for relations with stakeholders to maximize the project value. Article of Rajablu, Marthandan, Wan Fadzilah and Wan Yusoff (2015) is devoted to the analysis of six key indicators of the stakeholder theory that impact the success of the project. However, the data are processed using statistical methods and procedures, which are considered insufficiently efficient due to the presence of ambiguous and fuzzy estimates of project efficiency indicators for various stakeholders.

Analysis of the impact of accounting for corporate social responsibility on investment efficiency has become widespread in recent years (Benlemlih and Bitar 2016). In their previous works, the authors considered an approach under which the company's corporate social responsibility is expressed during goal-setting, inclusive of the interests of all stakeholders (Mazelis and Solodukhin 2013, Mazelis, and Solodukhin 2015, Mazelis, Rokhmanova and Solodukhin 2012), while the utility of the project is considered as levels of achievement of the goals achieved during the project implementation. Alternatively, to this approach, the models have been proposed to optimize the project portfolio within the investment program of development inclusive of risks and corporate social responsibility of the company, which adheres to a stakeholder management as discrete institutional alternatives (Lihosherst, Mazelis and Chen 2015, Mazelis, Solodukhin, Chen and Tarantaev 2016). The models are based on an approach that takes into consideration the need to use the principles of corporate social responsibility when developing strategic plans of activity (Maltseva 2009). For example, additional indicators of social and state value are introduced along with indicators of economic efficiency, and evidence of the efficiency of their account is provided in order to reflect a stakeholder significance of the project.

In the context of the increasing uncertainty, it seems promising to use the fuzzy set approach, where the verbal expert estimates of the input parameters, possible results of the projects implementation and the emerging risks are transformed into fuzzy sets with a subsequent formulation and solution of fuzzy optimization problems. Fuzzy optimization models with fuzzy objective functions and fuzzy constraints allow to obtain various solutions at various exogenously specified confidence levels (Anshin 2015). Increased attention in the works on project and portfolio investment in recent years has been paid to the use of fuzzy sets (Wei Zhou 2014).

Risks are accounted in the model within the framework of the portfolio investment theory of H. Markowitz using the scenario approach.

In the continuation of the paper of the authors (Lihosherst, Mazelis and Chen 2015), a modification of fuzzy models and an algorithm for their solution, which does not use the intermediate defuzzification of fuzzy variables at a rather early stage and the formulation of an optimization model using medians of fuzzy numbers, are proposed.

1. Model and algorithm of solution

This study will consider a company whose main stakeholders are: company personnel, founders and investors; society; structures and bodies of state administration. Each of the stakeholders has its own requests in relation to the company.

Let's assume that the company has N projects $\mathrm{P}_1, \mathrm{P}_2, \ldots, \mathrm{P}_N$. The goal is to form an optimal project portfolio taking into account their risks, utility, available resources and investment capabilities of the company. This task will be solved using a scenario approach that allows to foresee changes in the internal and external environment and assess the risks of projects and the portfolio in general. L possible scenarios of changes in the environment $E_1, E_2, \ldots, E_L$ with probabilities $p_1, p_2, \ldots, p_L$ are considered.

The experts are offered a certain linguistic scale that allows to convert verbal estimates into fuzzy numbers in order to model uncertainty during setting of the input parameters of the investment projects and assessing the results of projects implementation. Each project P_n is described by the following indicators: utility u_n; amount of resources required for implementation R_n. The utility of project P_n is found using the utility function U. The utility for each project and scenario u_n^l is considered as a random variable depending on external and internal factors that are functions of time. Utility variances $D_{u_n^l}$ will be considered as a measure of project and portfolio risk.

A binary variable x_n describes the inclusion of the project in the portfolio:

- if $x_n = 0$, the project is not included in the portfolio;

- if $x_n = 1$, the project is included in the portfolio.

The following algorithm for constructing and solving a fuzzy model is proposed:

- Definition of a set of scenarios $S_1, S_2, \dots, S_L$ and fuzzy estimate of probability of each of them. Expert estimates of probabilities are generalized (aggregated) and normalized (see: Ptuskin, 2004). They result in normalized fuzzy probabilities of scenarios $p_1, p_2, \dots, p_L$.
- Assessment of the level of satisfaction of the requirements of the owners, investors and personnel. To do so, the indicator of economic efficiency of the project is calculated, represented as the net present value of the project:

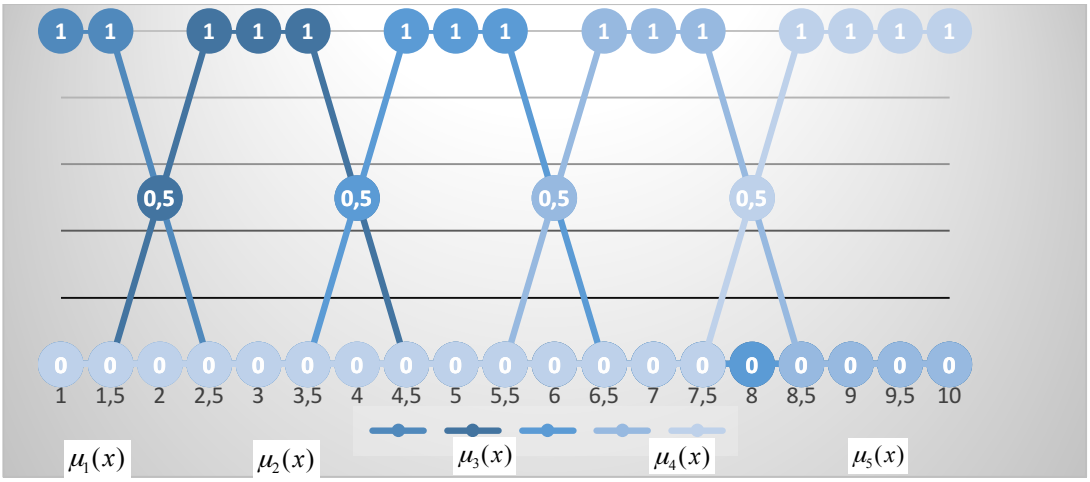
$$NPV_n^t = \sum_{t=1}^{T_n} \frac{CF_{nt}^l}{(1+r)^t} - \sum_{t-1}^{T_{inv}} \frac{I_t}{(1+r)^t}, (1) \quad (1)$$

where: n is a project number, l is a scenario number, t is a period number, T_n is time of the project implementation; T_{inv} is term of investment, r is a market interest rate corresponding to the project time T_n; CF_{nt}^l is the net profit of the project at the moment of time t for scenario l, I_t is amount of investment at the moment of time t. Net profit of the project and amount of investment are fuzzy trapezoidal numbers.

- Evaluation of social S_n and state G_n significance of project P_n using a fuzzy set theory. Social S_n and state G_n significances of the project have a number of parameters for their evaluation: s_i, $i \in \overline{1;p}$ and g_i, $g \in \overline{1;m}$, respectively.

The set of parameters is the same for all projects. Values of parameters for each project are determined based on expert estimates. At the same time, it is quite difficult to set these values in the form of a crisp number, and it is much easier for the expert to formulate the values of the characteristics as verbal estimates, taking subjective notions and sensations into consideration. One such way to simplify the task for experts is using a fuzzy set approach. Therefore, verbal estimates transformed into fuzzy trapezoidal numbers are used as estimates of the values of the parameters of social and state significances (Figure 1).

Figure 1. System of trapezoidal membership functions on the carrier [0;10].



Let's consider the following term sets of the linguistic variables s_i and g_i:

$s_i = \{\text{Very low; Low; Average; High; Very high}\}$;

$g_j = \{\text{Very low; Low; Average; High; Very high}\}$.

Let's introduce a system of five corresponding trapezoidal membership functions to describe the term sets (Zadeh 1978):

$\mu_1(x) = (0; 0; 1{,}5; 2{,}5), \mu_2(x) = (1{,}5; 2{,}5; 3{,}5; 4{,}5), \mu_3(x) = (3{,}5; 4{,}5; 5{,}5; 6{,}5),$
$\mu_4(x) = (5{,}5; 6{,}5; 7{,}5; 8{,}5), \mu_5(x) = (7{,}5; 8{,}5; 10; 10)$

The membership functions built are shown in Figure 1. The social S_n and the state G_n significances of project P_n are found using the following formulas:

$$\hat{S}_n = \sum_{i=1}^{p} w_i \hat{s}_i(\Pi_n), \tag{2}$$

$$\hat{G}_n = \sum_{j=1}^{m} v_j \hat{g}_j(\Pi_n), \tag{3}$$

where: $\hat{S}_n$, $\hat{G}_n$ are levels of social and state significance of the project, w_i, v_j are weights of parameters describing social or state significance; $\hat{s}_i(\mathrm{P}_n)$ is a value of parameter s_i for project P_n; $\hat{g}_i(\mathrm{P}_n)$ is a value of parameter g_i for project P_n.

To determine the weights of the parameters, they are ranked by their significance for the portfolio. The weights of the parameters of indicators of social and state significance are calculated according to the Fishburn formula:

$$w_i = \frac{2(p-i+1)}{p(p+1)}, \tag{4}$$

$$w_j = \frac{2(m-j+1)}{m(m+1)}, \tag{5}$$

where: i, j are numbers of parameters; p, m are a number of parameters of social and state significances.

- Determination of fuzzy utility of projects for each scenario according to the formula:

$$\hat{u}_n^l = u(\mathrm{P}_n, C_l) = NPV_n^l \sqrt{\hat{S}_n} \sqrt{\hat{G}_n} \tag{6}$$

Formulas based on the expansion principle are used to perform operations with trapezoidal fuzzy numbers (Zadeh 1978). The degree dependence on variables of social and state significances models the effect of saturation of utility by these variables.

- Calculation of fuzzy expectation of utility of project $\mathrm{P_n}$:

$$m_n = E\left(u_n^l\right) = \sum_{l=1}^{L} u_n^l p_l \tag{7}$$

and fuzzy elements of covariance matrix of utilities of projects i and j:

$$v_{ij} = \sum_{l=1}^{L} (u_n^l - m_i) \cdot (u_j^l - m_j) \cdot p_l \tag{8}$$

- Setting resource constraints:

$$R_{port} = \sum_{i=1}^{N} x_i R_i \tag{9}$$

where: R_i is required amount of resources for a project, which is a fuzzy number.

- Calculation of the portfolio utility:

$$m_{port} = \sum_{i=1}^{N} x_i m_i \tag{10}$$

- Determination of the portfolio risk using the following formula:

$$\sigma_{port}^2 = \sum_{i,j=1}^{N} x_i x_j v_{ij} \tag{11}$$

- The company's project portfolio is formed using the criterion of the maximum expected utility, with

restrictions on the degree of the portfolio risk and the amount of resources required for its implementation:

$$\begin{cases} \sum_{i=1}^{N} x_i m_i \to max; \\ \sum_{i,j=1}^{N} x_i x_j v_{ij} \le \sigma_{port}^2 \\ \sum_{i=1}^{N} x_i R_i \le R_{port}. \end{cases} \quad (12)$$

- Conversion of the fuzzy model (12) into a precise formulation using the approach presented in the work (Anshin, Demkin, Nikonov, and Tsarkov 2008). The confidence levels $\lambda_{\sigma^2}, \lambda_R, \gamma$ are fixed for restrictions on risk, resources and objective function, respectively. The result is the following system of relations:

$$\begin{cases} m \to max; \\ N_{\sum x_i m_i}(m, m, \infty, \infty) \ge \gamma; \\ N_{\sum x_i x_j v_{ij}}\left(\sigma_{port}^2\right) \ge \lambda_{\sigma^2}; \\ N_{\sum x_i R_i}\left(R_{port}\right) \ge \lambda_R; \\ x_i \in \{0,1\}. \end{cases} \quad (13)$$

Here $N_A(B) > \gamma$ means that number A meets the constraint B with the confidence level γ. For fuzzy trapezoidal numbers, the relations in (13) using formulas from (Dubois and Prade 1988, Wang and Hwan 2007) are presented in the form of crisp inequations and result in the crisp task of Boolean quadratic programming, which can be solved using typical packages of numerical optimization programs.

2. Results and discussion

The above fuzzy set model of formation of the project portfolio can be applied in real conditions. Let's consider an example of formation of a portfolio of real projects of the development and construction company conducting activity on the market of the Primorsk Territory.

The company considers four projects for implementation:

- The first project of the company P_1 is construction of a residential block of several houses with infrastructure and traffic junctions.
- The second project P_2 is construction of the concrete plant.
- The third project P_3 is construction of a highway interchange within the city, as part of the state order.
- The fourth project P_4 is infill construction of several houses.

Due to constraints on resources, investment capabilities and the level of expected risk for the company, not all projects will be included in the portfolio and implemented. The optimal composition of the portfolio must be determined. The optimal project portfolio is formed according to the algorithm described above.

1) Three scenarios for the environment development are considered: S_1 is pessimistic, S_2 is realistic and S_3 is optimistic. Probability of each scenario is determined expertly, according to the corresponding linguistic scale. The normalized fuzzy probabilities of scenarios are calculated. The results of the calculations are presented in Table 1.

Table 1. Normative fuzzy probabilities of scenarios

Scenario	Normative fuzzy probability of the scenario
S_1	(0.077; 0.227; 0.333; 0.667)
S_2	(0.385; 0.500; 0.722; 1.167)
S_3	(0.000; 0.091; 0.167; 0.333)

2) NPV is calculated using formula (1) in order to estimate the level of satisfaction of the requirements of owners, investors and company personnel for each project, taking the scenario into account. Table 2 provides the results of calculations.

Table 2. Fuzzy values of NPV of the project, taking the scenario into account

Project	Scenario		
	S_1	S_2	S_3
	Fuzzy value of NPV of the project, taking the scenario into account		
P_1	(0.890; 0.900; 0.906; 0.913)	(1.165; 1.167; 1.171; 1.173)	(1.254; 1.258; 1.260; 1.265)
P_2	(0.315; 0.317; 0.322; 0.325)	(0.481; 0.485; 0.487; 0.491)	(0.527; 0.534; 0.539; 0.542)
P_3	(0.165; 0.168; 0.170; 0.171)	(0.242; 0.246; 0.250; 0.252)	(0.295; 0.298; 0.300; 0.305)
P_4	(0.990; 1.000; 1.010; 1.015)	(1.580; 1.585; 1.587; 1.589)	(1.786; 1.788; 1.791; 1.793)

3) The key parameters of these indicators are identified, and the weights of the parameters are calculated using formulas (4), (5), respectively, after expert ranking, to calculate the social and state significances of the projects. The weight of the parameter depends on its importance for the parameter estimated. It must be noted that for each company, the sets of parameters of social and state significances will be different, in view of the specifics and peculiarities of the particular company under consideration. Two sets of parameters of social significance S_i and state significance G_i, provided in Tables 3, 4, were considered as an example.

Table 3. Parameters of social significance

Parameter name	Notation	Parameter weight, %
Level of housing provision in the city	S_1	0.25
Level of employment	S_2	0.21
Provision of the population with means of communication	S_3	0.18
State of the road infrastructure	S_4	0.14
Provision of population with medical aid	S_5	0.09
Amount of harmful substances emitted	S_6	0.09
Index of the physical volume of trade turnover	S_7	0.04

Table 4. Parameters of state significance

Parameter name	Notation	Parameter weight, %
Participation in the state program	G_1	0.33
Execution of the state order	G_2	0.26
Improvement of the city infrastructure	G_3	0.20
Influence of the state structures	G_4	0.13
Architectural merit	G_5	0.08

Then the values of the parameters of the social and state significances for each project are calculated. Table 5 provides verbal estimates of the parameters $s_i(P_1)$, $g_j(P_1)$, fuzzy values of the parameters $\hat{s}_i(P_1)$, $\hat{g}_j(P_1)$ and their weights for the project P_1 as an example.

Table 5. Values of the parameters of the social and state significance of the project P_1

Parameter notation	Verbal estimate	Fuzzy value, score	Parameter weight, %
S_1	Very high	(7.5; 8.5; 10; 10)	0.25
S_2	Average	(3.5; 4.5; 5.5;6.5)	0.21
S_3	High	(5.5; 6.5; 7.5;8.5)	0.18
S_4	Average	(3.5; 4.5; 5.5;6.5)	0.14
S_5	Average	(3.5; 4.5; 5.5;6.5)	0.09
S_6	Low	(1.5; 2.5; 3.5; 4.5)	0.09
S_7	Average	(3.5; 4.5; 5.5;6.5)	0.04
G_1	High	(5.5; 6.5; 7.5;8.5)	0.33
G_2	Very low	(0; 0; 1.5: 2.5)	0.26
G_3	High	(5.5; 6.5; 7.5;8.5)	0.20
G_4	Average	(3.5; 4.5; 5.5;6.5)	0.13
G_5	High	(5.5; 6.5; 7.5;8.5)	0.08

Final fuzzy values of the level of the social $\hat{S}_1$ and state $\hat{G}_1$ significances of the project P_1 are found using formulas (2), (3), respectively:

$$\hat{S}_1 = (4{,}68; 5{,}68; 6{,}81; 7{,}56), \hat{G}_1 = (3{,}81; 5{,}44; 5{,}68; 6{,}68).$$

The values of parameters of the social and state significances for projects P_2, P_3 and P_4 are calculated in a similar way. Fuzzy values of the level of the social $\hat{S}_1$ and state $\hat{G}_1$ significances of projects P_2, P_3 and P_4 are respectively equal to:

$$\hat{S}_2 = (2{,}64; 3{,}21; 4{,}55; 5{,}30), \hat{G}_2 = (3{,}44; 4{,}24; 5{,}47; 6{,}21);$$
$$\hat{S}_3 = (2{,}33; 3{,}08; 4{,}27; 5{,}13), \hat{G}_3 = (5{,}36; 6{,}36; 7{,}66; 8{,}07);$$
$$\hat{S}_4 = (3{,}51; 4{,}37; 5{,}44; 6{,}44), \hat{G}_4 = (1{,}11; 1{,}85; 2{,}98; 3{,}98);$$

4) Utilities of each project, taking the scenario into account, are identified according to formula (6). An example of calculating the utility for the project P_1, taking into account the scenario S_1, is provided below:

$$\hat{u}_1^1 = \hat{u}(P_1, S_1) = NPV_{11}\sqrt{\hat{S}_1}\sqrt{\hat{G}_1} = (0{,}890; 0{,}900; 0{,}906; 0{,}913)\times\sqrt{(4{,}68; 5{,}68; 6{,}81; 7{,}56)}\times$$
$$\times\sqrt{(3{,}81; 4{,}55; 5{,}68; 6{,}68)} = (3{,}7858; 4{,}575; 5{,}633; 6{,}486).$$

Table 6 shows the results of calculating fuzzy project utility values for each scenario S_1.

Table 6. Fuzzy values of the project utilities

Project	Scenario		
	S_1	S_2	S_3
	Project utility, taking the scenario into account, bln rub.		
P_1	(3.758; 4.575; 5.633; 6.486)	(4.919; 5.933; 7.280; 8.333)	(5.295; 6.395; 7.834; 8.987)
P_2	(0.948; 1.169; 1.606; 1.864)	(1.448; 1.788; 2.428; 2.816)	(1.587; 1.969; 2.688; 3.108)
P_3	(0.582; 0.743; 0.972; 1.100)	(0.854; 1.088; 1.432; 1.621)	(1.041; 1.318; 1.715; 1.962)
P_4	(1.954; 2.843; 4.067; 5.139)	(3.119; 4.507; 6.390; 8.045)	(3.525; 5.084; 7.211; 9.077)

5) Calculating the fuzzy expectations of the projects according to formula (7):
$m_1 = (2.181;\ 4.588; 8.441; 17.041)$, $m_2 = (0.630;\ 1.338; 2.737; 5.0563)$,
$m_3 = (3.373;\ 0.833; 1.644; 3.278)$, $m_4 = (1.350;\ 3.362; 7.172; 15.837)$.

Values of the covariance matrix calculated using formula (8) are provided in Table 7.

Table 7. Elements of the covariance matrix

Project	Project			
	P_1	P_2	P_3	P_4
	Values of the covariance matrix			
P_1	(-33.081; -4.899; 11.974; 335.055)	(-11.718; -1.990; 4.870; 114.633)	(-6.709; -1.130; 2.804; 66.912)	(-35.811; -5.542; 13.549; 351.013)
P_2	(-11.718; -1.990; 4.870; 114.633)	(-3.897; -0.706; 1.981; 39.225)	(-2.296; -0.419; 1.141; 22.896)	(-12.036; -1.984; 5.512; 120.091)
P_3	(-6.709; -1.130; 2.804; 66.912)	(-2.296; -0.419; 1.141; 22.896)	(-1.314; -0.221; 0.660; 13.368)	(-7.027; -1.154; 3.177; 70.098)
P_4	(-35.811; -5.542; 13.549; 351.013)	(-12.036; -1.984; 5.512; 120.091)	(-7.027; -1.154; 3.177; 70.098)	(-36.795; -5.460; 15.338; 367.733)

6) Setting resource constraints. To simplify the example, the resource constraint will be set for the financial type of resources only. Volume of the required financial investment for the projects implementation is provided in Table 8.

Table 8. Volume of the required financial investment for the projects implementation

Project	Fuzzy value of investment in the project
P_1	(2.677; 2.680; 2.686; 2.700)
P_2	(0.393; 0.395; 0.398; 0.400)
P_3	(0.197; 0.200; 0.205; 0.210)
P_4	(3.058; 3.065; 3.070; 3.078)

Constraint on financial resources of the company for implementation of the project portfolio R_0 amounts to 3.720 bln rub.;

7) The portfolio utility will be calculated using formula (9).

8) The portfolio risk will be determined using formula (10).

9) For a company striving to maximize utility, taking into account a certain level of risk and the set resource constraints, the model will take the following form, according to formula (11):

$$\begin{cases} \sum_{i=1}^{4} x_i m_i \to max; \\ \sum_{i,j=1}^{4} x_i x_j v_{ij} \le \sigma^2; \\ \sum_{i=1}^{4} x_i R_i \le 3{,}72. \end{cases}$$

10) In order to reduce the fuzzy optimization task to a crisp one, it is necessary to set the significance levels for the objective function and for each constraint. In the general case, these significance levels may vary. In our example, for simplicity, let's set the significance level of the constraint on risk as $\lambda_{\sigma^2} = 0{,}95$, on resources as $\lambda_R = 0{,}95$, and on the objective function as $\gamma = 0{,}95$. Conversion to crisp upper limits on risk requires preliminary calculation of the auxiliary matrix

$R = (r_{ij})_{ij=1}^{N}$, where $r_{ij} = (1-\gamma) \cdot a_3^{ij} + \gamma \cdot a_4^{ij}$, if $v_{ij} = (a_1^{ij};\ a_2^{ij};\ a_3^{ij};\ a_4^{ij})$.

The sum of all elements of the matrix R is the exact lower bound of all possible crisp auxiliary constraints on risk under which the solution of the optimization task is the set of all the projects under consideration (at the corresponding budget). In our example, it amounts to 2,138.94. Such artificially large values of the auxiliary constraints on risk are determined by the fact that the right boundaries of the fuzzy values of the covariance matrix $(a)_4^{ij}$ significantly exceed the abscissas of the remaining vertices of the trapezium $(a_1^{ij};\ a_2^{ij};\ a_3^{ij})$ in absolute value. Conversion from a fuzzy constraint on the total costs $(b_0^1;\ b_0^2;\ b_0^3;\ b_0^4)$ to a crisp auxiliary budget constraint b_0 also occurs according to a formula where the abscissas of only two right vertices of the trapezoid are involved: $r_{ij} = b_0 = (1-\gamma) \cdot b_0^3 + \gamma \cdot b_0^4$. Due to this, it is proposed to conduct defuzzification of fuzzy risk and fuzzy budget of the selected project portfolio using the mean maximum method, as well as defuzzification of fuzzy utility.

The calculations result in crisp coefficients of the objective function:

$$m_1 = 2{,}301, m_2 = 0{,}665, m_3 = 0{,}396, m_4 = 1{,}450.$$

The obtained values of the covariance matrix are presented in Table 9.

Table 9. Crisp values of the elements of the covariance matrix

Project	Project			
	P_1	P_2	P_3	P_4
	Values of the covariance matrix			
P_1	318.901	109.145	63.707	334.140
P_2	109.145	37.363	21.808	114.362
P_3	63.707	21.808	12.732	66.752
P_4	334.140	114.362	66.752	350.113

The "Find Solution" tool for the MS Excel add-in package is used to define the composition of the portfolio. Table 10 provides some results of the application of the model.

Table 10. Modeling of the formation of the project portfolio (maximization of expected utility of the project portfolio,γ = 0,95)

Constraint on total costs (bln rub.)	Auxiliary constraint on the risk of the project portfolio	Numbers of projects included in the portfolio	Project portfolio risk	Expected utility of the project portfolio	Total costs of the project portfolio (bln rub.)
3.72	712.98	1, 2	0.5	2.967	3.099

According to the data provided in the table, the following results were obtained in result of application of the model under consideration:

- projects for implementation are P_1, P_2;
- utility of the project portfolio $m_{port} = 2.967$;
- volume of resources required for the project portfolio $R_{port} = 3.099$.

At the solution of the standard task of optimization of the portfolio of projects, taking into account only the financial indicator of the projects NPV_n^l, the results of calculations for the example considered above are provided in Table 11.

Table 11. Modeling of the formation of the project portfolio

Constraint on total costs (bln rub.)	Auxiliary constraint on risk	Numbers of projects included in portfolio	Portfolio risk	Expected value of NPV of portfolio	Total costs of portfolio (bln rub.)
3.72	10.256	3, 4	0.5	0.819	3.287

Note: Maximization of the expected NPV of the project portfolio, $\gamma = 0{,}95$

According to the data provided in the table, the following results were obtained in result of application of the model under consideration:

- projects for implementation are P_3, P_4;
- NPV of the project portfolio $NPV_{port} = 0.819$;
- volume of resources required for the project portfolio $R_{port} = 3.287$.

The set of projects for implementation obtained in case of the use of the developed model differs from the set of projects for implementation obtained in the solution of the standard task of optimization of the project portfolio using financial indicators. Due to the fact that non-financial indicators of the social and state importance of the project, as well as constraints on the expected level of risk and the available resources for the company are taken into account in the model, a more accurate assessment of the project portfolio has been obtained, which takes into account the requirements of all stakeholders.

Conclusion

This paper proposes a fuzzy optimization model for the formation of a portfolio of investment projects, which allows to take into account non-financial indicators of social significance and state significance of projects, along with economic indicators, which allows to take into account the requirements of the main stakeholders.

Risks are managed within the framework of the portfolio investment theory of H. Markowitz using the

scenario approach. The model is a fuzzy quadratic programming task with a multiplicative objective utility function, which uses expert verbal assessments of qualitative indicators of social and state significances converted to fuzzy trapezoidal numbers. The fuzzy set approach allows to model the lack of information in the implementation of each scenario for the quantitative indicator of the economic efficiency of the project "net present value". Constraints in the model are also fuzzy. The fuzzy optimization task is reduced to a crisp one at the given significance level for the objective function and constraints and can be solved by standard numerical methods. By setting various levels of reliability, the decision-maker takes into account the existing uncertainty, to a greater or lesser extent. This will change the composition of the portfolio.

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The Impact of the Global Economic Crisis on Rural and Urban Poverty Gap

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Abstract:

In this study, we examine the impact of the 2008 Global Crisis on poverty gap across the globe. We look at the populations living on less than $1.25, $2, $2.50, $4, and $5 a day. We find that before the crisis, the poverty gap had been declining especially for the relatively less-poor population (*i.e*. the population living on less than $4 or $5 a day). This improvement in the poverty gap stopped after the crisis. When we examine the rural poverty gap and the urban poverty gap pre- and post-crisis, we find similar results. During the pre-crisis period, both rural and urban poverty gap had declined, but after the crisis, this improvement stopped. Overall, we suggest policymakers to focus on both rural and urban poverty rates when facing an economic crisis. We also suggest policymakers to focus on protecting the relatively less-poor population (*i.e*. the population living on less than $4 or $5 a day) since this group is the one that suffers the most due to an economic crisis.

Keywords: poverty; poverty gap; global crisis; economic crisis

JEL Classification: I30; I32; G01

Introduction

Several previous studies (*i.e*. Dhanani and Islam 2002, Skoufias and Suryahadi 2000, Zin 2002, and others) examine the impact of economic/financial crises on poverty. These studies generally show that an economic or financial crisis increases poverty levels.

In this study, we focus on the 2008 Global Crisis and examine the impact of this crisis on poverty gap across the globe. Poverty gap is the mean shortfall of the total population from the poverty line (counting the nonpoor as having zero shortfall), expressed as a percentage of the poverty line. This measure reflects the depth of poverty as well as its incidence.

We make three main contributions. First, we do not focus on a single country or a region. Instead, we use a comprehensive dataset of 173 countries which are in World Bank's World Development Indicators dataset. By using a more comprehensive dataset, we are hoping to draw more generalized conclusions when compared to the previous studies.

Second, we differentiate between rural poverty gap and urban poverty gap. In other words, we examine the impact of the 2008 Global Crisis on rural poverty gap and urban poverty gap separately. This way, we will know whether a big economic crisis like the 2008 crisis affects rural poverty, urban poverty or both.

Finally, we differentiate between different levels of poverty. We use several poverty gap measures using certain dollar amounts (the mean shortfall from $1.25, $2, $2.50, $4, or $5 a day) as well as poverty levels at national poverty lines (the mean shortfall from national poverty lines which are national estimates based on population-weighted subgroup estimates from household surveys). Using several poverty measures will ensure the validity of our results.

We believe that the results found in this study will shed a new light on the relation between economic/financial crises and poverty. We are doing our analyses during a very distinct time period in history: the period before and after the 2008 crisis. This is a very significant event; it affected all of the countries in the world, and its impact is still continuing.

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The paper proceeds as follows: Section 2 reviews the previous literature. Section 3 states our hypotheses. Section 4 explains the data and the methodology. Section 5 shows the empirical results. Finally, Section 6 concludes.

1. Literature review

There are several previous papers that examine the relation between economic (or financial) crises and human development (health and other issues). Within this literature, there are also papers that examine the relation between economic (or financial) crises and poverty.

The papers that examine the relation between economic/financial crises and human health find that crises have a significant negative impact on health and nutrition. De Pee *et al*. (2000) show that the 1997 economic crisis has caused Indonesia' currency to devalue significantly and this in turn resulted in increased food prices. The authors state that such a large reduction in purchasing power in Indonesia has negatively affected nutrition and health. Fouere *et al*. (2000) focus on poor households in Africa. They investigate the effects of currency devaluation on dietary change and nutritional vulnerability. Martin-Prével, Yves, *et al.* (2000) also focus on Africa. The authors examine the effects of the January 1994 devaluation of the African Financial Community (CFA) franc on nutritional in Congo. They show a decline in the quality of infant foods.

Later, Block *et al*. (2004) examine the impact of the 1997/1998 crisis on Indonesia. They show that that there was a significant drop in children's weight and their blood hemoglobin levels after the crisis. Brinkman *et al*. (2010) examine the impact of the 2008 crisis on young children, pregnant and lactating women, and the chronically ill people. The authors contend that these groups have been affected more significantly compared to the others. Bloem, Semba, and Kraemer (2010) argue that governments are emphasizing consumption of calorie-rich but nutrient-poor food and that this leads to a decline in dietary quality as well as quantity.

De Pee *et al.* (2010) contend that the 2008 global economic crisis, commodity price hikes, and climate change have had the worst impact on the poor. Similar to De Pee *et al.* (2010), Darnton-Hill and Cogill (2010) show that rising food prices affect the poor the most. This is especially true for food-importing, resource-limited countries. Christian (2010) examines the impact of economic crises on childhood mortality. The author recommends that, in order to reduce child mortality, nutritional and health surveillance data are urgently needed.

Wodon and Zaman (2010) argue that reducing import tariffs on food would likely benefit the non-poor, rather than the poor. Tiwari and Zaman (2010) estimate the impact of the 2008 crisis on undernourishment. They argue that there was an additional 4.4 percent increase in undernourishment in 2009. West and Mehra (2010) contend that economic crises affect both dietary quality/diversity and adequacy of vitamin A. Thorne-Lyman *et al.* (2010) argue that "low dietary diversity during the period prior to major food price increases indicates potential risk for worsening of micronutrient deficiencies and child malnutrition in Bangladesh".

Breisinger *et al*. (2011) examine Yemen. They argue that the 2008 crisis slowed the economy in that country and this has compounded the poverty effects of the food crisis. Webb and Block (2012) contend that structural transformation in a country supports improved nutrition, especially in rural areas. Nikoloski and Ajwad (2013) examine the impact of the 2009 crisis on Russia. They show that the crisis led to a decrease in poor households' income and that this decrease resulted in less spending on healthcare services. They also show that, due to the crisis, the most vulnerable people altered their health and nutrition behavior.

As mentioned above, there are several papers that focus directly on the relation between economic/financial crises and poverty. These studies generally find crises have a significant negative impact on poverty and poverty gap.

Skoufias and Suryahadi (2000) examine the changes in the distribution of living standards among Indonesian households during the economic crisis. They show that there was a considerable drop in household welfare during the crisis. Their results show that the average per capita expenditures fell significantly, and at the same time inequality increased. They contend that the poverty rate doubled from the pre-crisis level.

Said and Widyanti (2002) examine changes in poverty and inequality in Indonesia due to the 1997/1998 crisis. They show that the poverty rate rose by nearly seventy percent due to the crisis. They show that the increase

in rural poverty was relatively higher when compared to the increase in urban poverty. They also showed that poverty rates increased in all provinces.

Fallon and Lucas (2002) discussed the financial crises in 1990s. They discuss how economies that experienced the sharpest currency depreciations suffered the most. The authors contend that, families, especially wealthier families, smoothed their incomes through increased labor force participation and private transfers. According to the authors "the initial impact of the crises was on the urban corporate sector, but rural households were affected as well and in some instances suffered deeper losses than did urban families".

Dhanani and Islam (2002) examine the impact of the 1997 crisis on poverty in Indonesia. The authors recommend governments to establish a fiscally sustainable social safety net that is able to reinforce household coping mechanisms and social capital.

Suryahadi, Sumarto and Pritchett (2003) examine the impact of the 1997 crisis on Indonesia. They show that the poverty rate increased from fifteen percent at the onset of the crisis to thirty-three percent at the end of 1998. The authors contend that "after the peak point, the poverty rate started to decline again and reached the pre-crisis level of around fifteen percent at the end of 1999". According to the authors, due to the crisis, the country lost two and a half years in its fight with poverty.

Suryahadi and Sumarto (2003) show that the level of vulnerability to poverty among Indonesian households after the crisis increased from pre-crisis levels. The authors state that "furthermore, not only did the poverty rate in Indonesia increase significantly because of the crisis, but it appears that much of this increase was due to an increase in chronic poverty. Likewise, the results of this study indicate that the number of households that have high vulnerability to poverty has almost tripled after the crisis. As a result, the proportion of the total vulnerable group – the current poor plus the high vulnerability group – has jumped from less than one fifth of the population before the crisis, to more than one third after the crisis".

Zin (2005) discusses papers that examine the impact of the Asian Crisis on the countries in East Asia. The author explains that these studies show the uneducated, inexperienced, young female workers, and the urban sector suffered most from the crisis. According to the author "the rural and agriculture sectors suffered more than the urban sectors in countries such as Indonesia and the Philippines. In contrast, it was the urban sector and industrial workers who suffered most in countries such as Thailand, Malaysia and South Korea".

Habib *et al.* (2010) state that "a shortage of real-time data hinders evaluations of the impact of the global crisis on developing countries". They examine the impact of the crisis on poverty in Bangladesh, Mexico, and the Philippines. They show that the increase in poverty would be well over a million, and that the crisis has hit the middle-income households the hardest.

Ahmed and O'Donoghue (2010) examine the impact of the 2008 global crisis on Pakistan's economy. Their results suggest that, between 2007 and 2009, the poverty headcount ratio is likely to have increased by almost eighty percent. The authors contend that "this increase is attributable in part to the fuel and food crisis that preceded the financial crisis". According to the authors, after the crisis, there were wage increases for farm workers and wage reductions for skilled labor.

Sobrevinas, De Jesus and Reyes (2010) examine the impact of the crisis on poverty in the Philippines. They contend that there was a modest increase in poverty. The crisis affected some specific sectors in the economy. The degree of impact also varies among different groups of households. According to the authors, the households which are highly dependent on remittances as a source of income were affected more due to reduced remittance receipts. The authors also argue that "the households with members who are working in the affected sectors (*e.g.,* manufacturing) were negatively affected through reduced income". They recommend policies to mitigate the impact of the crisis on these affected sectors and groups of households.

Breisinger *et al*. (2011) show that the 2008 crisis impacted Yemen mainly through the drop in oil prices and a reduction in remittances. According to the authors, these factors slowed growth, including agricultural growth, and this in turn hit households hard. They show that poverty increased by eight percentage points due to the crisis.

Suryahadi, Hadiwidjaja and Sumarto (2012) assess the relationship between economic growth and poverty reduction in Indonesia before and after the Asian financial crisis. They show that the reduction rate in poverty slowed down significantly after the crisis.

More recently, Muñoz *et al.* (2016) estimate poverty measures like the poverty gap and the poverty severity indices using sample data collected from social surveys. They explain their novel method for the estimation of these poverty indicators in detail.

Collado *et al.* (2016) explore how poverty reduction can be improved and at what cost. The authors argue that the EU countries must develop not only effective employment policies but also ensure adequate social protection which includes increasing social transfers for working and non-working households while protecting work incentives. The authors show that it is costly for the governments to achieve these objectives.

Neuenkirch and Neumeier (2016) analyze the effect of US economic sanctions on the target countries' poverty gap during the period 1982–2011. They show that US sanctions are adversely affecting those living in poverty. They also show that the impact of sanctions on poverty increases with the severity of sanctions and is larger for multilateral sanctions than for unilateral sanctions imposed by only the United States.

Anyanwu and Anyanwu (2017) find that poverty reduction in Sub-Saharan Africa significantly lags other developing regions. For the period 1980 to 2013, the authors show that high income inequality, oil-dependence, institutionalized democracy, high prevalence of HIV among the female youth, and increased civil war episodes contribute to poverty, while higher levels of economic development, higher general government final consumption expenditure, higher official development assistance and aid received, urbanization, and access to improved water source reduce poverty.

Kudebayeva and Barrientos (2017) examine the main factors behind the strong decline in poverty experienced in Kazakhstan. They examine the 2001-2009 period and look into the contribution of growth and redistribution to poverty indicators. The authors find that growth was the main factor reducing poverty in the first half of the decade and redistribution is important in sustaining poverty reduction in the second half of the decade. The authors state that redistribution was crucial to sustaining poverty reduction in the aftermath of the financial crisis.

2. Hypotheses

In line with the previous literature on economic/financial crises and human development, we expect the overall poverty gap to deteriorate (*i.e.* increase) after an economic crisis starts. Therefore, we expect the overall poverty gap to deteriorate after the 2008 Global Crisis had started. Our first hypothesis is as follows:

Hypothesis 1: The overall poverty gap across the globe had deteriorated due to the global crisis.

We expect to see a similar deterioration in both rural and urban poverty gaps after an economic crisis starts. Therefore, our second and third hypotheses are:

Hypothesis 2: The rural poverty gap across the globe had deteriorated due to the global crisis.

Hypothesis 3: The urban poverty gap across the globe had deteriorated due to the global crisis.

The next section explains our data and methodology.

3. Data

In this study, we examine the impact of the 2008 Global Crisis on poverty rates across the globe. World Bank's World Development Indicators dataset has poverty-related data, so we use these data in our analyses. This dataset has poverty data on 173 countries across the globe.

Our variables and their definitions are as follows. The first seven variables are related to poverty gap. Poverty gap is the mean shortfall from the poverty line (counting the nonpoor as having zero shortfall), expressed as a percentage of the poverty line (this measure reflects the depth of poverty as well as its incidence):

- GAPS (Poverty gap at $1.25 a day (PPP) (%)): Poverty gap for the poor population living on less than $1.25 a day;
- GAPTWO (Poverty gap at $2 a day (PPP) (%)): Poverty gap for the poor population living on less than $2 a day.

- GAPTWOFIVE (Poverty gap at $2.50 a day (PPP) (%)): Poverty gap for the poor population living on less than $2.50 a day.
- GAPFOUR (Poverty gap at $4 a day (PPP) (%)): Poverty gap for the poor population living on less than $4 a day.
- GAPFIVE (Poverty gap at $5 a day (PPP) (%)): Poverty gap for the poor population living on less than $5 a day.
- NAGP (Poverty gap at national poverty lines (%): Poverty gap at national poverty lines is the mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.
- NAGPNC (Poverty gap at national poverty lines (%), inc. noncomparable values): Poverty gap at national poverty lines is the mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.

The next two variables are related to rural poverty gap:

- RUGP (Rural poverty gap at national poverty lines (%)): Rural poverty gap at national poverty lines is the rural population's mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.
- RUGPNC (Rural poverty gap at national pov. lines (%), inc. noncomp. values): Rural poverty gap at national poverty lines is the rural population's mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.

The next two variables are related to rural poverty headcount ratio:

- RUHC (Rural poverty headcount ratio at national poverty lines (% of rural pop.)): Rural poverty headcount ratio is the percentage of the rural population living below the national poverty lines.
- RUHCNC (Rural poverty headcount ratio at national poverty lines (% of rural population), including noncomparable values): Rural poverty headcount ratio is the percentage of the rural population living below the national poverty lines.

The next two variables are related to urban poverty gap:

- URGP (Urban poverty gap at national poverty lines (%)): Urban poverty gap at national poverty lines is the urban population's mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.
- URGPNC (Urban poverty gap at national poverty lines (%), including noncomparable values): Urban poverty gap at national poverty lines is the urban population's mean shortfall from the poverty lines (counting the nonpoor as having zero shortfall) as a percentage of the poverty lines. This measure reflects the depth of poverty as well as its incidence.

The final two variables are related to urban poverty headcount ratio:

- URHC (Urban poverty headcount ratio at national pov. lines (% of urban pop.)): Urban poverty headcount ratio is the percentage of the urban population living below the national poverty lines.
- URHCNC (Urban poverty headcount ratio at national poverty lines (% of urban population), including noncomparable values): Urban poverty headcount ratio is the percentage of the urban population living below the national poverty lines.

In the next section, we compare the pre-crisis period to the crisis period. We take the pre-crisis period as the 2006-2007 period and we take the crisis period as the 2007-2008 period. Then, using non-parametric tests

(only the results of the Mann-Whitney-Wilcoxon tests are reported), we compare the pre-crisis period to the crisis period.

4. Results

Table 1 shows the trend in our seven variables on poverty gap over time. Figure 1 graphically shows the variation in GAPS, GAPTWO, GAPTWOFIVE, GAPFOUR, and GAPFIVE, and Figure 2 graphically shows the variation in NAGP and NAGPNC over time.

Table 1 (and also Figure 1) shows that the variables GAPS, GAPTWO, GAPTWOFIVE, GAPFOUR, and GAPFIVE all went down until either 2007 or 2008, and after that, they went up. Similarly, Table 1 (and also Figure 2) shows that there was a similar trend in the variables NAGP and NAGPNC. These two variables also went down until either 2007 or 2008, and after that, they went up.

We conclude that the poverty gap had been declining up until 2007 or 2008, but that this improvement in the poverty gap stopped after the crisis started.

Table 1. Poverty Gap over Time

Year	GAPS	GAPTWO	GAPTWOFIVE	GAPFOUR	GAPFIVE	NAGP	NAGPNC
2005	2.04	5.41	8.58	18.11	24.34	8.40	8.10
2006	1.78	3.73	6.04	14.53	20.39	11.00	8.70
2007	1.01	3.57	4.78	7.07	11.03	6.45	6.45
2008	1.00	2.79	5.50	11.87	17.24	7.50	6.40
2009	1.14	3.05	5.64	12.60	18.16	7.80	8.30
2010	1.34	3.79	5.04	9.31	14.27	6.67	6.67
2011	1.32	3.98	6.02	13.23	18.79	7.85	7.85
2012	0.96	3.27	5.71	13.75	17.91	4.40	4.40

Figure 1. Poverty Gap

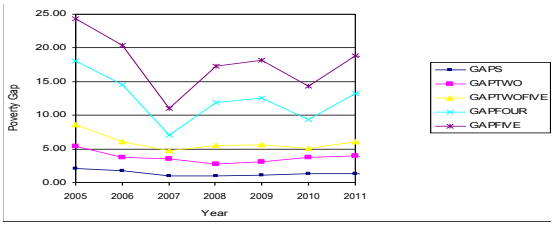


Figure 2. Poverty Gap at national poverty lines

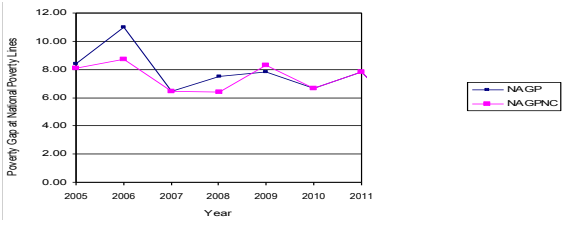


Table 2 shows the trend in our four variables on rural poverty gap and rural poverty headcount ratio *(i.e.* RUGP, RUGPNC, RUHC, and RUHCNC) over time. Figure 3 graphically shows the variation in these variables over time.

Table 2 (and also Figure 3) shows that three of these four variables RUGP, RUGPNC, and RUHC went down until either 2007 or 2008, and after that, they went up. We conclude that the rural poverty gap and the rural poverty headcount ratio had been declining up until 2007 or 2008, but that this improvement stopped after the crisis started.

Table 2. Rural Poverty Gap over Time

Year	RUGP	RUGPNC	RUHC	RUHCNC
2005	9.80	9.70	44.40	42.50
2006	17.90	13.85	48.45	41.25
2007	8.90	8.90	40.35	39.05
2008	8.95	8.70	43.65	38.20
2009	11.60	12.20	37.40	37.25
2010	8.00	8.00	37.20	36.00
2011	9.90	9.90	40.05	40.05
2012	6.35	6.35	29.60	29.60

Figure 3. Rural Poverty gap

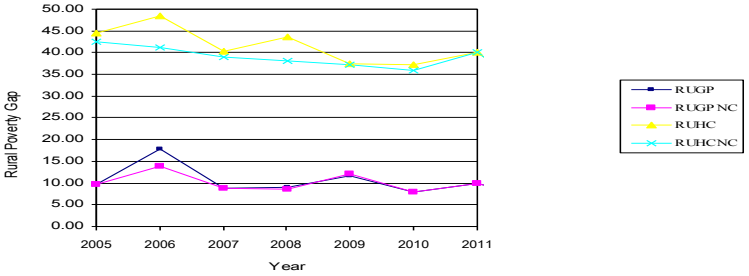


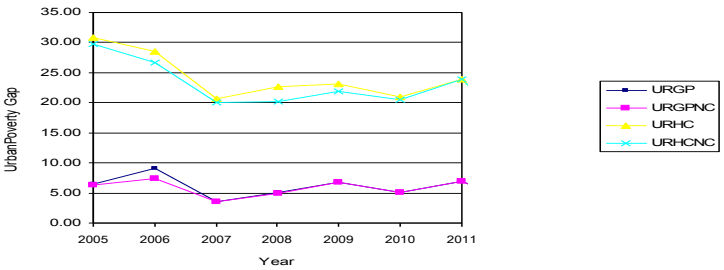
Table 3 shows the trend in our four variables on urban poverty gap and urban poverty headcount ratio (*i.e.* URGP, URGPNC, URHC, and URHCNC) over time. Figure 4 graphically shows the variation in these variables over time.

Table 3 (and also Figure 4) shows that all four variables went down until 2007, and after that, they went up. We conclude that the urban poverty gap and the urban poverty headcount ratio had been declining up until 2007, but that this improvement stopped after the crisis started.

Table 3. Urban Powerty Gap ower Time

Year	URGP	URGPNC	URHC	URHCNC
2005	6.50	6.30	30.90	29.80
2006	9.10	7.40	28.50	26.70
2007	3.60	3.60	20.60	20.00
2008	5.10	4.90	22.60	20.20
2009	6.80	6.85	23.15	21.90
2010	5.10	5.10	20.90	20.45
2011	7.00	7.00	23.90	23.90
2012	2.70	2.70	14.20	14.20

Figure 4. Urban Powerty Gap



In order to statistically test whether the trend in poverty gap had changed due to the crisis, we run non-parametric tests *(i.e.* Mann-Whitney-Wilcoxon). First, in order to see the pre-crisis situation, we compare the 2006 numbers to the 2007 numbers. Then, in order to see the effect of the crisis, we compare the 2007 numbers to the 2008 numbers.

Panel A in Table 4 shows the results of the tests that compare the 2006 values to the 2007 values. Panel B shows the results of the tests that compare the 2007 values to the 2008 values. As we are seeing in Panel A, there was a statistically significant decline in four of the seven variables from 2006 to 2007. The median value of GAPFOUR is 14.53% in 2006. The corresponding value is only 7.07% in 2007. This drop is significant at 10% level (p=0.0640). Similarly, the median value of GAPFIVE is 20.39% in 2006. The corresponding value is only 11.03% in 2007. This drop is significant at 5% level (p=0.0478). We can say that the poverty gap had been declining especially for the relatively less-poor population (*i.e.* the population living on less than $4 or $5 a day).

The poverty gap at national poverty lines, NAGP and NAGPNC, also declined significantly from 2006 to 2007. The median value of NAGP is 11.00% in 2006. The corresponding value is only 6.45% in 2007. This drop is

significant at 5% level (p=0.0403). Similarly, the median value of NAGPNC is 8.70% in 2006. The corresponding value is only 6.45% in 2007. This drop is significant at 10% level (p=0.0722). These results confirm that there had been a significant improvement in poverty gap before the crisis started.

On the other hand, Panel B shows that there had been no significant change in any of these seven variables from 2007 to 2008. None of the changes are significant at 10% level. These results in Panel B indicate that the improvement in the poverty gap stopped after the crisis.

Table 4. Poverty gap

Panel A. Comparison of 2006 and 2007							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
GAPS	6.04	1.78	11.23	4.12	1.01	7.27	0.2406
GAPTWO	10.88	3.73	16.40	7.25	3.57	11.44	0.1626
GAPTWOFIVE	13.90	6.04	18.79	9.61	4.78	13.92	0.1309
GAPFOUR	22.13	14.53	23.06	16.55	7.07	19.45	0.0640
GAPFIVE	26.96	20.39	24.46	20.72	11.03	21.90	0.0478
NAGP	15.17	11.00	12.72	9.28	6.45	8.92	0.0403
NAGPNC	13.85	8.70	12.46	9.03	6.45	8.72	0.0722
Panel B. Comparison of 2007 and 2008							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
GAPS	4.12	1.01	7.27	3.06	1.00	5.52	0.2106
GAPTWO	7.25	3.57	11.44	7.26	2.79	10.38	0.3924
GAPTWOFIVE	9.61	4.78	13.92	10.23	5.50	13.25	0.4844
GAPFOUR	16.55	7.07	19.45	18.58	11.87	19.26	0.3098
GAPFIVE	20.72	11.03	21.90	23.45	17.24	21.65	0.2422
NAGP	9.28	6.45	8.92	10.36	7.50	10.51	0.4310
NAGPNC	9.03	6.45	8.72	9.59	6.40	10.18	0.4957

Table 5 shows our results for rural poverty gap and rural poverty headcount ration. Panel A shows the results of the tests that compare the 2006 values to the 2007 values. Panel B shows the results of the tests that compare the 2007 values to the 2008 values. As we are seeing in Panel A, there was a statistically significant decline in RUGP and RUHC variables from 2006 to 2007. The median value of RUGP is 17.90% in 2006. The corresponding value is only 8.90% in 2007. This drop is significant at 10% level (p=0.0777). Similarly, the median value of RUHC is 48.45% in 2006. The corresponding value is only 40.35% in 2007. This drop is significant at 10% level (p=0.0932). We can say that the rural poverty gap and the rural poverty headcount ratio both had been declining before the crisis started. On the other hand, Panel B shows that there had been no significant change in any of these variables from 2007 to 2008. None of the changes are significant at 10% level. These results in Panel B indicate that the improvement in the rural poverty gap and the rural poverty headcount ratio stopped after the crisis.

Table 5. Rural poverty gap

Panel A. Comparison of 2006 and 2007							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
RUGP	22.00	17.90	16.51	13.35	8.90	11.03	0.0777
RUGPNC	19.91	13.85	16.46	12.76	8.90	10.77	0.1370
RUHC	47.40	48.45	21.36	40.35	40.35	20.20	0.0932
RUHCNC	44.50	41.25	22.44	39.05	39.05	20.03	0.1388
Panel B. Comparison of 2007 and 2008							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
RUGP	13.35	8.90	11.03	15.24	8.95	12.86	0.3965
RUGPNC	12.76	8.90	10.77	14.53	8.70	12.69	0.4203
RUHC	40.35	40.35	20.20	41.28	43.65	20.85	0.4410
RUHCNC	39.05	39.05	20.03	38.73	38.20	21.36	0.4784

Table 6 shows our results for urban poverty gap and urban poverty headcount ration. Panel A shows the results of the tests that compare the 2006 values to the 2007 values. Panel B shows the results of the tests that compare the 2007 values to the 2008 values.

As we are seeing in Panel A, there was a statistically significant decline in URGP, URGPNC, and URHC variables from 2006 to 2007. The median value of URGP is 9.10% in 2006. The corresponding value is only 3.60% in 2007. This drop is significant at 5% level (p=0.0336). Similarly, the median value of URGPNC is 7.40% in 2006. The corresponding value is only 3.60% in 2007. This drop is significant at 10% level (p=0.0638). The median value of URHC is 28.50% in 2006. The corresponding value is only 20.60% in 2007. This drop is significant at 10% level (p=0.0588). We can say that the urban poverty gap and the urban poverty headcount ratio both had been declining before the crisis started.

On the other hand, Panel B shows that there had been no significant change in any of these variables from 2007 to 2008. None of the changes are significant at 10% level. These results in Panel B indicate that the improvement in the urban poverty gap and the urban poverty headcount ratio stopped after the crisis.

Table 6. Urban poverty gap

Panel A. Comparison of 2006 and 2007							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
URGP	15.10	9.10	18.95	6.97	3.60	8.61	0.0336
URGPNC	12.47	7.40	17.00	6.65	3.60	8.30	0.0638
URHC	27.31	28.50	12.14	22.96	20.60	15.31	0.0588
URHCNC	25.26	26.70	12.56	22.32	20.00	14.85	0.1191
Panel B. Comparison of 2007 and 2008							
VARIABLES	MEAN	MEDIAN	STDEV	MEAN	MEDIAN	STDEV	PVALUE
URGP	6.97	3.60	8.61	8.34	5.10	10.12	0.2937
URGPNC	6.65	3.60	8.30	7.81	4.90	9.96	0.3844
URHC	22.96	20.60	15.31	23.61	22.60	14.16	0.4172
URHCNC	22.32	20.00	14.85	22.18	20.20	14.31	0.4770

Conclusion

In this study, we examine the impact of the 2008 Global Crisis on poverty gap across the globe. We use World Bank's World Development Indicators dataset. This dataset has poverty data on 173 countries across the globe.

As our sample period, we choose the 2005-2012 period which covers the three-year period before and after the crisis. We then look into the populations living on less than $1.25, $2, $2.50, $4, and $5 a day. We look into several variables including "poverty gap", "poverty gap at national poverty lines", "rural poverty gap at national poverty lines", "rural poverty headcount ratio at national poverty lines", "urban poverty gap at national poverty lines", and "urban poverty headcount ratio at national poverty lines".

Our results show that poverty gap had been declining especially for the relatively less-poor population (*i.e.* the population living on less than $4 or $5 a day). This improvement in poverty gap stopped after the crisis started. When we examine the rural poverty gap and the urban poverty gap separately pre- and post-crisis, we find similar results. During the pre-crisis period, both rural and urban poverty gap had declined, but after the crisis started, this improvement stopped.

Overall, we suggest policymakers to focus on both rural and urban poverty rates when facing an economic crisis. We also suggest policymakers to focus on protecting the relatively less-poor population (*i.e.* the population living on less than $4 or $5 a day) since this group is the one that suffers the most due to an economic crisis.

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Tracing Value Added and Job Creation Across Industries in the Slovak Republic

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Abstract:

Increasing participation of the Slovak Republic in the global value chains (GVCs) represents one of the key implications of the steadily growing position of important Slovak industries in both domestic and international terms. Slovak Republic is mainly positioned in the downstream activities of GVCs. However, his fact contributes to the relatively limited domestic value added creation. The aim of this article is to analyze whether the changes and the increasing participation of the Slovak republic in the GVCs influenced the position of important industries in term of value added creation and employment. We analyze the multipliers of production and value added using input-output model. The factors of skill structure of labor demand will be estimated using the system of cost share equations derived from translog cost function. The data covers period 2000-2014 and 1995-2009 for socio-economic analyses and come from World Input-Output Database (WIOD). The results for two analyzed industries show that their impact on total industrial production has decreased during the analyzed period. The results for employment analysis clearly revealed the differences between domestic and foreign orientated industry.

Keywords: value added; employment; multipliers; GVCs; offshoring; labor demand; input-output model; translog cost function

JEL Classification: J31; F14; F16

Introduction

Over the past decade, there has been a significant change in the organization of world trade and production. The share of regions in world added value has considerably changed. The share of the value added EU27 was 29% by 2003, while in 2011 it was only 24% (Lábaj 2014). World exports of value added are around 70% - 75% of gross exports while in the 1970s and 1980s it varied around 85%. However, there are large differences in this indicator between countries (Johnson 2014). EU countries from Central and Eastern Europe (CEE) generate about 5% lower domestic value added compared to old EU (EU15) countries. Foreign value added represents a larger share of CEE exports than the EU-15. Although the CEE countries have become major suppliers of intermediates and components, semi-final products and final products, they are shown to have an increasing share of imports included in their exports. In the CEE, the share in global value chains (GVCs) is higher than the EU-15 average, so they can improve their positions in the long run and increase domestic added value in exports (Vrh 2015). Therefore, this article will be interested in the question whether the changes and the increasing participation of the Slovak republic in the GVCs were influenced the position of important industries in term of value added creation and employment. We will analyze the multipliers of production and value added using input-output analysis. The factors influencing the skill structure of labor demand will be estimated using the system of cost share equations derived from translog cost function. The data covers period 2000-2014 and 1995-2009 for socio-economic analyses and come from World Input–Output Database (WIOD).

This paper is divided into five sections. Following the introduction, the relevant empirical literature is reviewed in Section 1. In Section 2 we provide a description of characteristics regarding analyzed industries and skill upgrading. In Section 3 we provide main results of input-output analysis of selected industries with a brief overview of input-output model that we employ to calculate the values of multipliers. In Section 4 we discuss the effects of GVCs on employment particularly on the skill structure of labor demand. In this section we provide a brief

overview of model that we employ to examine the impact of offshoring on labor demand as well. Finally, concluding remarks are made in Section 5.

1. Literature review

International fragmentation of production draws increasing attention in both theoretical literatures in the area of foreign trade, *i.e*., Grossman and Rossi-Hansberg (2008) and Costinot, Vogel, and Wang (2013) and empirical literature *i.e*., Feenstra and Hong (2007), Johnson and Noguera (2012), Baldwin and Lopez-Gonzalez (2013), Los, Timmer and De Vries (2015). The process of fragmentation is often analyzed in literature under the names such as vertical specialization, outsourcing, offshoring or trade in task. Due to international fragmentation of production in world economy we may observe changes in understanding of international competitiveness. Intention of countries to participate in new international division of labor based on participation of country in the global value chains reveals lot of opened questions for industrial policy framework. Traditional measures of export performance provide biased information for policy decisions (Labaj 2014, Habrman 2013). As a result, many authors focus on estimations of domestic value added shares in unit of exports that is used as a measure of vertical specialization in foreign trade. Examination of relative importance of individual sectors of the economy in the international production chains naturally corresponds with a requirement to use appropriate methodology (Lábaj 2014). In order to examine structural and intra-industrial linkages, empirical literature tend to implement input-output analysis that is based on the use of multiregional input-output tables that provide crucial information not only on value added within individual segments of production chains but also on quantitative and qualitative features of inputs (labor and capital) (Backer and Miroudot 2013). Empirical literature on input-output analysis concentrates on examination of equilibrium in the individual country. Such studies are based on the use of input-output tables due to their precise ability to monitor not only value added in export industries but also on the individual levels of a production chain.

Several empirical studies for the Slovak economy focused on analyzing the position and importance of individual industries for the national economy or analyzed the importance of selected sectors for the individual regions of Slovakia. Kubala, Lábaj and Silanič (2015) made an overview of this issue in the context of structural links in the Slovak economy in 2010 and the identification of key sectors. Hečková and Chapčáková (2011) analyzed the competitiveness of the manufacturing industry during period 1998-2008. They concluded that the manufacturing industries produced a low value added and provide a limited space for the use of skilled workers in production processes contrary to high import demand. Lábaj, Luptáčik a Rumpelová (2008), Dujava, Lábaj a Workie (2011), Habrman, Kočišová a Lábaj (2013), Lábaj (2013) analyzed complex cross-sectorial links in the economy of Slovakia, focusing on total production, added value, employment and imports for the years 2000, 2005 and 2008. These studies bring important information on multiplier effects of final-use of individual commodities for Slovakia's economy and the importance of each final-use category for value added and employment creation. An approach that explores key sector based on the analysis of comparative advantages, has been investigated, for example by Balog *et al.* (2013). This approach does not take into account the importance of domestic demand and the complex linkages between industries.

Differentiation of the employment in individual regions of Slovakia in terms of high-tech and low-tech manufacturing industries and services was studied by Gašparíková, Nemcová and Páleník (2006). The sector of information and communication technologies (ICT) within the regions of Slovakia was analyzed by Hudec and Šebová (2012). Their results confirm that the ICT sector has become important in the sectorial structure of Bratislava and Košice regions over the last two decades.

Luptáčik *et al.* (2013) analyzed the importance of the automotive industry for the economy of the Slovak Republic. They stated that in 2012, 9% of total employment in the Slovak economy, direct and indirect depends on the automotive industry. The share of value added generated by the automotive industry in total national value added was over 11%. The value added generated directly by automotive industry was 4%. The main results of the study suggest that the automobile industry generates directly and indirectly 17% of the Slovak economy gross production and create more than 200,000 jobs.

Creation of value added in the Slovak economy was also examined by Habrman (2013) who notes that exports generate lesser effects than domestic demand. Despite the great openness of the Slovak economy, most

of the value added (even GDP) is still generated by domestic demand (58-63% of the added value) while exports generate the remaining part (37-42% of value added). Production for the domestic market generates higher effects than output for export. A deeper look at the sectorial structure of the economy shows that the three most exporting sectors - Automotive, Electrical and Optical Equipment and basic metal and fabricated metal account for up to 50% of the economy's exports, but only 40% of the effects of all exporting sectors on value added and employment. This is mainly caused by the automotive industry, whose production is highly fragmented, and therefore domestic value added of the export generated in Slovakia represents only 26%. On the basis of these studies, further analysis will concentrate on automotive sector and construction as the most important sectors in term of production, export and value added creation.

2. Stylized facts

The type of competitiveness selected by Slovakia was based on low taxes and salaries instead of investments in research and development and quality factors (*e.g.* quality of institutions, education system or national innovation system). The growth of labor productivity has been achieved mainly by transfers of technologies and organizational innovations in the framework of multinational companies. The Slovak economy achieves a strong position, both in comparison with the Central European economies and with the innovation leaders, only in the area of foreign direct investments and transfer of technologies. Increased arrival of foreign investments into the economy is demonstrated by the high level of a production process. In the 1997-2011, a clear trend towards specialization in certain product types could be seen in the Slovak export of goods. In 2011, more than a half of the Slovak export was made by only three product classes (MHSR 2013).

The next tables illustrate the main characteristic of the most important industries in terms of production, export and value added creation in Slovakia such as automotive - manufacture of motor vehicles, trailers and semi-trailers (that includes the manufacture of motor vehicles for transporting passengers or freight) as well as construction (including general construction and specialized construction activities for buildings and civil engineering works). The construction sector is included mainly for comparison of typically domestic sector with high level of domestic value added and employment creation. The source of data is WIOD database that provides annual time-series of world input-output tables from 2000 to 2014 and provides data on the factor inputs used in production, low, medium and high-skilled workers and capital (for period 1995-2011).

Table 1. The main characteristics of selected Slovak sectors

	2000	2008	2009	2011	2014
GO (millions of USD)	47,953.6	222,650.9	193,954.5	228,356.7	229,289.1
VA / GO (%) total	38.4	39.5	41.8	38.9	39.7
EXP / GO (%) total	15.7	31.1	27.6	31.9	35.8
GO Automotive / GO (%)	4.6	8.7	7.0	10.2	12.2
GO Construction / GO (%)	7.7	9.4	10.0	8.4	7.1
VA Automotive / VA (%)	1.9	3.2	2.3	3.6	3.8
VA Construction / VA (%)	7.2	9.5	9.7	8.9	8.4
EXP Automotive / EXP (%)	18.3	22.4	20.7	25.5	25.7
EXP Construction / EXP (%)	0.6	0.8	1.0	0.7	0.7

Source: data from WIOD

Note: Automotive = manufacture of motor vehicles, trailers and semi-trailers. GO = gross output, VA = gross value added, EXP=export

From the data in Table 1 a slight change in the share of value added in total output, but in particular a significant increase in export, can be noticed. This growth of exports, as already mentioned, can be associated with the production of the automotive sector, whose share in the total production of Slovakia increased from 4.6% to 12.2% (in connection with the current foreign direct investment of another car manufacturer in Slovakia it can be expected that this share will increase). This is also supported by the growing share of automotive exports in total exports, which in 2014 accounted for up to 25.7% of whole export.

On the other hand, the share of construction in the total output is almost unchanged (growth was mainly in the pre-crisis period). Similarly, the share of exports is small, but the significant difference can be seen in the share of value added that is more than 8% for construction, but less than 4% for automotive. Construction is among the sectors that produce the largest share of value added in the Slovak economy.

In the Slovak Republic, the share of capital and labor in value added creation has unusual unbalanced ratio (capital has unusual high share and labor low share). This development is related to the massive inflow of foreign capital. In Germany and France, the share of capital in the value added creation declined in favor of labor. The high share of high skilled labor on the value added creation is due to the high contribution of the service sector in production of vehicles in France and Germany and conversely, with low share of input from services in the Slovak Republic and other CEE countries.

Table 2. The share (%) of labor and capital in value added creation for individual industries in Slovakia in 1995 and 2011

		1995	2011			1995	2011
Automotive	LAB/VA	42	30	Construction	LAB/VA	55	33
	CAP/VA	58	70		CAP/VA	45	67
Total Industries	LAB/VA	37	39				
	CAP/VA	63	61				

Source: WIOD, own calculations

Note: LAB/VA = share of labor in value added creation, CAP/VA = share of capital in value added creation

The share of high skilled labour in value added creation in the industry of automotive in the Slovak Republic was one of the lowest in the EU. Therefore, the Slovak Republic competed mainly with large stock of (foreign) capital and average high proportion of medium skilled labor. Slušná, Balog *et al*. (2015). Table 2 supports these conclusions and also points to a significant change in favor for capital share in the construction sector.

Table 3. The share (%) of persons engaged in total number for individual industries in Slovakia in 1995 and 2011

	1995	2011	Growth rate
Total industries	100	100	6.83
Agriculture, Hunting, Forestry, Fishing	9	4	-57
Basic Metals and Fabricated Metal	4	3	-7
MANUFACTURING (Total)	27	20	-21
Electrical and Optical Equipment	3	3	4
Automotive (Transport Equipment)	1	1	24
Electricity, Gas and Water Supply	2	2	-15
Construction	7	9	34
Wholesale Trade and Commission Trade	5	7	61
Retail Trade	5	11	112
Other Inland Transport	5	4	-15
Financial Intermediation	1	2	46
Real Estate Activities	1	1	15
Renting of M&Eq and Other Business Activities	5	9	107
Public Admin and Defense	6	6	8
Education	9	7	-16
Health and Social Work	6	6	4

Source: data from WIOD

The Slovak economy is significantly specialized in the area of industry, especially in the area of industrial production with higher and lower medium technology. In the EU27 approximately 4.5% of labor force works in the industrial production with medium-high technology, whereas in Slovakia this share is 8.1%. Slovakia is the third most specialized economy in this area in the EU. In Slovakia almost 65% of this production is created by production of motor vehicles and spare parts thereof. Such a high share in the production demanding medium-high technologies can be seen in no other EU27 country. Similar situation is in the case of industrial production with

medium lower technology where in the EU27 the share in the total employment is on the level of 4.4% and in Slovakia 7.5%, which makes 176 thousand workers MHSR (2013).

From the point of view of job creation (see Table 3), the construction industry belongs to the sectors with the greatest employment. Automotive does not directly produce such employment as construction, but its indirect effects are significant. Luptáčik *et al.* (2013) as already mentioned stated that in 2012, 9% of total employment in the Slovak economy, direct and indirect depends on the automotive industry. The growth rate of employees during period of 1995-2011 was 24%.

The current situation in advanced countries give an impression that firms shifts low-skilled intensive stage of production to low-skilled abundant countries and that offshoring is a cause of rising demand for skilled workers. This could tent to conclusion that offshoring will contribute to reduction of the demand for relative unskilled workers resulting in falling wages of unskilled labor in developed countries (Foster- McGregor, Stehrer and de Vries 2013). The studies on the impact of offshoring for individual old EU member states (*e.g.* Belgium, Sweden) confirm that the shift away from low-skilled workers is driven by offshoring to Central and Eastern Europe countries (Ekholm and Hakkala 2005, Hertveld and Michel 2012). Therefore, the conclusion resulting for CEE countries assumed rising demand for low-skilled labor. However, this is not confirmed in Slovakia (see Table 4). The share of low-skilled labor is declining (although the data from the WIOD are available only for 1995-2009), but we believe that this trend continues. Overall, the share of high-skilled labor increases, even faster in automotive than in the construction sector.

Table 4. The share (%) of hours worked by high, medium and low skilled labor for individual industries in Slovakia in 1995 and 2009 (share in total hours)

		1995	2009	Δ			1995	2009	Δ
Total Industries	H_HS	13.4%	18.8%	5.4%	Construction	H_HS	5.2%	6.4%	1.2%
	H_MS	77.1%	77.3%	0.2%		H_MS	85.1%	89.3%	4.2%
	H_LS	9.5%	3.8%	-5.6%		H_LS	9.7%	4.3%	-5.4%
Automotive	H_HS	5.2%	8.3%	3.1%	Manufacturing (total)	H_HS	6.6%	8.3%	1.8%
	H_MS	84.5%	87.9%	3.4%		H_MS	83.0%	87.9%	4.8%
	H_LS	10.3%	3.8%	-6.5%		H_LS	10.4%	3.8%	-6.6%

Source: data from WIOD

Note: H_HS = share of hours worked by high-skilled labor, H_MS = share of hours worked by medium-skilled labor, H_LS = share of hours worked by low-skilled labor. The data are available only for period 1995-2009.

The Slovak Republic, like other European countries, experienced considerable skill upgrading of employment. The growth of jobs requiring the medium and high skilled workers increased the demand for high skilled labor and thus it is in contrast with the image of Slovakia as a low-skilled production factory. In addition, the strategy for future industry clearly indicates that new innovative manufacturing systems will need flexible labor force with innovative knowledge level and IT experiences.

3. Input-output analysis for selected sectors

In the next section, through the input-output analysis, the development of the production multipliers and value added of these two sectors will be monitored, allowing us to look closer at sectorial performance.

3.1. Input-output model

Identification of the key sectors in the economy requires structural models and input-output analysis, taking into account the complex links between sectors in the national economy. Backward linkages are the most advanced analyses built on the Leontief inverse matrix and intermediate input matrix. Forward linkages are a slightly less used model. According to Cardanet and Sancho (2006), no general consensus about optimal model has been adopted so far, because each of the methods has its advantages and disadvantages, although models based on the Leontief inverse matrix can be clearly interpreted and are well supported by the theory of production. The Leontief model is based on a symmetrical input-output table, presented for the first time in the 1930s by the Nobel

Prize winner, Wassily Leontief. The model is based on the equilibrium of resources (supply) and use (demand). Leontief's input-output model allows analysis of cross-sector and interregional structural links in the world economy therefore represented an advantage compared to other macroeconomic models. While aggregated models consider total output in the economy as one product, the Leontief model assumes that outputs from the production process are different goods and services. The interest is focused on the volume of total output as well as on the structure of production. Standard input-output analysis is typically made for one country or region where foreign countries are represented by import and export. By deriving it is possible to obtain an input-output model for two regions or more regions of the world economy (Lábaj 2014).

Leontief's input-output model for one region assumes the division of the economy into the n sectors, with the output of each sector being used to satisfy final demand (households, public administration, investment or exports) or used as an intermediate product for the manufacture of other products (in the same or other sectors). Country's gross output can be expressed as column vector:

$$X = \begin{bmatrix} X_1 \\ \vdots \\ X_2 \end{bmatrix} \quad (1)$$

Final use as the ultimate goal of production serves to satisfy the needs of various economic subjects. Under this notion, we understand the purchase and use of various goods and services by households, investment by firms, final government consumption and export, indicating the final consumption of products and services abroad (foreign demand for products and services). Final demand vector can be written as follows:

$$Y = \begin{bmatrix} Y_1 \\ \vdots \\ Y_2 \end{bmatrix} \quad (2)$$

The matrix Z represents the nxn input-output (I – O) matrix of coefficients that stand for intermediate use (specifying units of intermediate goods in the production of one unit of gross output). The matrix Z can be written as:

$$Z = \{z_{ij}\} = \begin{bmatrix} Z_{11} & \cdots & Z_{1n} \\ \vdots & \ddots & \vdots \\ Z_{n1} & \cdots & Z_{nm} \end{bmatrix} \quad (3)$$

So country ´s gross output has to satisfy the following accounting relationship (Koopman *et al.* 2014):

$$\begin{aligned} X_1 &= Z_{11} + Z_{12} + \ldots + Z_{1n} + Y_i \\ &\vdots \\ &\vdots \\ X_n &= Z_{n1} + Z_{n2} + \ldots + Z_{nn} + Y_n \end{aligned} \quad (4)$$

The country production system can be written as input-output model as follows:

$$X = \begin{bmatrix} X_1 \\ \vdots \\ X_2 \end{bmatrix} = \begin{bmatrix} Z_{11} & \cdots & Z_{1n} \\ \vdots & \ddots & \vdots \\ Z_{n1} & \cdots & Z_{nm} \end{bmatrix} \times \begin{bmatrix} 1 \\ \vdots \\ 1 \end{bmatrix} + \begin{bmatrix} Y_1 \\ \vdots \\ Y_n \end{bmatrix} \quad (5)$$

By reorganizing the equation (4), the gross output vector X can be expresses as (Vrh 2015):

$$x = Z_i + y \quad (6)$$

where: *i* represents a unit column vector.

From the intermediate input matrix *Z* it is possible to calculate the matrix of technical coefficients noted as *A*. From the matrix *A* we can read the structure and volume of direct inputs of different commodities to produce one unit of production in the sector *j*. For example, we can find an answer to the question as how many agricultural products and minerals are used to produce one unit of production in manufacturing. The individual elements of the matrix A are noted as a_{ij} and are calculated as follows (Lábaj 2014):

$$a_{ij} = \frac{z_{ij}}{x_j} \tag{7}$$

Therefore, the enrolment of the technical coefficient matrix calculation is as follows:

$$A = Z(x) \tag{8}$$

Using equivalent adjustments, we calculate Leontief's inverse matrix L:

$$x = Ax + y \tag{9}$$

$$x = (I - A)^{-1} y = L_y \tag{10}$$

where: I stands for unit matrix (n x n) and (I – A) – 1 = L represents Leontief inverse matrix.

Leontief's inverse matrix links final demand and production. It represents the overall direct and indirect effects for each sector's production when the final demand increases. If the inverse matrix L is multiply by individual component of final consumption (for example export), the getting result will capture the part of the output generated by this component (export). The horizontal sum of the L matrix elements represents the production multiplier, which characterizes the need for both direct and indirect inputs if the final demand for one commodity increased by one. The vertical sum of the Leontief matrix captures the direct and indirect demand of the domestic sector inputs; thus how much domestic output will grow if demand for the sector is increased by an additional unit (Duvajová 2014).

For measuring the domestic and foreign contents, the value-added coefficient vector *v* is defined as:

$$v = [v_1' \ldots \quad v_n'] \tag{11}$$

where: v'_1 represents the total value added of industry 1 for whole economy.

Dividing the elements of the value added vector $v^{`}$ by the elements of the total production vector *x*, we obtain the vector of the direct value added coefficients *v* that give us the value added generated in a given sector per unit of production of the sector.

To find the matrix of value added cumulative coefficients it is necessary to multiply unit vector of direct value added coefficients V(nxn) with Leontief inverse matrix that can be written as:

$$VL = \begin{pmatrix} v_1 & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & v_n \end{pmatrix} \begin{bmatrix} l_{11} & \cdots & l_{1n} \\ \vdots & \ddots & \vdots \\ l_{1n} & \cdots & l_{nn} \end{bmatrix} \tag{12}$$

The individual elements of the VL matrix represent directly and indirectly generated value added in a particular sector caused by one final-use unit of the commodity. The multiplier of the value added of the j-commodity is then calculated as the corresponding column sum of the matrix elements. The value added multiplier reflects the value added that generates one final consumption unit of the *j-th* commodity. Multiplying the matrix VL by final demand *y*, we obtain the direct and indirect value added generated by one sector of economy.

$$VA = VLy \tag{13}$$

To determine value added generated by, for example, export or domestic demand, the value in the *va* expression is replaced by its part, *i.e*. by export e(n x 1), or domestic demand d(n x 1), (Habrman 2013).

$$va = VLe;\ va = VLd \tag{14}$$

3.2. Results of input-output analysis for automotive and construction industries

Multiplier of production can be defined as the production of all commodities in the economy necessary to satisfy one unit of final demand for one commodity. It can be calculating as the sum of individual column in the Leontief inverse matrix. It should be noted that the multipliers of production are bigger when the links with domestic production are stronger and weaker with foreign countries (import). These multipliers are greater than one, since increasing the final consumption of the commodity by one unit causes an increase in production at least by this unit. Based on the results in Table 5, we can state that both industries have a multiplier effect on the development of other industries. However, in both sectors, their impact is reduced. The decline of this indicator may be due to an increasing dependence on imports.

Value added indicator specify the share of value added per unit of production. In the case of these two sectors, it is possible to find a significantly higher share of value added of the construction sector where the trend during observed period is positive. Contrary, the automotive sector reduced the share of value added per unit of production during the period although its total production significantly increased. The reason of this low value added is the limited share of module and system manufacturers compared to the production of finished cars. Then the production of finished cars in Slovakia consists in general of assembly of individual modules together.

Table 5. Results of multipliers for automotive and construction sectors

	2000	2008	2009	2011	2014
Production multiplier – Automotive	1.72	1.48	1.47	1.48	1.55
Production multiplier – Construction	1.98	1.79	1.80	1.78	1.64
Share of value added per unit - Automotive	0.16	0.15	0.14	0.14	0.12
Share of value added per unit – Construction	0.36	0.40	0.40	0.47	0.47
Value added multiplier – Automotive	0.37	0.30	0.29	0.28	0.27
Value added multiplier – Construction	0.71	0.72	0.73	0.79	0.76
Share of exported value added (%) – Automotive	77.40	93.70	94.30	95.40	95.20
Share of exported value added (%) - Construction	6.50	11.50	11.60	13.80	16.90

Source: data from WIOD

The value added multiplier examines the relationship between value added and final demand. This multiplier indicates the value added created by increasing one unit of final demand for the selected sector. The value of this multiplier confirms the decreasing importance of automotive industry for value added creation in Slovakia during observed period. The value added creation of this industry compared to other sectors is third lowest. The low values of this multiplier indicate that input for production is mainly intermediate consumption and thus the real value added creation diminish. Multiplier of value added in Construction industry did not change significantly although the trend is positive. As expected, it is possible to conclude the important significance of construction for value added creation in Slovak economy.

The relatively low value added generated in the automotive sector in Slovakia, according to the last indicator - the share of exported value added in 2014, is almost all exported abroad. This confirms the high connection to GVCs, but also the high vulnerability of the Slovak automotive industry to external influences. Moreover, there is an important network of domestic subcontractors connected to the production of cars. It is necessary for domestic intermediate suppliers to focus not only to subcontracting Slovak companies but to increase their importance as intermediary suppliers abroad. Conversely, the construction sector is mainly driven by domestic demand, when only 17% of the value added is exported from the Slovak Republic. However, it is interesting that the value added in export is considerably growing.

From these findings it is clear that, despite the low creation of value added, the position of the automotive sector is significant for the Slovak economy and affects the production of the whole economy. Similar results were obtained for the construction sector. It´s disturbing due to the strong dependence of the automotive sector on developments abroad, and due to the cyclical character of the industry that is prosperous especially in times of economic boom. Similarly, the construction sector is highly sensitive to economic developments and expectations

either in the Slovak Republic or outside the Slovak Republic. The strong impact of these sectors on the Slovak economy may pose a significant threat to sudden unexpected external shocks.

The OECD also states that Slovak Republic needs, to reconsideration of its position in GVCs. The involvement of the Slovak Republic in GVCs is highly concentrated, with strong involvement in a limited number of industries. With a relatively high share of intermediate inputs used for exports abroad, combined with a relatively low level of the share of domestically produced inputs in third countries' exports, the Slovak Republic is mainly positioned in the downstream activities of GVCs, often involving the assembly or manufacturing of components and parts. This contributes to the relatively limited domestic value added created by exports. Half of the value of exports is value added from abroad embodied in intermediates, compared to one quarter on average in the OECD. There is a great potential for diversification of the economy, which, however, needs an appropriate supply response, driven by skills and innovation. The Slovak economy can make more out of its privileged position in by upgrading and diversifying its supply capacity. This could contribute to increasing the domestic value added created by exports. Competitiveness in GVCs requires strengthening factors of production that are unlikely to cross national borders. This implies mainly investment in human capital and skills OECD (2013).

4. The effects of Global Value Chains on the skill structure of labor demand in selected sectors

Rising participation in GVCs caused not only changes in sectorial performance but also important socio-economic impacts. The recent empirical studies supposed that the demand for skilled workers relative to unskilled workers as well as the relative wages of skilled workers have risen in OECD countries. The question is whether increased participation in GVCs is a cause of the rising demand for skilled workers? Whether outsourcing and offshoring is a large enough activity to have an adverse effect on labor market? Foster-McGregor *et al.* (2013) suggest that the demand for skilled workers was closely related to various measures of technology such as R&D but not with measures of trade. The changes of skill demand away from medium skilled workers toward high-skilled workers are explained by changes in ICT capital inputs. Michaels *et al.* (2014) concluded that ICT polarized labor market by increasing demand for the highly educated at the expense of the medium educated workers. The effects of trade openness are positive but insignificant when proxies for ICT are included in the model.

In the following section, attention will be focused on a detailed specification of significant factors for employment, namely the impact of offshoring, but also on other factors of the labor demand in the automotive and construction sectors of Slovakia.

4.1 Model specification

To analyses the effect of GVCs represented by offshoring on the skill structure of labor demand we follow the approach that considers the relative demand for labor. Model will be based on translog cost function (see Berndt, Wood 1975) that is frequently used in empirical studies. Instead of estimating the translog cost function directly, we estimate a system of cost share equations derived from it. The translog cost function, so-called flexible functional forms, allows substitution elasticities to be unrestricted and they should not even be constant. Cost minimizing relative input demands may depend on the level of output.

Denoting *C* as total variable costs, w_i represents wages for different skill types and prices of material that are optimally selected for $i = 1, \ldots, M$, x_k represents fixed inputs and outputs (fixed input capital *k* and gross output Y), *z* represents proxies for technological change, *O* represents offshoring and *DO* represents domestic outsourcing (quasi-fixed) (notation of variables see in Appendix 1). The general formulation of the translog cost function is as follows (Foster-McGregor *et al* 2013):

$$\ln C = \alpha_0 + \frac{1}{2}\sum_{i=1}^{M}\alpha_i \ln w_i + \sum_{k=1}^{K}\beta_i \ln x_k + \sum_{y=1}^{Y} y_y z_y + \frac{1}{2}\sum_{i=1}^{M}\sum_{j=1}^{M}\gamma_{ij} \ln w_i \ln w_j + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K}\delta_{kl} \ln x_k \ln x_l +$$
$$\frac{1}{2}\sum_{y=1}^{Y}\sum_{p=1}^{R} y_{yp} z_y z_p + \frac{1}{2}\sum_{i=1}^{M}\sum_{k=1}^{K}\theta_{ik} \ln w_i \ln x_k + \frac{1}{2}\sum_{i=1}^{M}\sum_{y=1}^{Y}\delta_{iy} \ln w_i z_y + \frac{1}{2}\sum_{k=1}^{K}\sum_{y=1}^{Y}\delta_{iy} \ln x_k z_y \quad (15)$$

Taking first derivatives of the cost function with respect to wages and material we obtain $\frac{\delta \ln C}{\delta \ln w_i} = \left(\frac{\delta C}{\delta w_i}\right)\left(\frac{w_i}{C}\right)$ where $\left(\frac{\delta C}{\delta w_i}\right)$ represents the demand for input i. Differentiating the translog cost function (1) with respect to input prices we obtain a set of N cost share equations of the form:

$$s_i = \alpha_i + \frac{1}{2}\sum_{j=1}^{M}\gamma_{ij}\ln w_j + \frac{1}{2}\sum_{k=1}^{K}\theta_{ik}\ln x_k + \frac{1}{2}\sum_{y=1}^{Y}\delta_{iy}\ln z_y, \quad i = 1,...,M \tag{16}$$

Taking differences between two periods the equations for wage shares of different labor skill and material in industries $n = 1,...,N$ become:

$$\Delta s_i = \alpha_0 + \sum_{j=1}^{M}\gamma_{ij}\ln w_j + \theta_K \Delta \ln K + \theta_Y \Delta \ln Y + \delta_O \Delta \ln O + \delta_{DO}\Delta \ln DO + \varepsilon_i \tag{17}$$

Instead of estimating the translog cost function directly, most authors estimate the system of cost share equations because the number of parameters to be estimated is lower (Hertveldt and Michel 2013). Specification of our model follows approach employed by Foster-McGregor *et al.* (2013) and Hertveldt and Michel (2013) that considers labor and material inputs to be flexible and other inputs to be quasi-fixed. Dependent variables in the model are represented by the shares of each labor type on total variable costs. Total variable costs are calculated as the sum of total labor compensation plus the value of intermediate input purchases.

The source of data is the WIOD database consisting of a complete dataset for industries over the period of 1995-2009. When examining effects of offshoring and domestic outsourcing the WIOD data enables us to measure the intermediate input purchases by each industry from each industry. Foster-McGregor *et al*. (2013) distinguish between narrow and broad offshoring considering imported intermediates in a given industry from the same industry and imported intermediates from all industries. In our analysis we consider a broad measure of inter-industry offshoring *O* calculated as:

$$O_n = \frac{\sum IIM_n}{V_n} \tag{18}$$

where: IIM refers to imported intermediate purchases from industry, n is the industry index and V refers to value added. Measures of domestic intermediate use DO are constructed in a same manner:

$$DO_n = \frac{\sum DIM_n}{V_n} \tag{19}$$

where: DIM stands for domestic intermediate purchases, n is the industry index and *V* refers to value added.

Domestic intermediate use or domestic outsourcing can capture efficiency gains due to a reallocation of production within industries in a country while international offshoring capture efficiency gains due to fragmentation and includes industry specialization across borders.

Data for labor is split into three different skill categories (low, medium and high skilled) according to ISCED classification. The average wages by education level are calculated as the ratio of labor compensation for each labor skill type to the total hours worked of each labor skill type (according to Foster-McGregor *et al*. 2013). The values for gross output and capital stock are available directly from the WIOD.

The cost functions are estimated as a system of demand equations for all variables. The complete system of equations is estimated using seemingly unrelated regression (SUR) method.

4.2. Results

The model implies that outsourcing, offshoring and capital inputs may substitute for labor of different skill types. The estimation results for Equation (16) gives the mix set of the coefficients for all variables. To save the space the descriptive statistics for the variables are not reported here, they are available upon request. The results for each of the labor cost shares for automotive industry (see Table 6) and then for construction industry (see Table 7) will be discussed.

In general, offshoring should have a negative effect on the labor-intensity in an industry (the technology effect), but a positive effect on the level of output, due to the productivity gains from offshoring (the scale effect) Hijzen and Swaim (2007). The results of recent empirical studies show, that offshoring has impacted negatively upon all skill levels within industries for sample of 40 countries and 35 industries over the period 1995-2009 Foster-McGregor *et al*. (2013). The impact of offshoring on manufacturing employment for example in Belgium between 1995 and 2007 is found to be significant and lower the employment shares of low-skilled workers Herveltd and Michel (2013). Ekholm and Hakkala (2005) searching the evidence for Sweden found that offshoring tends to shift labor demand away from workers with an intermediate level of education.

Table 6. SUR results for automotive sector

	ΔSLS	ΔSMS	ΔSHS
ΔwLS	0.885645**	-0.284341**	-0.695522**
	(0.347663)	(0.123200)	(0.329953)
ΔwMS	-2.024672*	1.363281***	0.645269
	(1.141585)	(0.404540)	(1.083434)
ΔwHS	0.793834	-0.699650**	-0.139118
	(0.798795)	(0.283066)	(0.758105)
ΔwII	-0.116344	0.059008	0.060607
	(0.336492)	(0.119242)	(0.319352)
ΔK	-0.296899	-1.107201***	-2.538717***
	(0.797206)	(0.282503)	(0.756598)
ΔGO	-0.201047	0.831622*	2.805503**
	(1.159916)	(0.411035)	(1.100831)
ΔO	-0.087817	-1.053631***	-1.861268***
	(0.639532)	(0.226629)	(0.606955)
ΔDO	-0.269534	-0.492583***	-0.882438**
	(0.350252)	(0.124118)	(0.332411)
Constant	10.711860	11.000180	16.64463
R-squared	0.977814	0.989346	0.921883

Source: own calculations

Note: The set of equations are estimated by SUR, standard errors are reported in parentheses. ***, **, *, Significant at 1, 5 and 10% respectively. For notation of variables see in Appendix 1.

The results for Slovak automotive industry indicate that offshoring influenced negatively the cost share of medium and high skilled labor demand. The coefficient for low skilled level we found insignificant. The offshoring impact coefficient is larger in absolute value as domestic outsourcing coefficient that underline the international fragmentation of this industry. The significant negative effect of capital influence is reported for medium and high skilled level. This could be explained by increasing capital intensity. The low-skilled labor demand is influenced mainly by changes in own wages and wages of medium-skilled labor. The coefficient for price of domestic intermediates tend to be insignificant for all skilled labor highlighting the facts about high level of imported intermediate in automotive industry and low influence of domestic intermediate suppliers.

It is possible to conclude that the most significant factor influencing different skill level of labor demand differs. The strongest effect on the cost share of low-skilled is found in the case of wages (negative), on the medium-skilled labor in the case of own wage (positive) and on the high-skilled labor in the case of gross output (positive).

The decreasing demand for low-skilled labor could be so attributed to wages contrary to medium skilled labor. The rising demand for high skilled labor in automotive industry is driven by growth of gross output (see Table 4 and Table 6).

Table 7. SUR results for construction sector

	ΔSLS	ΔSMS	ΔSHS
ΔwLS	0.442306	-0.031265	0.444685
	(0.543893)	(0.106465)	(0.307094)
ΔwMS	2.588125*	0.317181	-1.952589**
	(1.458584)	(0.285513)	(0.823547)
ΔwHS	-3.133852*	-0.022819	2.087059**
	(1.493018)	(0.292253)	(0.842990)
ΔwII	-0.795494	0.055456	0.029207
	(1.013381)	(0.198366)	(0.572176)
ΔK	-1.438398***	-0.439334***	-0.291970
	(0.366900)	(0.071819)	(0.207159)
ΔGO	2.222195***	0.262727**	-0.041393
	(0.540821)	(0.105864)	(0.305359)
ΔO	-0.477714	-0.265398***	-0.250183
	(0.340754)	(0.066701)	(0.192397)
ΔDO	-0.295215	-0.299069***	-0.213066
	(0.397178)	(0.077746)	(0.224255)
Constant	8.846314	6.543458	5.431079
R-squared	0.929083	0.846271	0.905428

Source: own calculations

Note: The set of equations are estimated by SUR, standard errors are reported in parentheses. ***, **, *, Significant at 1, 5 and 10% respectively. For notation of variables see in Appendix 1.

The negative influence of offshoring can be observed in construction industry as well (see Table 7). The comparison of results for these two industries revealed as expected significantly stronger impact of offshoring on the labor demand in case of automotive industry. The coefficient for offshoring in construction industry is quite low and insignificant in the case of low and high skilled labor. The significant factors for labor demand in construction industry are mainly the wages, capital and gross output changes. The capital substitution decrease demand for low-skilled labor in construction industry contrary to results for automotive industry. The results clearly revealed the differences between domestic and foreign orientated industry. The main driver of changes in labor demand for domestic industry such as construction industry was level of wages, output growth and capital substitution.

Conclusion

Increasing participation of the Slovak republic in the GVCs were influenced the position of important industries in term of value added creation and employment. Slovak Republic is mainly positioned in the downstream activities of GVCs, often involving the assembly or manufacturing of components and parts. This contributes to the relatively limited domestic value added creation.

The position of two important industries such as automotive and construction is different. Although in both sectors, the impact on total industrial production is reduced due to an increasing dependence on imports. Significantly higher share of value added is observed in the construction sector contrary to the automotive sector. The multiplier of value added confirms the decreasing importance of automotive industry for value added creation in Slovakia. The multiplier in construction industry did not change significantly although the trend is positive. As expected, it is possible to conclude the important significance of construction for value added creation in Slovak economy. From these findings it is clear that, despite the low creation of value added, the position of the automotive sector is significant for the Slovak economy and affects the production of the whole economy. Similar results were obtained for the construction sector. It´s disturbing due to the strong dependence of the automotive sector on

developments abroad, and due to the cyclical character of the industry that is prosperous especially in times of economic boom. Similarly, the construction sector is highly sensitive to economic developments and expectations either in the Slovak Republic or outside the Slovak Republic. The strong impact of these sectors on the Slovak economy may pose a significant threat to sudden unexpected external shocks.

Rising participation in GVCs caused not only changes in sectorial performance but also the important socio-economic impacts. The question is whether increased participation in GVCs is a cause of the negative effect on the labor-intensity in an industry? The results for Slovak automotive industry indicate that offshoring influenced negatively the cost share of medium and high skilled labor demand. The decrease demand for low-skilled labor could be attributed to wages. The rising demand for high skilled labor in Slovak automotive industry is driven by growth of gross output. The negative influence of offshoring is observed in construction industry as well. The comparison of results for these two industries revealed as expected significantly stronger impact of offshoring on the labor demand in case of automotive industry. The results clearly revealed the differences between domestic and foreign orientated industry. The main driver of changes in labor demand for domestic industry such as construction industry was level of wages, output growth and capital substitution.

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APPENDIX 1

Notation of variables for translog cost function

Cost shares	
S_{LS}	Cost share of low skilled labor
S_{MS}	Cost share of medium skilled labor
S_{HS}	Cost share of high skilled labor
S_{II}	Cost share of intermediate inputs
Input quantities	
LS	Number of hours worked by low skilled labor
MS	Number of hours worked by medium skilled labour
HS	Number of hours worked by high skilled labor
II	Intermediate inputs
Flexible factor prices	
w_{LS}	Wage of low skilled labor
w_{MS}	Wage of medium skilled labor
w_{HS}	Wage of high skilled labor
w_{II}	Prices of intermediate inputs
Fixed input and output quantities	
K	Capital
Y	Gross output
Offshoring and domestic outsourcing	
O	Offshoring
DO	Domestic outsourcing

Developing Intelligent Decision Support Systems in Multi-Criteria Problems of Administrative-Territorial Formations Infrastructure Projects Assessment

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Abstract:

The article proposes a new methodology for multi-criteria assessment of the alternatives and presents the technology for implementing this methodology in decision-support web services for the purpose of ranking and optimizing to improve transport infrastructure in the administrative-territorial formations. The proposed methodology for constructing the hybrid preference function enables to take into account the inter-criteria preference dependency, to achieve the required accuracy, it includes a stepwise procedure for entering and editing preferences. The methodology is invariant with respect to the subject domain. Along with infrastructure projects, it was used to solve the problems of ranking applications for space experiments. As exemplified by solving the task of selecting infrastructure projects with limited financial resources the article shows the use of a software implementation of the hybrid methodology in the web-service decision support system (WS-DSS).

Keywords: decision support; vectorial criterion; infrastructure projects; administrative-territorial formation; hybrid preference function.

JEL Classification: O18; O21; O25; P21

Introduction

The proposed methodology implies that a decision maker (DM) sets non-intersecting domains in the criteria space. A certain level of preferences is indicated for these domains. Next, a set of the criteria space cells, which do not intersect with the domains specified by the DM, will automatically be formed. Based on Pareto dominance and a number of other methods for determining dominance, preferences are defined between the domains set out by the DM and the cells that were determined automatically. Then an oriented graph is formed. The vertices of the given graph correspond to cells and domains, and the arcs correspond to the relation of preference between them. At the next stage, the graph is analyzed according to the individual preference levels. In practice, several non-dominant

alternatives can often fall into one cell or domain. In this case, it is difficult to compare them; therefore, it is suggested either to divide the given domain into smaller ones, or to apply a quantitative method for comparison within the boundaries of the domain under consideration.

1. The problem background

1.1. Introducing the problem

Infrastructure projects play an important role in the socio-economic development of municipalities, cities, regions, states and other administrative-territorial formations (ATF) (Fomina *et al.* 2014). An infrastructure project is defined as a large-scale investment project that involves construction works. The infrastructure project includes the following life cycle processes: strategic identification and substantiation of priorities, comprehensive expertise and feasibility study of investments in the construction or technical upgrade of infrastructure facilities, assessment of the project efficiency with the purpose of providing infrastructure services by building or upgrading infrastructure facilities, achievement of economic and social effects of the project during the subsequent operation (Fomina *et al.* 2014). The tasks of the infrastructure project lead to new solutions and implementation of innovative developments. The results of the introduction of innovative developments are needed to implement an infrastructure project, because introduction and development of innovations is an important condition for the successful launch of the project (Batkovskiy *et al.* 2015).

The need to take into account the costs for the implementation of projects and other economic indicators, including the expenses for the transport infrastructure operation, determines the specifics of setting the tasks of the infrastructure project assessment. An essential aspect of the problem setting is its multicriteriality – the need for a comprehensive account of numerous indicators (criteria) (Bomas and Sudakov 2011). Criteria of the infrastructure project can be quantitative (numerical) and qualitative (lexical). As a rule, mathematical methods of decision-making are oriented towards the criteria of only one of these types (Lotov and Pospelova 2008, Podinovskii 2007, Sobol and Statnikov 2006, Keeney and Raiffa 1976). In the most common method of analyzing hierarchies, lexical criteria are translated into numerical estimates (Saaty 1980). However, the work of Podinovskij and Podinovskaja (2011) demonstrates the existence of problems in which the given method gives an incorrect ranking of alternatives. A hybrid methodology for the vectorial criterion scalarization was created for joined operation with both lexical and numerical particular criteria (Eskin and Sudakov 2014). It made possible to solve the following tasks:

- providing the decision-maker (DM) with the tools for formalizing qualitative judgments about the preferences for infrastructure projects with a high-dimensional vectorial criterion;
- identifying preferences at all points in the criteria space so that further evaluation of alternative projects is carried out without involving the DM (as a result, the process of selecting and ranking alternatives occurs quickly and it becomes possible to optimize solutions automatically, but taking into account the DM's preferences);
- ranking of alternatives with regard to inter-criteria preference dependency (in this way, it is possible to eliminate situations where alternatives with the estimates that are unsatisfactory for the DM according to one criterion receive a high generalized score owing to other criteria);
- ensuring the discriminability of the alternatives if the values of the criteria are subject to artificial discretization when the continuous scale is replaced by scores.

The methodology is called hybrid, because it combines elements of qualitative methods (the ZAPROS method (Closed Procedures by Reference Situations), the qualitative importance of criteria, preference functions) and quantitative methods (weighted sum, ideal point). Hybrid methodology can be applied to solve a wide range of tasks for assessing infrastructure projects by economic and technical indicators for the subsequent allocation of funding.

1.2. Exploring the problem importance

A complex of interrelated servicing facilities or structures that provide and/or form the basis for the ATF socio-economic system functioning is commonly referred to as infrastructure (Zhang and Babovic 2011). The problem of

the ATF infrastructure development, the organization of its creation financing, expansion, upgrading, and subsequent operation is particularly topical now. ATF enterprises are engaged in projects that are most closely related to the following processes:

- provision of comfortable activities of companies' employees (this task is especially relevant in cities established on the basis of large ATF enterprises);
- development of transport infrastructure that provides transportation support for the functioning of ATF enterprises;
- improvement of engineering infrastructure, including engineering and technical support of structures and buildings;
- creation of an information infrastructure that provides information support for the operation of ATF enterprises.

Application of innovative technologies for infrastructure projects is carried out in the form of innovative projects that are characterized by the availability of changing tasks of this project and the terms dictated by the plan for its upgrading (construction). The stages of the implementation of infrastructure innovation projects include:

- conceptual design (research and development) as stages preceding an infrastructure project generation;
- project creation;
- manufacture and utilization of products as stages of its implementation.

Specific activities of ATF enterprises in the implementation of infrastructure projects necessitate the participation of the state in this process. The industry affiliation of ATF enterprises undertaking infrastructure projects also imposes its own peculiarities in their implementation. Studies show that there is a significant similarity between infrastructure projects that are carried out in various industries.

When managing a large project, it is necessary to consider the following factors: riskiness, long-term duration, organizational complexity, technological complexity, innovativeness, uniqueness, and large scale. An infrastructure project can include projects to create infrastructure facilities that embody innovation and use innovations in their management. Management of infrastructure projects involves the account of:

- riskiness due to a complex system of systemic interaction and a long horizon for planning economic processes;
- the large scale of the changes and the investment attractiveness of the project and its objectives in the course of its implementation;
- the prolongation of the design phase due to the need to develop innovations, the imposition of design and construction phases;
- the need to involve unique resources (highly qualified specialists, materials, instruments, *etc.*).

The large scale and technological complexity of the design solutions admit the possibility of their financing from various sources. Infrastructure project is characterized by a wide range of financial and organizational-legal interactions between participants, with complex interdependencies on each other and, as a result, an integrated system is formed for the infrastructure project creation based on a unified scheme for its implementation. Many different schemes of public-private partnership have already been created, which are advisable to use in the implementation of infrastructure projects, if there are certain conditions, for example:

- construction process – possession process – usage process;
- construction process – development process – usage process;
- designing process – construction process – management process – financing process;
- purchase process – construction process – usage process;
- leasing process – development process – usage process;
- construction process – transfer process – usage process;
- construction process – possession process – usage process – transfer process;
- construction process – renting process – possession process – transfer process;

- construction process – leasing process – usage process – transfer process;
- construction process – transfer process – usage process.

However, large infrastructure projects in the ATF are highly cost-intensive in any way they are implemented. Hence, it is required to carry out a thorough, scientifically sound assessment of the economic effect of projects. Large-scale changes in the structure of the ATF management bodies and crisis phenomena are taking place in the Russian economy. Therefore, it is necessary to improve the project evaluation quality and search for new forms of interaction between the private and public sectors of the economy for the effective implementation of infrastructure projects. The development and implementation of new methods for assessing infrastructure projects in the ATF is intended to improve the quality of management decisions. The necessity and possibility of using a new hybrid methodology for scalarization of a vectorial criterion (Batkovskiy and Kravchuk 2016) is justified below with this objective in view.

2. Methodology

Methodological framework for the analysis of development of intelligent decision support systems in multi-criteria tasks of assessing infrastructure projects were developed by Russian scientists as: Nesterov *et. al* (2015), V.A. Sudakov (2014), Osipov and Sudakov (2015). In this study, the above methodological foundations have been developed with reference to the tasks of assessing the infrastructure objects of administrative-territorial formations.

2.1. Preference formalization

Let us denote the dimension of the optimality criterion as *n.* Let the coordinate axes correspond to partial optimality criteria. The value of the preference function (PF) is assigned to each point of the criteria space. The PF corresponds to the DM value system and enables to identify the worst and best solutions.

The DM must specify non-intersecting areas in the criteria space. In practice, guided by own knowledge and experience, the DM sets the domains of unsatisfactory solutions, domains of satisfactory solutions, and domains of good solutions. It is quite easy to carry out this procedure for a small set of domains (scale 4-10). It is not required that all points in the criteria space are acceptable; information about preferences in unacceptable points is not used. Prior to perform the domain construction procedure, it is necessary to break the axes of all criteria into intervals. The tuple of these intervals for all criteria will be called a cell.

The DM selects a subset of cells and specifies the preference level for it – a certain value in the specified lexical scale: unsatisfactory, satisfactory, excellent, etc. The level of preferences shows that solutions from one domain are better than solutions from another domain, however, it is not indicated how much better, that is, preferences are set in a qualitative scale. It is only required to observe the transitivity of preferences. Absence of transitivity violation is verified automatically.

If the preference domains are sufficiently large, and there are many ranked alternatives, then it is highly likely that several unmodified alternatives will fall into one domain. In this case, a formal (quantitative) method of ranking alternatives within the required domain should be used. The quantitative methods that can be used are: the Chebyshev distance, the Germeyer's convolution, the multiplicative convolution, the ideal point, the weighted sum. The non-linearity of the DM's judgments and the dependence of the criteria on preferences are manifested only with significant changes in the criteria values, therefore the application of this combined methodology is justified. Essential changes in the criteria are those that lead to a transition from one domain of preferences to another. The disadvantages of quantitative methods, such as the influence of scaling factors, mutual compensation of criteria, are not significant in the case of a small domain.

Let us perform mathematical formalization of the method. To do this, the following notation is introduced: i is the number of the criterion. Further, for each i-th criterion let us define gradations: t_{ij} is the j-th gradation; $j = 1 \ldots q_i$, where q_i is the amount of gradations. Lexical terms are gradations for qualitative criteria. A range of values with left and right boundaries is a gradation for quantitative criteria.

The criteria-based preferences should contain one extremum (for example, the comfort temperature in the room is an ideal value) or be monotonous. Gradations should be ordered according to preferences:

$$\forall i,j: t_{ij+1} > t_{ij} \quad (1)$$

The Cartesian product of sets of all combinations of gradation values forms a complete space of criteria:

$$A = \left\{t_{11}, t_{12}, ..., t_{1q_1}\right\} \otimes \left\{t_{21}, t_{22}, ..., t_{2q_2}\right\} \otimes ... \otimes \left\{t_{n1}, t_{n2}, ..., t_{nq_n}\right\} \quad (2)$$

The cardinality of a set of combinations of gradation values is defined as the product of the number of gradations:

$$Q = |A| = \prod_{i=1}^{n} q_i . \quad (3)$$

For the simplest tasks, Q is a sufficiently large number, thus, for 8 criteria and 6 gradations: $Q = 8^6 = 262{,}144$. For all A elements, preferences should be specified, which is labor-intensive. For this reason, it is convenient to consider the unification of a part of the elements of the A set as a domain for which the preference level is introduced.

Let M_k (where $k = 1…K$) are the sets of points of the criteria space in the user-defined domain. For all M_k, the gradations are assigned by all criteria: m_{ik} are the sets of gradation numbers of the criterion i included in the set M_k. Thus, M_k are subsets of the A set.

Let us take any point of the criteria space: $X = \{x_1, x_2, …, x_n\}$, where x_i is the value of the criterion i. Any x_i must necessarily fall into one and only one gradation t_{ij}. The belonging of the point X to the set M_k. is verified by the predicate:

$$W(X,k) = \&_{i=1}^{n} \left(\bigvee_{j \in m_{ik}} (x_i \in t_{ij}) \right) \quad (4)$$

Further, for all preference levels P, the domains comprising it are set out with a certain preference level $P(M_k)$. The admissible values of P are integers, the smaller the number, the less preferred is the corresponding M_k domain. Only comparison operations are admissible with the values of $P(...)$, while arithmetic operations are inadmissible (Sudakov 2014).

In the process of entering domains, it is necessary to check that the M_k sets must differ by at least one criterion, if they have different levels of preferences. Therefore, after a new domain appears, and when an existing domain changes, it is necessary to check the validity of the formula:

$$\forall k_1, k_2 (P(M_{k_1}) \neq P(M_{k_2})) \rightarrow (\exists i (m_{ik_1} \cap m_{ik_2} = \varnothing)) \quad (5)$$

If the value is false, then the DM must adjust the preferences or change the boundaries of the M_k sets. For the M_k. sets with an equal level of preferences, their intersection is admissible

2.2. Building a hybrid preference function

In the general case, the unification of the M_k sets does not constitute the entire A set, therefore it is necessary to determine the level of preferences for all elements of A that do not belong to any of the M_k domains. Such elements will be called A cells. Let us denote them as:

$$T_l = \{t_{1g_{1l}}, t_{2g_{2l}}, ..., t_{ng_{nl}}\}, \quad (6)$$

where: g_{il} is a gradation number of the l cell (l =1...L) for the criterion i.

It is necessary to determine all combinations of gradations that do not fall into the M_k sets. The following predicate corresponds to this condition:

$$\forall l \forall k \exists i (g_{il} \notin m_{ik}) \quad (7)$$

An algorithm for finding such combinations of gradations is given in the work of Nesterov and coauthors (2015).

To determine the number of cells *L*, it is necessary to subtract the number of cells in all the M_k sets from the total number of combinations of gradation of the *Q* criteria values. For non-intersecting M_k sets, the number of combinations to be covered by them must be added:

$$L = Q - \sum_{k=1}^{K} \prod_{i=1}^{n} |m_{ik}| \quad (8)$$

Since the criteria graduations are sorted by increase in preference, Pareto optimality condition can be applied to cells T_l and M_k sets. As a result, the relation of dominance of some cells over others appears:

$$\forall i(g_{il_1} \geq g_{il_2} \,\&\, \exists i(g_{il_1} > g_{il_2}) \rightarrow T_{l_1} > T_{l_2} \quad (9)$$

and also the relation of dominance of some cells over sets:

$$\forall i(g_{il} \geq \max j,\ j \in m_{ik}) \,\&\, \exists i(g_{il} > \max j,\ j \in m_{ik}) \rightarrow T_l > M_k \quad (10)$$

as well as the relation of dominance of sets over cells:

$$\forall i(\max j,\ j \in m_{ik} \geq g_{il}) \,\&\, \exists i(\max j,\ j \in m_{ik} > g_{il}) \rightarrow M_k > T_l \quad (11)$$

Additionally, there is a dominance relation between all M_k sets, which is determined by the preference levels set out by the DM:

$$\forall k_1 \forall k_2 (P(M_{k_1}) > P(M_{k_2}) \rightarrow M_{k_1} > M_{k_2} \quad (12)$$

With the help of qualitative importance of criteria, one can determine dominance between the cells. The dominance can exist if the following conditions are met:

- a qualitative preference relation is set out for the criteria, for example, the criterion *i+1* is more important than the criterion *i*,
- for all criteria a scale with the same number of gradations (homogeneous scale) is used, for example, a four-point scale (expert assessments 2, 3, 4, 5).

The relation of dominance of the cell l_1 over the cell l_2, if they are obtained from each other by means of permutation of the gradation numbers by two criteria and are homogeneous, is determined by the predicate:

$$\exists i_1 \exists i_2 (i_1 < i_2) \,\&\, (\forall i(i \neq i_1 \,\&\, \mathrm{i} \neq i_2) \rightarrow (g_{il_1} = g_{il_2})) \,\&\, (g_{i_1 l_2} > g_{i_1 l_2}) \,\&\, (g_{i_2 l_1} > g_{i_2 l_2}) \,\&\, (g_{i_1 l_1} = g_{i_2 l_2}) \,\&\, (g_{i_2 l_1} = g_{i_1 l_2}) \rightarrow T_{l_1} > T_{l_2} \quad (13)$$

The value of the implication premise is true, if while permutating the values of two criteria from one cell, the other one is obtained. Moreover, of these two cells, the dominant is one where the greater value is indicated in the less important criterion.

Expressions (9) - (13) allow for construction of an oriented graph of dominance of M_k sets and T_l cells. The directed arcs of the graph indicate the dominance relation between the vertices to which the M_k sets and T_l cells correspond. The graph should be checked for cycles. If a cycle is found, this should be reported to the DM. The cycle is possible if the DM's judgments are non-transitive. For each cycle, it is necessary to define the M_k sets comprising it. Next, one should inform the DM about where it is required to enter the preference level adjustments or change the M_k sets. In the practical problems, the existence of a cycle is a rare situation.

After checking for the absence of cycles, the graph analysis algorithm is used, it is called the graph 'disassembly'. Therein the preference levels are defined for all M_k and T_l :

1) $p = L+K$;

2) to determine the non-dominant vertices in the graph and assign them a preference level *p*;

3) exclude the vertices defined in step 2 from the graph;

4) if the graph is empty, then complete the work of the algorithm;
5) $p = p - 1$;
6) return to step 2.

The algorithm starts with assigning the maximum preference level to the variable p, which is possible if all M_k and T_l are distinguishable by preference. Further, the preference level decreases with the transition to the next group of dominated vertices, until all the vertices are considered.

If all the vertices are distinguishable by preference, then upon completion of the algorithm p will be equal to zero. However, it is possible that part of the vertices will have one level of preferences. Let us introduce Z – a generalized criterion for the level of indistinguishability of alternatives on a complete A set:

$$Z = \frac{p}{L + K} \cdot 100\% \quad (14)$$

The value of this criterion that is close to zero indicates a high degree of distinguishability of alternatives, which increases the multi-criteria analysis accuracy. A value close to 100% indicates the need to detail the DM's judgments. To reduce the Z level, new M_k sets should be introduced.

As a rule, M_k and T_l include more than one analyzed alternative. For comparison of arbitrary vectors of the criteria space, it is necessary to change the complex estimation of the alternative when the criteria are changed within the same preference level. To do this, the total preference value as the sum of two components can be defined:

$$Y(X) = p(X) + D(X) \quad (15)$$

where: the first component $p(X)$ is a qualitative level of preferences corresponding to the T_l cell or the M_k domain found when the graph is 'disassembled'; the second component $D(X)$ is a quantitative refinement of the preference, normalized within the range from 0 to 1, obtained by the quantitative method of criterion convolution, within the cell or set into which the X vector value fell.

The $Y(X)$ function, which computes the combined value of preferences, is called the hybrid preference function (HPF) (Osipov and Sudakov 2015).

The combined estimation of the alternative obtained with this methodology consists of an integral part reflecting the DM's qualitative judgments and a fractional part reflecting a quantitative approach to multi-criteria estimates. The fractional part is used to optimize alternatives on a continuous set and to increase sensitivity to small changes in the criteria.

This hybrid (combined) methodology simplifies the procedure for constructing the preference function, since there is no need to specify it in detail on the entire criteria space. In addition, the methodology makes it possible to apply quantitative vectorial criterion convolution methods that, as a rule, require less input of DM's judgments to compare more accurately alternatives existing in one preference domain in the tasks of selecting promising infrastructure projects.

3. Results

3.1. Program implementation of the hybrid methodology

In the Internet at ws-dss.com a public cloud program module is available that implements a hybrid methodology. In the WS-DSS, all modules act as independent agents. Thus, the control frame is missing. Agents interact through messaging. If the agent sends a message to a specific recipient, the message is called a target one. If the message does not have a specific recipient, then the recipient agents must subscribe to the required message types. This approach of independent agents leads to a weak connectivity of the modules, which reduces the labor inputs required to make changes and increases system performance (Sprague 1980).

The targeted transmission of messages to the WS DSS operates in the following sequence:

- Primary values of criteria are transmitted from the problem domain model to the module of multi-criteria

analysis of alternatives;

- Comprehensive assessments of alternatives are transmitted from the multi-criteria analysis module to the optimization module;
- New alternative variants of model parameters are transmitted from the optimization to the problem domain model.

In case of the presence of variational behavior, the targeted transmission of messages is difficult to implement. An example of such variational behavior of DSS is the use of different methods of multi-criteria analysis of alternatives. It is convenient to implement each of these methods as a separate agent. When using target messages, the model should know which agent-method to transmit the result of the work. However, the model does not know and should not know such agents-methods.

For the above reasons, it is advisable that the problem domain model publish the results of its work on a certain 'bulletin board', and the methods of multi-criteria analysis could 'read' these advertisements by selecting the appropriate ones. This approach corresponds to the Blackboard template (Craig 1995).

DSS integrates with computer models using web services that exchange XML/JSON data in accordance with the restful API methodology. This approach is invariant with respect to the selection of software development tools, allows for the use of heterogeneous free system software, and admits implementation and scaling in a distributed computing environment. The concept of a representative state proposed in the paper by R. Fielding (2000) allows for the autonomous creation of variational modules, and reduces the probability of errors in their integration. Additional costs of creating Web services and reducing the performance of the calculations associated with the data transfer over the network should be mentioned as the disadvantages of this approach.

3.2. A case study of practical use of the hybrid methodology by the evaluation of the transport modeling results

Projects aimed at the development of transport infrastructure are currently playing an important role. For the ATF backbone enterprises, they have special significance. In the single-industry towns, the implementation of transport infrastructure projects ensures the normal livelihoods of the ATF employees.

In the Russian Federation, there are currently 319 single-industry towns (mono-profile municipalities). Let us demonstrate the implementation of hybrid methodology in the ATF as a case study of transport model assessment by vectorial criterion. The complexity and importance of implementing projects to improve the transport infrastructure in these cities should also be mentioned, which significantly increases the relevance of their assessment by the vectorial criterion. As of January 1, 2016, according to the monitoring data, the population in single-industry towns totaled 13.6 million people.

The number of employed population in single-industry towns was slightly less than 6 million people, of which about 17% are employed in the town-forming enterprises. As of January 1, 2016, technical readiness of infrastructure facilities, the implementation of which was launched in 41 monotowns in 2010-2011, amounted to approximately 82%. Based on the monitoring results, the Ministry of Economic Development of the Russian Federation formed a list of 15 mono-towns where a significant crisis socio-economic situation was identified. With regard to these monotowns, the work is underway to select infrastructure activities and investment projects that facilitate the implementation of integrated development projects, including with the help of the mono-town development fund. The Mono-City Development Fund has concluded 24 development agreements with 17 constituent entities of the Russian Federation (The RF Government web-site).

Next, the application of the hybrid methodology will be shown on the example of the problem of selecting from 10 alternative infrastructure projects. The initial transport situation in a certain monotown is preset, the ATF enterprise being its backbone enterprise. It is necessary to improve the transport situation in order to increase the efficiency of the ATF enterprise development and ensure comfortable living conditions in the monotown. Each of the projects is connected with some infrastructural changes improving the transport situation in the monotown.

For each infrastructure project, assessments were made according to five criteria:

- maximum (K_TT_max) and medium (K_TT_med) travel time coefficients along the arcs of the transport network graph;

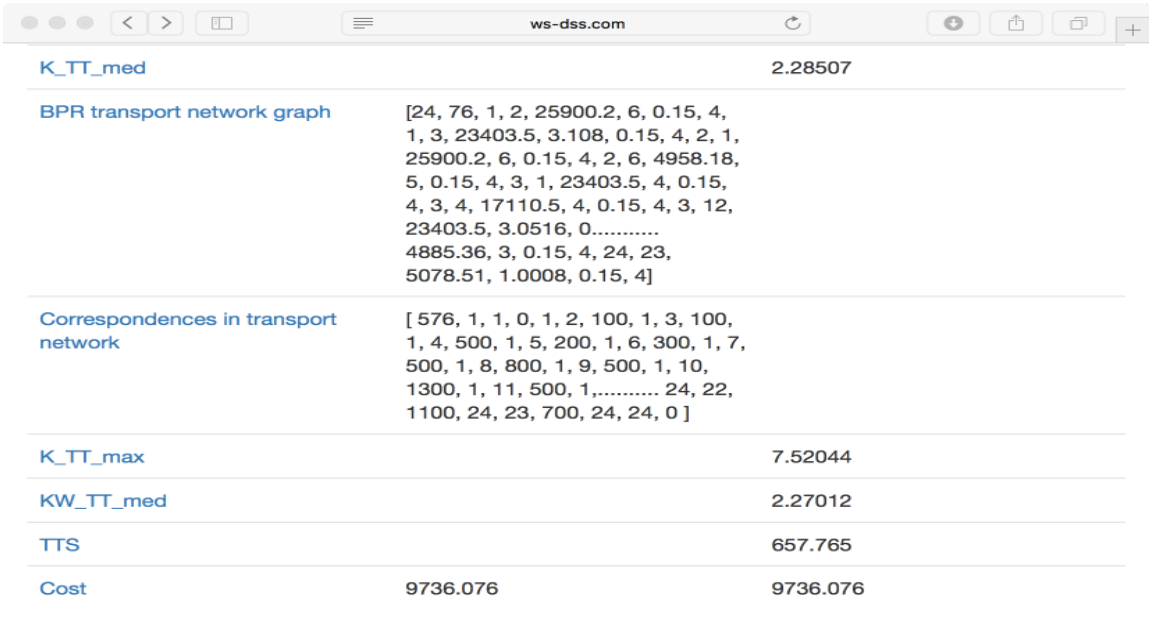
- medium (KW_TT_med) travel time coefficient along the graph arcs, weighted by traffic volume;
- total travel time (TTS - Travel Time Sum) along all arcs of the transport network graph;
- the total cost of the infrastructure project implementation.

For all projects, the bandwidth characteristics of all graph arcs were preset:

- capacity of the arc (capacity);
- time of travel along the arc at zero load (free_flow_time).

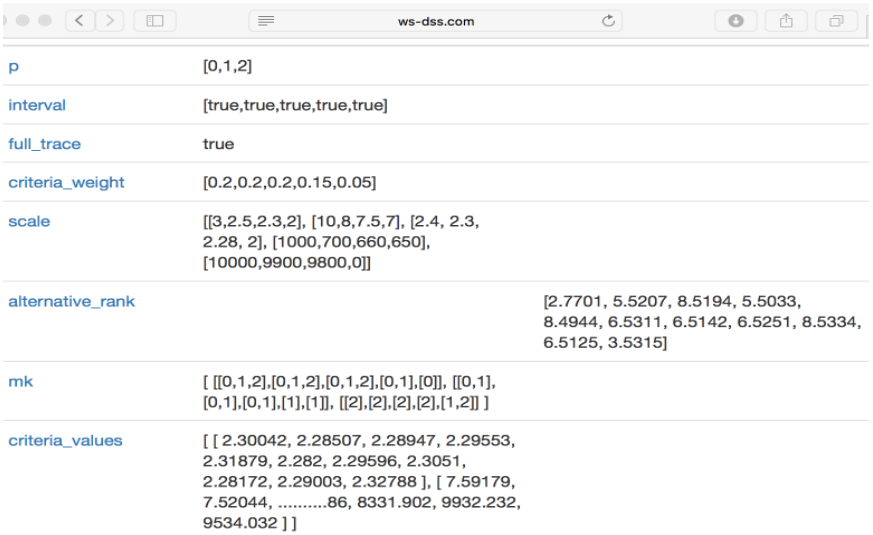
The values of these parameters were supplied to the input of the transport model described in the paper by Gasnikov and coauthors (2014). The model describes the transport network of a monotown. The function of the costs for traveling along the arc is determined by the classical BPR-function (BPR – Bureau of Public Road). The Bureau of Public Road is located in the United States and is well known for its quality transportation models. The Bureau of Public Road is now part of the Federal Highway Administration (FHWA), a division of the US Department of Transportation that specializes in road transport. A set of correspondences and the network graph were supplied to the input of the transportation model. At the output, the model returned the found equilibrium state (distribution of flows along the arcs), obtained by solving the optimization problem of quadratic programming (Nesterov 2012). Figure 1shows the results of calculating the criteria based on the BPR model for one of the infrastructure projects.

Figure 1. The model parameters and criteria values



Nine of the considered 10 projects proved to be Pareto optimal. The selection on such a set without involving the DSS is complicated for the DM. Therefore, the DM's preferences were prescribed in the form of a hybrid function. Parameters of the hybrid function are shown in Figure 2. The ranking result for the projects was saved in the alternative_rank array.

Figure 2. The DM's preferences and ranking results for the projects



Conclusion

The majority of the routine methods for solving high-dimensional problems fail to take into account inter-criteria preference dependency. However, the proposed methodology for the formation of hybrid preference function includes algorithms for determining the DM's value system for a high-dimensional criterion and takes into account the preference dependency.

The creators of new methods and approaches investigate, as a rule, either qualitative or quantitative criteria. The presence of heterogeneous criteria forces them to translate quantitative criteria into qualitative ones by discretizing them or qualitative criteria into quantitative ones by attributing numerical estimates. Unlike other approaches, the hybrid methodology is invariant with respect to the subject domain. It enabled to solve a wide range of problems associated with a multi-criteria assessment by a high-dimensional criterion consisting of qualitative (lexical) and quantitative (numerical) components.

Many applied information systems contain methods of decision-making theory; however, the method is 'hard' implemented by the developer of the system and does not contain a procedure for selecting both the method itself and its parameters. The work offers to integrate WS-DSS Web services in the applied information systems for multi-criteria analysis of alternatives. The choice of methods and value system in this approach remains with the user, not with the system designer. This approach allows solving the task of selecting infrastructure projects in conditions of limited financial resources.

The implementation of the proposed method of constructing the hybrid preference function in the ATF will ensure the improvement of the socio-economic status of their inhabitants

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Social Media, Corporate Website and its Impact on Consumer Purchasing Decisions

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Abstract:

Successful marketing communication is rooted in the knowledge of customers, competitors, colleagues and the ability of a business entity to generate profit. Marketing innovations directly related to the modern-day phenomenon – the Internet. The article deals with the Internet marketing and the selected social media from the point of view of consumers living in the region of Eastern Slovakia. The aim of the research is to analyse the existence of differences in the impact of advertising on the basis of the consumer's family and to determine the credibility of the website and its presentation on Facebook. The Student's t-test method for independent samples and the Pearson correlation coefficient were used to find the differences. The results of the research indicate that there is no statistical significance between the respondents' group and the extent of the advertising impact. The presumed fact that the presence of a web site, or more precisely the E-shop, on social networks can be to a certain extent a competitive advantage of each company, has not been confirmed in the research. From the conclusion we assume that not all current consumers are affected by social network advertising. The submitted contribution can serve as a support tool for social networking marketers as well as for the professional public who is looking at the Internet marketing and social networking from the consumer's point of view.

Keywords: advertising; internet; social networks; consumer

JEL Classification: M31; M37; M39

Introduction

The increasing intensity of competition, globalization and the emergence of a united European market, which we are a part of as an EU member state, and from 1 January 2009 the entrance into the euro area, increase the requirements for the competition not only in the domestic and European markets, but also in the world (Ziaullah *et al.* 2014, Jangl 2016). It gradually expands the traditional understanding of marketing to its modern perception in relation to customers, business partners and the surrounding world (Baronienė, Žirgutis 2017).

Recently, there have been fundamental changes in the Slovenian Internet business, which have also been significantly affected by globalization. Foreign products and services are continuously entering the Slovak market. The vast majority of Slovak businesses use Internet marketing as well as social media and website promotion. Since 1990, the Internet has provided us just basic functions such as emails, searching online and general purpose.

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Nowadays, it plays an important role in human interaction and enables the connection between the traditional media such as film, television, music and the phone. Internet users have the ability to connect from anywhere via any device. Access to new digital technologies and websites has accelerated other forms of human interaction through online forums, news and social media. Email was originally the core of everything. However, the rise of social networks, especially the Facebook social network has changed the concept for online communication and has combined personal and public space on the Internet. Facebook has monthly 1.2 million active users, which means it is more than 50% of the Internet users worldwide. Several authors De Pelsmacker *et al.* (2013), Kotler *et al.* (2007), Remeikiene *et al*. (2017), Kotler and Keller (20070, Dahl *et al*. (2003) and Chafey and Chadwick (2012) point out that the social networking sites enable users to connect by creating personal profiles, inviting friends to access those profiles, sending e-mails and instant messages between each other. These personal profiles can include photos, video, audio files, blogs, link to websites, in fact any type of information. Consumer behavior on the Web has been the subject of considerable research in the last few years, but understanding it is made difficult by the fact that the main entities involved, consumers and businesses, have been transformed (Machová *et al.* 2014, Koufaris 2002). It is clear that this area influences many aspects of the current online and offline business (Kozubíková *et al.* 2015). Despite that we can say that electronic trading has its special features and differences. Everybody who wants to enter the network world in order to offer their products and services there must be aware of the distinctive approach, count on it and adapt to it. The results show that motives of online shopping behavior are independent on age of respondents. Motives in each age group are the same and marketers do not have to select motives of online shopping according to age of respondents. (Svatošová 2013).

1. Literature review

Internet has been here for a quite long time, however, the beginnings of real online marketing can be traced back to the end of the nineties. Advertising has been on the Internet since 1994 and some marketers began to understand that the Internet's potential is great. However, the technical possibilities and mainly limited access of people to the Internet limited marketing possibilities. Then the situation began to improve and the companies started to present themselves and their products via web pages. Web pages started to replace brochures, catalogs and then finally started to sell (Janouch 2010).

The internet refers to the computer network infrastructure that enables the exchange of digital data on a global scale. Through historical developments (the Internet was first a military tool developed to make communication possible in case of nuclear war and was later adapted by academics to share end exchange information) and intentional efforts, nowadays the Internet is a unique, independent medium that is not owned or operated by a commercial or government body (Fill 2006, Rossiter and Bellman 2005). Internet as a global communications platform offers companies several options (Přikrylová and Jahodová 2010):

- space for the presentation of the company and its products;
- information source;
- tool for customer relationship management;
- an efficient and new sales channel;
- supply chain management, new distribution channel;
- management of internal company processes.

Sheehan (2010) in his publication states that traditional television viewing has been affected by Internet and online videos. The most prominent and popular alternative TV is YouTube. Watching YouTube can be just as fun as watching television. People watch YouTube in their free time and can share what they like with their friends. YouTube has become the third most visited website on the Internet worldwide. Websites have become an integral part of the communications mix of companies as well as all other institutions. Websites are an essential platform to which other communication tools in the online as well as offline environment refer to. Websites could be considered as a direct marketing tool because they allow direct sales and are interactive, can adapt their content and form to each specific visitor and their effectiveness can be easily verified. Websites can be also perceived as a public relations tool because they allow communication with key groups such as employees, potential employees,

journalists, partners and customers alike (Karlíček and Král 2011). There is a number of activities that have to be carried out before setting up a website. A business entity has to clarify its goals and carry out some analyses. Today the web is totally different than it used to be five years ago and even a year ago. Despite the fact that conditions change rapidly, the principles governing the creation of good websites hardly ever change. It is always necessary to make a website user-friendly, a user has to learn very quickly what the website is about and what the company offers (Janouch 2010). Ridgway (2005) states that the world of websites has evolved and now includes enormous volume of electronic products, e-books, reports, and other forms that can be downloaded in electronic form from web sites or from e-mail attachments. The biggest advantage of online shopping is the availability of information and its dissemination. Comparing prices from online stores takes a few minutes, and thanks to social networks interesting quotes are massively distributed to potential consumers. Social networks can reach much wider audience than word-of-mouth references. The reason why a company should have its own website and not just a profile on social networks is simple. Your profile on a social network is owned by a company that runs that network. Social media is somewhat restrictive because if the information provided is not interesting, nobody is going to make a purchase (Kabani 2013). Social networks are a rapidly growing global phenomenon on all continents. Social networks come as a powerful and sophisticated new type of a marketing channel. Marketing is becoming more precise, personal and social. Social networks give marketers new information via profile information of consumers and the involvement of community members and recommendations on social networks (Shih 2010). When social networks began to emerge, they immediately grabbed attention of ordinary consumers. Social networks, however, were not a new phenomenon. Online communities have developed in each phase of the Internet's development, even in times long before the occurrence of websites. Back then, people realized online communication is much more convenient and started to include visual aspects. Social networks operate better when they involve a large number of users who are sharing a larger number of details about themselves (Treadaway and Smithová 2011). Many active users sometimes have no idea that what they find on their Facebook wall is a targeted ad. What does it mean for a business entity that decides to place its ad on Facebook? This means that Facebook allows it to target its ads on the audience it wants to reach. Because Facebook allows business entities to divide users based on their demographics, interests, country or city. For example, if a business entity operates an e-shop with children's clothing, the target group will be mothers aged between 20 to 35 years who are married their liked pages include children's toys, children furniture, etc. Business entities can check Facebook statistics regarding their marketing activities. Stats are provided in a clear and simple form, marketers can check how many people liked their Facebook page and number of "likes" in the given period, page views, number of sent messages, number of comments or shares under each post. Such post can easily replace newsletters and e-mails clients get at regular intervals. Posts can have various forms - text, pictures or even videos. If the content of these posts is of a high quality and grabs attention of users, people will probably share it on the social network and maybe all over the Internet.

2. Methods and methodology

The aim of the research was to analyze differences in the impact of advertising on consumers with different gender, determine the trustworthiness of a website and its presentation on Facebook. The respondents were consumers living in Eastern Slovakia. Of 153 respondents who participated in the research were 81 women and 72 men. The largest age group consisted of people aged 19-29 years (N = 123, 80.39%). The questionnaire was also completed by 15 respondents aged 30-39 years, which represents approximately 9.80% of the total number of respondents. Slightly fewer people (10 people – 6.54 %) belong to the age group 40-49 years. The lowest representation can be observed in the age group 18 years and below, where only one person, aged 17 (0.65%), turned in his questionnaire. The survey also featured four people older than 50 years (2.62%).

To achieve the set goal we came up with the following hypotheses:

- H1: We assume the existence of a relationship between the trustworthiness of the website and its presentation on Facebook.

- H2: We assume there is a statistical significant difference between the gender of respondents and the extent to which they are being affected by Ads.

Respondents (consumers) answered closed questions. Primary data obtained were then processed in a statistical program Statistica. The research made use of Student's t-test for independent samples and Pearson's correlation coefficient. In the first part of the questionnaire the questions aimed at the respondents' views on the importance of individual features of the website from which they order a product.

The first question concerned clarity of the website. 120 respondents said that they the clarity of the website is a very important factor. The answer "agree" was chosen by 29 respondents. Only 2 people out of 153 stated that this factor is not very important. Page ranking in search engines is yet another aspect that affects the consumer on the Internet, as confirmed by 127 respondents. On the other hand, 17 respondents stated it is not important to them and 9 stated they do not know.

The trustworthiness of the seller is not only issue on the Internet but also in brick-and-mortar stores. In our questionnaire we asked about the trustworthiness of the website. 126 respondents answered "definitely agree" while 22 chose the answer" agree". Only one respondent answered negatively and four stated they do not know. Option "definitely not" was not chosen by any respondent. The presence of a website or e-shop and on social networks can be somewhat a competitive advantage. However, the results of our research show that this factor is for consumers not so important. Only 20.92% (51 people) of respondents stated this to be an important aspect. 17 people stated they have no opinion on this.

3. Results and discussions

In the following part of the article we provide statistically processed data which we used to test two above-mentioned hypotheses. The first hypothesis is analyzed in Table 1.

H1: We assume the existence of a relationship between the trustworthiness of the website and its presentation on Facebook.

The first hypothesis was verified using Pearson's correlation, which is a measure of dependency between the variables. The correlation coefficient can take values in the interval <-1,1> as follows:

- 1: quantities are indirectly dependent, a decrease in one variable causes an increase in the other variable;
- 1: values are directly dependent, an increase in one leads to an increase in the other;
- 0: analyzed variables are independent.

Table 1. Pearson's correlation coefficient

		Website credibility	Facebook page
Website credibility	Pearson Correlation	1	-,043
	Sig. (2-tailed)		,594
	N	153	153
Facebook page	Pearson Correlation	-,043	1
	Sig. (2-tailed)	,594	
	N	153	153

Source: (output of the statistical program SPSS Statistics).

These statistics indicate there is a linear relationship between the variables. We thus confirm the hypothesis because the correlations are positive and within the specified interval. The analysis showed a significant relationship between the variables at a significance level of $\alpha < 0.01$.

The correlation coefficient reaches the level $r = 0.594$, which can be interpreted as a moderate to strong relationship between the monitored variables. Social networks are becoming more and more popular. This gives rise to new social networks and new opportunities for advertising in this environment. Business entities can present themselves even though they have no website since Facebook page/ profile can easily replace it. A Facebook page/profile should contain up to date information about the business entity and its products and services. In this environment, it is necessary to remember that the key to success is the number of fans liking the page/ profile. If

consumers are satisfied with a given brand, they become fans and are willing to watch the activities of the brand on social networks and recommend the brand to other users. It is therefore necessary to share information, photos or videos in a smart way without angering users.

We agree with Zamazalová (2009), who argues that advertising is one of the most widely used and best-known marketing communications tool; that is what crosses people's minds when it comes to company communication. However, it is not the most important tool. Usually it needs to be properly linked with other communication and marketing tools that a business entity uses. The most common is the combination of sales promotion and advertising. Advertising usually acts as a support tool and enhances the effect of sales promotion.

H2: We assume there is a statistical significant difference between the gender of respondents and the extent to which they are being affected by Ads.

Table 2. The average value

Gender	N	Mean	Std. Deviation	Std. Error Mean
Man	72	2.9583	1.26087	,14859
Woman	81	3.0370	1.22927	,13659

Source: Output of the statistical program SPSS Statistics

Table 3. Student's two-sample t-test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	,495	,483	-,391	151	,697	-,07870	,20153	-,47688	,31948
Equal variances not assumed			-,390	147.935	,697	-,07870	,20183	-,47755	,32014

Source: (output of the statistical program SPSS Statistics).

In order to verify this hypothesis, we divided our respondents according to their gender (women and men). Level of significance was set to p = 0.05. P value reached 0.697. This hypothesis was therefore rejected; there is no relationship between the variables. The research results indicate that there is no link between the gender of respondents and the impact of advertising (no statistical significance).

Conclusion

In the beginning of our research, we have focused on the time they spend on the Internet every day after finding out all the basic demographic and social data of the respondents. Only a small group of respondents spend on the Internet less than an hour per day. On the contrary, today's population spend more and more time on the Internet. This trend assures us that any organization or company which wants to gain a competitive privilege on its market should not forget about the internet marketing. The results of the research point to the fact that respondents, when they have to choose the most effective ads, most often they did not choose the traditional ways to promote TV, radio and print advertising.

Social networks were the kind of advertising that occurred most often in respondents' replies. Social networks on the Internet are undoubtedly growing and becoming more and more popular. As social networks are growing and creating new social networks, the opportunities for advertising in this environment are increasing. This form of presentation of the company on the Internet is possible even without the existence of a website, which can be replaced by a Facebook page. In the case of an online store, it works only on Facebook. The good name of the company and the website itself is built with the satisfaction of every single customer. It is the whole process of

running the e-shop as such. The basics are the correctness and timeliness of the information about the products offered, the time of the delivery and the published price. The other significant attributes of the website were also its intelligibility and clarity. In practice, this means that an e-shop visitor should be oriented on the page without any problems, and in a relatively short time with the filtering should be able to find what he needs at the moment. It can be speeded up by a filter that can be set and sorted for products such as price, brand, colour, size and other parameters. In this context, they are somewhat harassing pop-up ads and banners. If there are a lot of advertisements placed on the web page, the visitor leaves the e-shop.

Apart from being visible on the Internet each business entity should be aware of what the Internet has to offer. Online world has changed the already-existing marketing models and brought strategies that can be applied with much greater overall effect than basic types of advertising. Knowledge of terms such as PPC, SEO and personalization of consumer goes hand in hand with success. The results indicate that on the Internet it does not matter whether a consumer is a woman or man or where he/she lives. Advertising affects both men and women, those living in big cities as well as those in small villages. One of the research hypotheses confirmed the relationship between the trustworthiness of business entity's website and its presentation on Facebook. Our research indicates that marketing activities should also include online activities since they open up new possibilities and offer new ways of achieving one's objective.

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Assumptions on Innovation into a Circular Economy

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Abstract:

Nowadays innovation in any field is essential for sustainable development, having in mind the actual trend to circular economy. Even that 40% of innovative products fail if the market is not able to understand and adopt the innovation, causing resource losses used for research, design, development and product promotion. It is also obvious that the development of mobile technologies and the extension of internet all over the world determine another trend: the second life on social media of the new Z generation. Having in mind these assumptions this research focus on finding out which are possible tools that can be useful in decreasing the rate of failure of innovative products on the market. Within smesonline.eu project we developed a virtual business environment that promotes circular economy principles. The project promotes the open source technologies and social media communication advantages in obtaining sustainable development. The article case study shows how to use different technologies (Java Servlets and MySQL) in order to develop a web business solution from scratch with virtually no costs. Single.

Keywords: circular economy; innovation; IoT; IioT; SM; virtual reality; 4th Industrial Revolution

JEL Classification: D87; I31; M21; M31; O13; O30

Introduction

The article aim is to discover appropriate tools for sustaining the innovation and mitigating the risk of failure. The article start hypothesis is that some of the factors that cause the innovation failure are: expensive technologies, lack of communication regarding the new added value of innovation. Thus the article emphasizes the advantages of using open source technologies, virtual and augmented reality advantages and social media communication. The smesonline.eu project inspires a business ecosystem for sustainable development. As an example the case study present a small web business solution developed from scratch using free open technologies (Java Servlets & MySQL).

1. State–of–arts

The competitiveness of the modern companies relies on sustainable innovation. Usually small innovations are easily accepted by the market, but for radical innovations the percentage of flop can reach the 90% threshold. Radical innovations imply new substantial technology in new products and existing products to provide a substantial increase in customer interest and requiring considerable change in consumption or usage patterns. If a radical innovation is associated with a lack of awareness and knowledge in the potential consumer mind it increases the level of risk as the innovation to be accepted on the market. That is why all the innovative products/services/ideas

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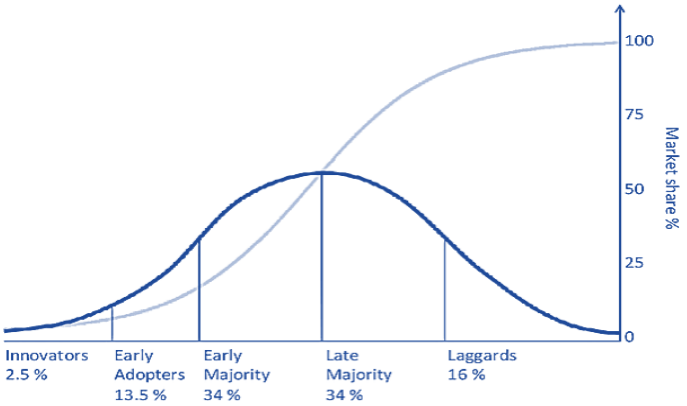
diffusion has to be associated with a trusted brand or world-renowned person in the field. It is also mandatory to be associated with workshops, festivities or other meeting sessions, organized in the scope of knowledge diffusion at least for the innovators and early adopters' consumers. The consumer needs to know what it is, how it works and what potential advantages can offer for him. Consumers' acceptance of traditional innovation depends on whether the consumer understands innovation and, if so, the extent to which his mental representations can be changed. (Moore 2017). The online marketing communications efforts have to motivate the innovators and early adopters' consumers to influence, by their example, the early and late majority consumers, through social media communication. (Figure 1).

Figure 1. The 5 Customer segments of technology adoption



Source: Moore 2017

Communication channels and oral word can raise the awareness regarding a product/ service/ innovation, but it is seen as an "external consciousness". The knowledge is assimilated through familiarity in the field, when trying to match the innovative offer with the existing one. Only understanding the utility of the new feature/ product/service/ innovation can make a real change in the consumer behavior. For the consumer's prior information is vital to understand the information provided.

In the process of accepting innovation, the analogy is an efficient method to:

- to describe complicated ideas or processes (*eg.* using Google Analytics software instead of writing and inserting own script in the site to count the visits);
- to explain the phenomenological experiences, that are associated with the previous experience with the intention of being directed toward something, as it is an experience of or about some object;
- to offer rational reasons for adopting innovation.

For a hybrid innovation to be adopted are useful discussions about the comprehension of novelty based on fields of innovation. The understanding of innovation features depends on customer knowledge of fields implied in innovation. The risk of fail depends on customer transferring selective knowledge and the true offerings of the innovation remains hidden.

The creativity and innovation human potential is supported by updating and inhibition. It seems that updating is the main factor that influence the correlation of intelligence and creativity (Jaušovec 2017). This fact enhance the role of transferring knowledge in order to understand and facilitate innovation.

2. Eco-innovation into a circular economy

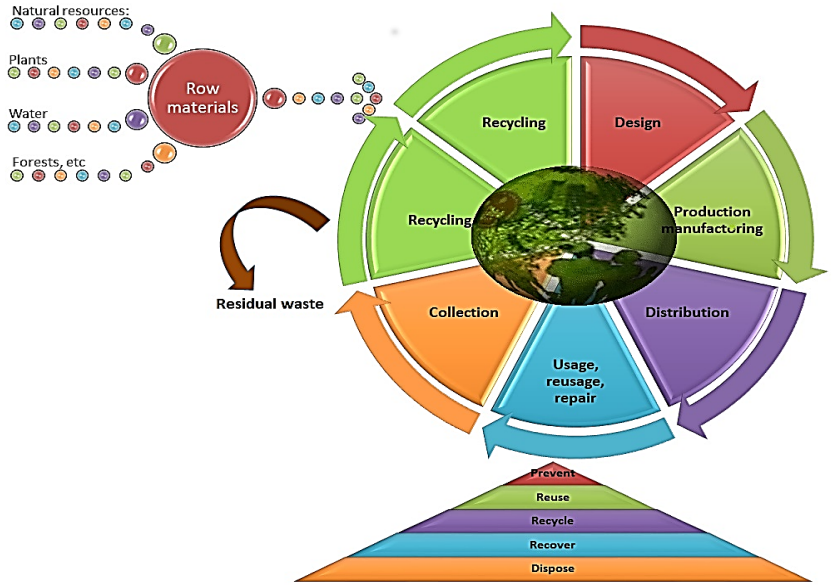
The linear economic model of development (take-make-dispose pattern) is reaching its limits. The materials are harvested and extracted, then are used to manufacture a product that is sold to consumer, when then discard it when no longer serve its purpose. The companies' exposure risk is increasing in the same time with the increase of price for materials, associated with supply disruptions. A circular economy would not just 'buy time' but also reduce the amount of material consumed to a lower set point.

This is the point in which every company looks for circular economy model of development (prevent-reuse-recycle-recover-dispose pattern) tying to take the advantages of global reverse networks, reorganizing the materials flows, bringing innovations in business models with the help of technology and human kind cooperation (Figure 2).

The circular economy should focus on increasing the efficiency of financial resources investments, increasing the sustainability of using the resources, without affecting the environment, and a spread of safety environmental behavior and communication and social connections among people.

The circular economy starts from a product design that respects the Eco-sustainable development principles. All the production manufacturing and distribution are based on circular economy polices. The companies are committed to reuse, repair the previous technologies and collect and recycle the residual waste.

Figure 2. Circular economy flow



Source: Adaptation after Anastasio (2016)

In the field of world-steel the circular economy is about 4R (Worldsteel 2017):

- reuse (rail tracks, by-products, steel beams, water, car doors);
- re-manufacture (machine tools, engine, wind turbines, electric motors, office furniture);
- recycle (bridges, buildings, packaging, cars);
- reduce (waste, energy and raw materials consumption, application weight);
- these will be translated in row material conservation, a higher degree of innovation, new offer of jobs, efficiency of invested capital, and reduce the CO_2 footprint.

The collaborative consumption and sharing a new model of business can be obtained by technology platforms, that facilitate the:

- redistribution markets: reallocation of items or services where the request meets the offer. In the present the auction sites, such as OLX, Tocmai.ro, eBay or local classified ads (Craigslist) facilitate this process;
- renting products, not own them. Examples include renting a car (Rent-A-Car and City Car Share for mobility services), equipment rental (Getable) and peer-to-peer (P2P) high-end household rentals from Snapgoods;
- the in-tangible assets (time, skills, money, experience, knowledge, music, services: training, consultancy) can be shared in collaborative lifestyles platforms, such as P2P Learning Startup Skill g, Airbnb for offering accommodation, and TaskRabbit for outsourcing small jobs and tasks to others in their neighborhood. (WEF 2014);

- tangible assets, that are very expensive or very difficult to reach can be provided by virtual reality. For example, a big provider of cars, cannot afford to create a show room in the center of an overburdened town. But can create a small showroom offering the clients the complete experience of driving the car through virtual reality. Using holograms, the car provider can transpose the client in a natural climate.

The artificial intelligence, health, electric cars, education, 3D printing, agriculture and jobs will turn to the Fourth Industrial Revolution, in the Exponential Age:

- the software will disturb most traditional industries in the next 5-10 years. Uber is just a software tool. The company does not own a car, but it is now the world's largest taxi company. Airbnb is the largest hotel company in the world, although it does not own any properties;
- artificial Intelligence*:* Computers become exponentially better in understanding the world. Nowadays a computer surpasses the world's best Go gamer (a strategic and complex game compared to chess) 10 years earlier than expected. In the US, young lawyers are not already getting jobs, because of IBM Watson (Watson is a computerized artificial intelligence system capable of answering natural language questions). Watson offer legal advice (so far for more or less basic things) in seconds, with precision of 90%, compared with an accuracy of 70% when executed by humans. Watson is already providing healthcare for cancer diagnosis four times more accurate than human healthcare. Facebook now has a form recognition software that can recognize faces better than people;
- autonomous vehicles: Soon the first self-driving cars will appear and the entire industry will start to be disturbed. Nobody will want to own a car anymore. We'll call a car by phone, the car it will appear at the client location and lead him to specified destination, without caring about parking. Thus there will be no need to get a driving license or to have a car. The consequences are in changing cities with fewer traffic and cars than now and with more parks for children, transforming the former parking lot into parks. There will be less car accidents. Most car companies may end up in bankruptcy. Traditional car companies are trying to evolve and build only a better car, while technology companies (Tesla, Apple, Google) are revolutionizing the industry by building a computer on wheels (a computerized machine). Insurance companies will have massive problems, because without accidents, insurance policies will become one hundred times cheaper. The cities will be less noisy, because all cars will operate on electricity. Electricity will become incredibly cheap and clean / non-polluting;
- solar production has been on an upward curve for 30 years, but only now can the impact be seen. Last year, more solar energy was produced than fossil energy (non-renewable). The price for solar energy will drop so much that all coal companies will go out of business in the next years;
- organic production will be the focus of sustainable business practices, implying an overall management of processes and integrated approaches. It is a business model implying the principles of corporate social responsibility. (Arabska 2016);
- health: There are developed medical devices that are connected to the phone, having the function of scanning the retina, blood sample and breathing, thus identifying almost any disease (Chipin 2017). For a small price, in a few years everyone will have access to world-class medicine, almost free of charge. Holographic medical visualization slows 3D atlas projection, helping the learning process (the future of education can be found with Augmented Reality tablet, especially in medicine, because it's easier to learn anatomy using 3D insights). Future surgeons can be trained for surgery in virtual reality (Figure 3). Cheap electric energy will lead to an abundance of cheap water. In most places, not lack of water is a problem, but drinking water;
- 3D Print: The price of a 3D printer has dropped from $ 18,000 to $ 400 in 10 years. At the same time, it has become 100 times faster. All the big shoe companies started printing shoes using 3D technology. Airplane parts are already printed in 3D. The space station now has a printer that eliminates the need for the large number of spare parts used in the past. Soon, new smart phones will have 3D scanning capabilities; Create 3D-printable objects in a room-sized virtual workshop can increase the sales;
- holograms help customer to touch and feels the products, in a virtual reality (see Figure 3);

- a performance sportsman can do the training is catching a real ball but seeing it in a virtual reality, where is the partner;
- dangerous chemicals can be mixed/tested in the safety of virtual reality;
- tactical heads-up display is used in the US Army (see Figure 3);
- nano-retina can project images directly into the person eyes, making "all the dreams come true" and transforming augmented reality in a very dangerous one.

Figure 3. The real world and virtual worlds come together like never before

Source: Virtuality 2017

For common people these facts seem just stories, and don't trust in it even when you show them the advantages. It's obvious the vital need of extended communication regarding present and near future technologies, as to be accepted by the market.

As an answer to these challenges it is obvious that the online communication has to become the major channel of innovation spread. The mobile networks (#5G) and the extended trend to #IoT (Internet of things, with a lot of new smart interconnected devices) (Santucci 2016), #IIoT (Industrial Internet of things) (IA 2017), #OTT (Over-the-top) (Rohde 2015) are assoc with new applications on smartphones become available, potentially influencing the user experience. The company has to be where the client is and has to determine him to install its application. Most of the clients are selective in installing new applications since Smartphone batteries discharge very quickly, and the internet is sold by gigabytes.

The internet providers and the mobile smart devices providers has to collaborate as to Internet access speeds" and applications usage (IoT, IIoT, OTT, virtual augmented reality). The professional online advertising, using specialized instruments, is now the expertise of digital marketing innovative agencies. To take advantage of the new technologies companies can collaborate or launch services in digital marketing. This approach cab be based on developed optical infrastructure spread all over the world, IPv6 implemented in each level of Internet, customers and modern mobile operators should be adapted and educated to the new ecosystem, sustained by the governments (Jurčić 2017) and the adoption of circular economy principles.

The trend is the companies to become agents for EID (the eco industrial development). This has to be done through: ecolabelling, policies and government (Sertyesilisik 2016).

3. Open Source Green Technology

We are aiming to a sustainable development of the economy that takes into account the needs of future generations, focusing on developing green technologies and create pervasive cyber mechanisms that signal by feed-back loops misbehavior in conducting business and any environment abuse. We try to advise SMEs in order to reduce costs and improve automation of business processes, replacing proprietary software licenses with open source and eco-friendly technologies.

"Open-source architecture (OSArc) is an emerging paradigm (...) references open-source culture, modular design, avant-garde architectural theory, science fiction, language theory (...) adopts an inclusive approach towards a collaborative use of design and design tools by professionals and ordinary citizen users." (OS 2017).

The goal of smesonline.eu project is to inspire a business ecosystem in which access to resources is made in a transparent manner, the social responsibility of companies translates into a right relationship with tax authorities and involves campaigns, volunteering, sponsorships for sustainable development. We are pursuing a dedicated research and gather technologies in order to develop eco-friendly solutions. Our approach is focused for do-it-yourself people, meaning that we are using easily accessible software components which are as inexpensive as possible, and keeping integration as simple as we can. We will be going for maximum efficiency and keeping our systems uncomplicated by over-design.

The project list includes more complicated and ambitious projects as well as simpler ones:

- Extract-Transform-Load Applications (ETL) - from TXT, CSV, XML, JSON to Database and vice-versa;
- Automation scripting in Perl & Bash for logging and reporting services;
- Custom Object Relational Mapping (ORM) or Hibernate (JBoss/Spring);
- Business Process Management tools (BPM) and integration platforms (Mule);
- Distributed Applications in Cloud with Java Spring;
- Building RESTful Web Services with Spring Boot Actuator;
- Using WebSocket to build an interactive web application, *etc*., see more at: http://smesonline.eu/#about).

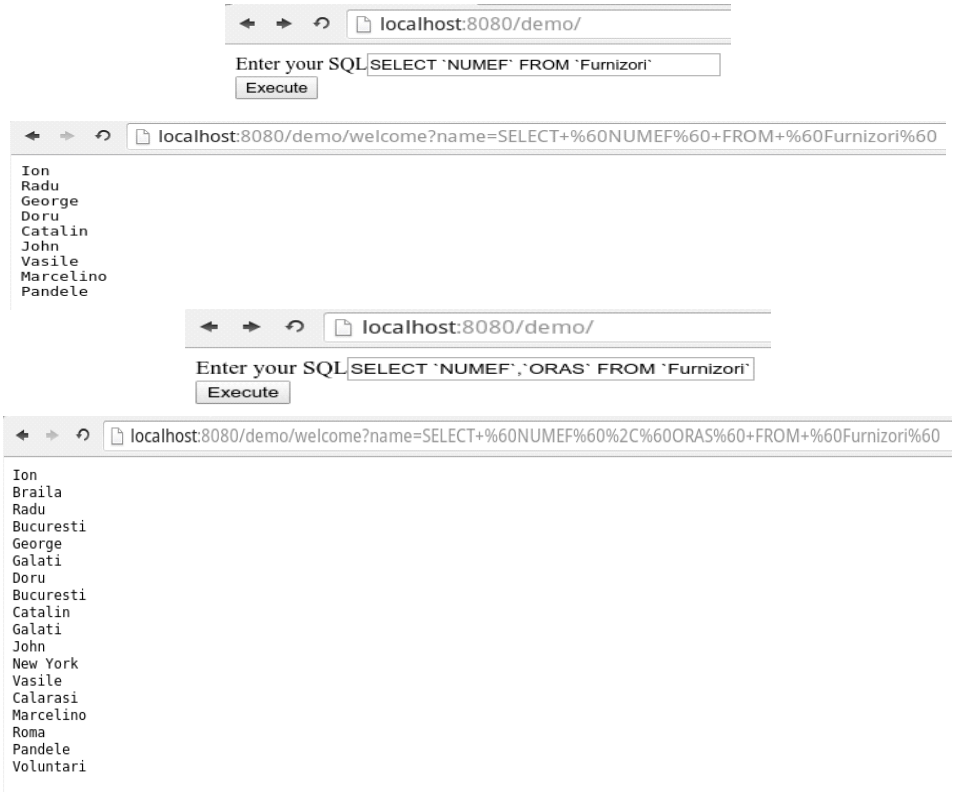
We include full instructions to use our software solutions that you can download and watch videos to learn how to integrate them with your business (http://www.smesonline.eu/movies/MYFILE.html). We will even host live webinars for free where you can ask questions of the designers.

In the case study below we demonstrate how to mix together two different technologies (Java Servlets and MySQL) in order to provide enhanced efficiency and functionality to a web business solution from scratch with virtually no costs. Such advantage can be obtain only with expensive frameworks and licensing for complex web servers (Ex. WebLogic, WebSphere), unless you consider open source software components smartly combined after a modular driven architecture.

We built a service in Java 1.7 that allows the access of a MySQL data-source through a REST-full service, using open source software. The steps for development the service are presented below:

- Download MySQL Connector (*e.g.* mysql-connector-java-5.1.18-bin.jar) from https://dev.mysql.com/downloads/connector/j/;
- The MysqlCon.java code is compiled with the .jar archive of the connector using the command: javac -classpath "/home/linuxlite/Downloads/mysql-connector-java-5.1.18-bin.jar" MysqlCon.java;
- The MysqlCon.class Object Code is executed as a result of compilation with the command: javac –classpath"/home/linuxlite/Downloads/mysql-connector-java-5.1.18-bin.jar:/home/linuxlite/Downloads/servlet-api.jar" MyServlet.java;
- The result of SELECT `NUMEF` FROM `Furnizori` provided as a URL parameter is presented in Figure 4.

Figure 4. Example of open source application: REST service implemented in Java 1.7 with MySQL



Source: own source - developed application

The source code for the servlet is as follows:

```
import java.sql.*;
import javax.servlet.http.*;
import javax.servlet.*;
import java.io.*;
public class MyServlet extends HttpServlet{
public void doGet(HttpServletRequest req,HttpServletResponse res) throws ServletException,IOException
{
try{
Class.forName("com.mysql.jdbc.Driver");
Connection con=DriverManager.getConnection("jdbc:mysql://localhost:3306/Furnizori_de_componente","root","");
Statement stmt=con.createStatement();
ResultSet rs=stmt.executeQuery(req.getParameter("name"));
ResultSetMetaData rsmd = rs.getMetaData();
PrintWriter pw=res.getWriter();
while(rs.next())
for (int i=1; i<=rsmd.getColumnCount();i++)
pw.println(rs.getString(i));
con.close();
}catch(Exception e){ System.out.println(e);}
}
}
```

The data source table is as follows:

```
CREATE TABLE `furnizori` (
  `F#` int(3) NOT NULL,
  `NUMEF` varchar(20) NOT NULL,
  `STARE` int(2) NOT NULL,
  `ORAS` varchar(20) NOT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1;

INSERT INTO `furnizori` (`F#`, `NUMEF`, `STARE`, `ORAS`) VALUES

(1, 'Ion', 10, 'Braila'),
(2, 'Radu', 30, 'Bucuresti'),
(3, 'George', 20, 'Galati'),
(4, 'Doru', 50, 'Bucuresti'),
(5, 'Catalin', 15, 'Galati');
```

Conclusion

The world is changing very fast on behalf of technology. The article is a pleading for using the benefits of technology in scope of a better future for humankind. The article postulate the idea that innovation, good preservation of environment, sustainable development through circular economy, mass communication and human behavior change, can provide a better future for the next generations. The smesonline.eu project inspires a business ecosystem for sustainable development and the case study is an example of how to use free open technologies (Java Servlets & MySQL) as to get high functionality for a web business solution.

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Analysis of Russian Companies' Practice of Marketing Orientation

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Abstract:

Background: The article aims to study the certain aspects of marketing activities in Russian companies and to classify companies according to the proposed factors affecting the marketing orientation.
Objectives: To reveal factors that describe marketing orientation of Russian companies, to assess their attitudes and to classify Russian companies according to various directions of marketing orientation.
Method: Classification of Russian companies consisted of 28 quantitative variables that described the attitude of the representatives of companies to various aspects of marketing environment. Attitudes were identified through personal interviews of representatives of 116 Moscow region companies. The principal component method and hierarchical cluster analysis were used as analytical methods.
Findings: We identified four clusters of enterprises after determining eight factors which characterized 69.7% of the variance of the initial data. We considered these clusters and established key differences between them.
Limitations of the research: The sample size and the geography of the research stem from the specifics of the search study regarding its methodology and extension of the geography of the survey.
Value and originality of the research: We revealed a previously unused classification criterion for the company marketing orientation – the geographical representation of the business which determines the differentiation of marketing activities.

Keywords: marketing orientation; factors of marketing environment; marketing performance; classification of Russian enterprises; method of principal components; cluster analysis.

JEL Classification: D40 ; D42 ; D47

Introduction

The role marketing orientation plays in business strategy has been widely discussed since the moment the concept of marketing was developed. Marketing has established itself as a key aspect of the company's activities (Becher, Halsted 2001). In addition to that, as theoretical and practical aspects of a company performance show, marketing orientation contributes to the formation of a sustainable competitive advantage (Porter 2006).

Marketing orientation has been evolving with the time: it has shifted its focus from the product to sales and consumer needs, and then to building long-term relationships with customers. Strong marketing orientation implies both financial and non-financial benefits for companies (Lingsa and Greenleyb 2009). Marketing orientation refers to a culture where a company generates excellent value for its consumers, focusing on consumer needs and long-term profitability (Narver and Slater 1990). Marketing orientation is directly linked to several areas of the company's strategy and its activities (Ejdys 2015). It is associated with such outcomes as creation of a sustainable competitive

advantage (Narver and Slater 1990, Pelham and Wilson 1996), profitability (Narver and Slater 1990), new innovative products (Lukas and Ferrell 2000), and overall efficiency of the performance (Slater and Narver 1994). The concept of marketing orientation was also considered and studied by Russian researchers and marketing experts. We have thoroughly examined all these papers and identified prospects for further research and study of the marketing orientation of Russian and foreign companies that account for dynamic changes in market conditions depending on the scale of company activities in different regions of Russia.

1. Literature review

Marketing orientation implies that the company adopts strategic thinking. It applies a long-term approach to the analysis of changes in the external environment regarding its own mission and potential. However, these studies are descriptive and do not examine the influence of environmental factors on changes in the marketing orientation of companies. Analysis of the papers by international researchers shows that there are two prevailing approaches to determining marketing orientation: one defines it as the philosophy adopted by the company and the other – as a specific market behavior that has a positive effect on the company's performance. The main conclusions of these studies carried out by international scientists are presented in Table 1.

Table 1. Basic approaches to defining marketing orientation and its factors

Researchers	Approaches to defining marketing orientation (MO)
Gounaris, Avlonitis, 1995	*Strategic thinking:* Consideration of the company's potential, its mission, analysis of the external environment.
Avlonitis and Gounaris, 1997	*Behavioral approach:* Three factors are offered to determine MO: (1) marketing research, (2) obtaining well-positioned products and customer satisfaction, (3) keeping contact with the marketplace (promotion and sales).
Hooley, Lynch and Shepherd, 1990	*Philosophical approach to understanding marketing orientation.* A set of specific beliefs
Narver and Slater, 1990	*Behavioral approach to marketing orientation*: Three MO factors are identified: (1) customer orientation, (2) competitor orientation and (3) cross-functional coordination
Kohli and Jaworksi, 1992	*Behavioral approach based on three factors*: gathering information about the market, distribution of information, feedback on information through strategy and plans
Deshpande and Webster. 1989	*Philosophical approach*: Degree of marketing orientation explains the company's readiness to innovation
Baker, 1989	*Philosophical-behavioral approach:* Marketing orientation, as a specific business culture, implies identification of customers' needs, mobilization of the company's resources, win-win principle
Trout and Ries (1985)	*Behavioral approach*: Collecting information on the market and business processes to develop competitive advantage
Piercy (1992)	*Behavioral approach*: Three components of MO are identified: the strategy of market's defining and its target segments, product differentiation, and marketing planning based on market information analysis

Despite some differences in the definitions the researchers give, the general features of marketing orientation are quite clear and deal with a thorough understanding of customers and competitors' behavior, as well as building relationships with customers on the basis on their constant study.

Most of the papers by international authors date back to the 1980-1990s, when the economic and social situation in the global markets was relatively stable, in contrast to the current situation that is characterized by a significantly greater turbulence. A study conducted by IBM shows that prediction of the competitive environment development has become incredibly difficult, and the boundaries between industries are being blurred, whereas companies of one sector are applying their experience in other sectors, and new business models are being developed (IBM - Global C-suite Study 2015).

Consideration of the strongest influence of environmental factors, both micro and macro ones, becomes a significant component of the company's marketing orientation. In the current socio-economic and technological

conditions, the companies' ability to adapt quickly to environmental conditions is one of the main factors for ensuring a stable position in the market.

The concepts of marketing orientation that were considered in the early scientific papers are general, and do not take into account the conditions of operating in different countries. What is more, they do not sufficiently reflect the current situation of business environment development. In this regard, when studying marketing orientation of Russian companies, we propose a fuller and more comprehensive analysis of the factors influencing the external environment and the company's reaction to their changes.

2. Methodology

2.1. Research on marketing orientation

Numerous empirical studies of marketing orientation aim to identify the relationship between companies marketing orientation and their operating results.

The relationship between marketing orientation and business results has been studied in different countries. Mahmoud (2011) conducted a survey among managers of small and medium-sized businesses in Ghana, with the results showing a strong relationship. Taghian and Shaw (2008) conducted a study among Australian companies, and the findings demonstrated the same correlation (Chiciudean, Arion, Mureșan 2015).

In Spain, Armario *et al*. (2008) examined the characteristics of small and medium-sized enterprises considering the increasing global reach. The research findings confirmed that the growth of the companies' marketing orientation leads to better operating results. It was also found that a strong marketing orientation helps to develop the most efficient internal educational environment of enterprises, due to which they can react more quickly and more effectively to a changing market situation.

In Sweden, Tajeddini *et al.* (2006) researched 650 companies with the number of employees varying from 5 to 200. The study revealed a positive correlation between customer orientation and market share, return on investment (ROI), and the share of new product sales in the total turnover. According to this study, correctly applied competitor orientation also has a positive impact on the market share and the share of sales of new products in the total turnover.

Baker and Sinkula (2009) studied the behavior of US small business companies. The findings showed that the growth of marketing orientation has a significant positive impact on business profitability. However, the researchers draw attention to the fact that marketing orientation means not only tracking consumer preferences, but also monitoring all parameters of the external environment.

Siu and Liu (2005) evaluated 307 small and medium-sized Chinese enterprises. The findings revealed that companies of this size perform better if marketing becomes the central component of their business philosophy. Companies with better results have a marketing strategic plan, while others are focused on reducing costs and increasing productivity. The most successful companies have a specialized marketing department.

In Russia, a number of studies have also been conducted to assess the degree to which marketing orientation influences the financial performance of the company. Tret'ak and Lagutaeva conducted a survey in Russia as part of a global study of the Contemporary Marketing Practice of Russian companies of different industries, different sizes and history. The researchers aimed to determine the influence of marketing orientation on financial results (Tret'ak and Lagutaeva 2015). The results of the study confirmed such a relationship, which was consistent with the findings of studies conducted in several other countries. Researchers from St. Petersburg conducted a survey of 150 local companies in different industries to identify elements of marketing orientation with a subsequent assessment of the impact of each of them on financial performance results. The research findings proved there is a weak relationship between the elements examined and the financial results. The strongest influence on financial results is exerted by the orientation to the macro environment and the competitive environment (Arenkov *at al*. 2006).

Loginov and Pron'ko proposed to measure the degree of company market orientation, its impact on the development of marketing capabilities and the impact of the latter on financial results (Loginov and Pron'ko 2014). They concluded that marketing orientation has a positive influence on marketing capabilities, but the correlation

between marketing capabilities and financial results is very weak. We believe it would be viable to consider the direct relationship between marketing orientation and financial results.

In addition to the research on the relationship between marketing orientation and business success, which can be considered proven, a number of studies have been carried out which describe the elements of marketing orientation present in the company performance (Polereczki, Vukoszavlyev, Veha, Szakaly 2016).

There have been a number of studies which classified companies according to the extent they apply marketing orientation in their business activities. Hooley, Lynch and Shepherd (1990) investigated the attitudes to marketing orientation on the example of UK marketing directors. Having assessed the correlation, the researchers identified a group of companies that fully adopted the marketing orientation as a business philosophy for the whole company. This group was called "Marketing Philosophers". Another group singled out was called "Departmental Marketers" (companies where marketing functions are assigned only to the marketing and sales departments), there are also the "Sales Supporters" group (which sees marketing as a function of sales support) and "Usures" (these are not actually focused on marketing and are not sure what benefits it brings to the company).

A similar study (Gounaris and Avlonitis 1995) aimed to create a classification based on a different level of marketing orientation and which would take into account different levels of adaptation to the market. Besides, the authors attempted to test the hypothesis which states that marketing orientation is equally developed by the companies in the industrial and consumer market.

Kazakov proposed to expand the Narver and Slater model to service companies and added two factors, which enabled him to classify Russian service enterprises. He developed a typology of Russian companies consisting of three groups: Group 1 (macretorides) – the most market-oriented companies with a significant innovation component, actively pursuing competitive advantages; Group 2 (pankratiasts) represents the average level of market orientation, with focus primarily on competition and low innovation activity; Group 3 – companies collaborating with the state agencies that have the lowest indicator of market orientation, but highly developed competences for interaction with government bodies (Kasakov 2012).

Yuldasheva and Shirshova identified the relationship between the marketing orientation and the marketing environment of a company and proposed a typology of marketing orientation that considers four groups of companies: Type 1 – the ones in favor of traditional marketing, Type 2 – market-oriented companies, Type 3 – technology-oriented and product-oriented companies, and Type 4 type – those favoring relationship marketing. It is worth mentioning, this research covered mainly small business companies (Yuldasheva and Shirshova 2013).

It should be noted that the concept of marketing orientation is changing with the time, with priorities regarding marketing tools used shifting as well. In addition to that, the models proposed by international scientists should be adapted and tailored for companies operating in the Russian market, due to the specifics of the market and its current turbulence, as well as national and cultural specifics of different regions, uneven distribution of economic activity concentrated mainly in large cities, diverse natural climatic conditions, long distances and other special factors.

All of the above determines the relevance and necessity of further research aimed at the assessment of marketing orientation development for companies in different business sectors, as well as Russian and international companies operating in the Russian market. Thus, the research objectives are stated as follows:

- to analyze the application of various elements of marketing activities by enterprises of different types;
- to identify the significant factors affecting the choice of marketing activities by a company;
- to propose the classification of enterprises on the basis of selected synthetic factors.

The conducted analysis of international and Russian scientific papers, as well as conclusions drawn by the authors of this study regarding the need for further research to identify and confirm how much certain factors influence the development of marketing orientation for companies operating in the Russian market, made it possible to formulate the following hypotheses:

H1: The main differentiators for using certain marketing elements are: the company's geography, the type of the market and the size of the company;

H2: Consideration of macro-environment factors by companies is an important element of marketing orientation;

H3: Russian companies use a varied set of marketing elements and in different combinations, which can be used for their classification.

2.2. Research methods of the marketing orientation of Russian companies

The program of complex empirical research included several stages: conducting three in-depth interviews with experts from companies of different sizes and different business spheres to clarify the previously formulated hypotheses, which were next to be tested by quantitative research (Aaker *at al.* 2004). As a quantitative survey tool, we used a specially developed structured questionnaire (polling company representatives) which consisted of 17 questions to determine and evaluate various aspects of the marketing activities of companies and 4 questions to determine the companies' characteristics (Skorobogatykh *at al.* 2017). The questions of the questionnaire dealt with the evaluation by experts – representatives of companies, – of the following aspects of the company activities: general marketing level, relationships with customers, communication with target audience, development of new products, planning, budgeting, evaluation of marketing effectiveness, price sensitivity, collection and use of information on the market.

The sample was formed using the database of enterprises provided by the Plekhanov Russian University of Economics business school. We decided not to include in the sample monopolists' companies, state-owned companies, as well as those being the key clients of state-owned companies. Consequently, the sample was made up of those companies that operate in the real market environment: companies of different sizes, working in different types of markets, with different geography. To test the hypotheses and conclusions, when forming the sample, we selected companies operating in Moscow and the Moscow Region as the most developed one regarding the application of modern business practices and marketing activities that can be considered as benchmarks for sharing the practice of their marketing orientation in the regions.

To collect the information, we conducted a personal survey of representatives of the above-described companies, who apply marketing orientation in their business to a bigger or smaller extent. The method of personal interview ensures a higher number of fully completed questionnaires. In total, 116 experts from 116 companies took part in the survey. The respondents (experts) were managers and specialists of marketing, sales and financial services of companies of various types. We decided that not only experts in the field of marketing, but also those working in sales and finance, would be invited as experts. This is due to the fact the experts of other departments are closely connected with marketing services and can also access marketing development of their companies. Sales departments have a particularly close connection to marketing departments, since they are most interested in marketing activities. The evaluation of specialists in financial services is most interesting from the perspective of understanding the process of marketing costs planning, as well as a general evaluation of the effectiveness of marketing activities and their contribution to business results. Thus, experts were chosen on the basis of the following criteria:

- experts should have practical experience and a university degree in economics;
- experts should have access to information on the marketing development level and application, as well as its elements in the companies where they work.

To analyze the empirical information obtained during the study, we used multidimensional statistical methods. The method of principal components allowed us to reveal the interrelation of original variables and move to a new coordinate system from 28 original variables to 8 synthetic factors. In addition to that, we conducted a hierarchical cluster analysis according to the Ward's method to classify enterprises on the basis of factors obtained as a result of component analysis (Mkhitarian *at al.* 2010). Statistical analysis was conducted using IBM SPSS Statistics.

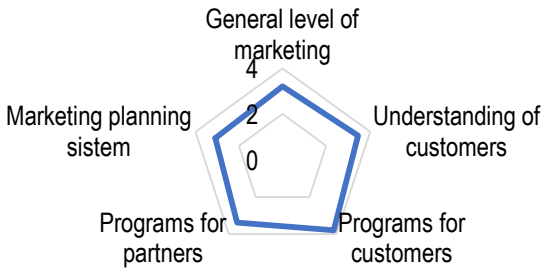
3. Research results

To test hypothesis H1, it was necessary to assess the overall level of marketing development and its particular aspects depending on the company size, market type (B2B and B2C) and the geography of companies. Considering the size, the companies that took part in the study were divided into three groups: large (32%), medium (43%) and small (25%). The share of companies operating in the B2C market estimated 37%, in the B2B market - 63%. Regarding the geography of their operation, all companies were divided into three groups:

1. Companies operating both in the domestic Russian and international markets (36%);
2. Companies operating in the Russian national market (in most of the country's regions) (30%);
3. Companies operating in no more than three Russian regions (with a limited target market (34%).

Let us consider the main findings of the study. We consider it viable to start the analysis with generalizing data on the whole set of the surveyed companies (Figure 1). The diagram shows average estimates of marketing activity estimated for all companies. The axes of the radar chart are average estimates of the overall level of marketing activity, the degree of consumer understanding, and the effectiveness of communication programs for customers and partners (intermediaries).

Figure 1. Marketing estimates for the total set of companies.



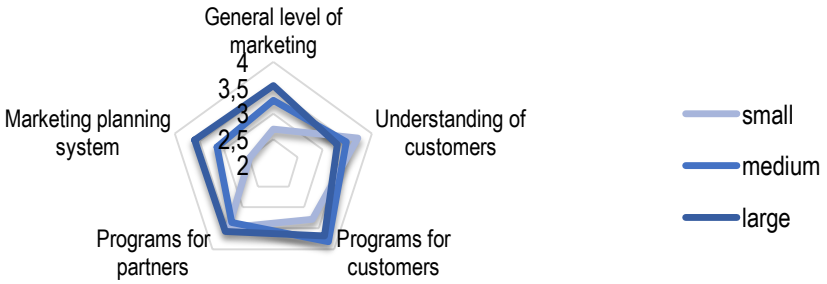
Source: original authors' estimation using the results of companies' survey

The experts interviewed assessed the marketing activity just above the average score (according to a five-point Likert evaluation scale, with 1 as the least important, 5 – the most important), which in this case can be seen as satisfactory. Estimates of particular elements or directions of marketing activities vary significantly from one another. The highest rating in the companies surveyed was given to the development of customer programs. Whereas planning is seen as an important element of the marketing management system, a planning approach to managing marketing activities is not implemented to a sufficient extent, with the evaluation of this element being the lowest.

3.1. Marketing evaluation in companies of different size

Figure 2 shows a diagram of average estimates of marketing activities for companies of different sizes.

Figure 2. Marketing assessment in companies of different sizes: large, medium and small business



Source: original authors' estimation using the results of companies' survey

Estimated marketing figures vary significantly for enterprises of different sizes. For large companies, the most characteristic feature is the close results for certain areas of marketing activities in the company. Marketing in large companies can be described as balanced and systemic. The close results of different elements suggest that there are no clearly expressed priorities in marketing activities. Such companies, as a rule, have a well-developed marketing department with high-qualified staff.

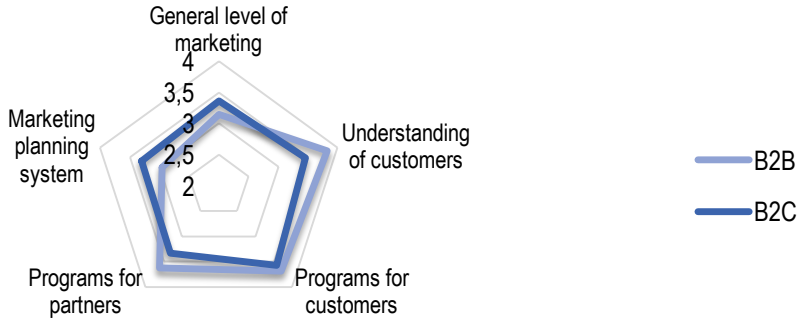
The smaller the company is and the fewer resources it has, the higher is the need to select the most important, profitable areas of marketing activity. Thus, small businesses are focused on small segments and narrow market niches. One of the key success factors for such a strategy is a very good understanding of customers and the full adaptation of the market supply to their requirements. This fact explains the high scores given for this marketing aspect by small businesses.

The survey also shows that the smaller the size of the enterprise is, the weaker the function of marketing planning it has. At the same time, programs aimed at consumers are more effectively used by large and medium-sized companies. Estimates of the effectiveness of various programs (marketing or incentive), aiming at intermediaries, are almost identical for all types of companies.

3.2. Marketing evaluation for different types of the market

Figure 3 shows a chart of average marketing estimates for companies by type of markets in which they operate (B2B or B2C).

Figure 3. Marketing estimates for companies operating in B2B or B2C markets.



Source: Original authors' estimation using the results of companies' survey

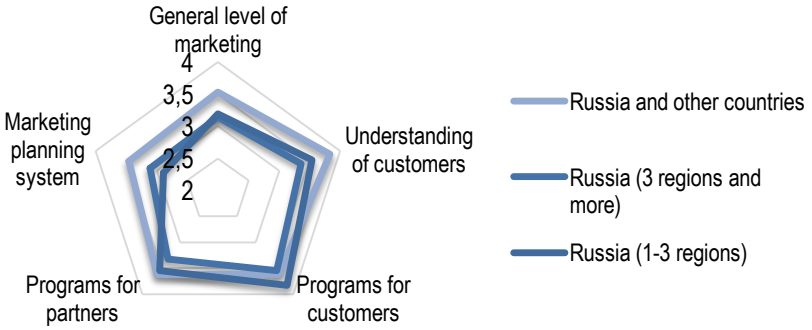
Relationship marketing is less developed in the consumer market than in the B2B market. At the same time, it should be noted that, the role of intermediaries is not so great in the B2B markets compared to the B2C market; there are more direct distribution channels, which explains the lower ratings of customer programs compared to those of companies operating in the B2C market.

In general, marketing in the companies in the B2C market is more balanced than marketing of companies operating in the B2B market. According to experts, companies in the B2C market demonstrate both a higher overall level of marketing and such an important aspect of it as planning.

3.3. Marketing evaluation according to the company geography

Markets geography influences the marketing activities of the company. The study confirms this statement (see Figure 4).

Figure 4. Marketing estimates for companies with different geographical distribution.



Source: original authors' estimation using the results of companies' survey

As Figure 4 shows, the experts gave the highest marks to the studied marketing elements in the companies of the first group. The average score for all marketing components is 3.6 points. The lowest scores were received by the companies of the second group – 3.1 points, whereas in the third group the score estimated 3.4 points. The variation in the estimates of certain marketing elements increased with a narrower geography of the business.

International companies demonstrated very close estimates of marketing. The wider and more diverse the geographical market is, the more diverse is the typology of consumers, as well as the behavior motives, the requirements to the product itself, service, prices and other elements of the supply. This fact makes requires a wide range of marketing tools and a deeper awareness of the importance of marketing orientation of the business.

Narrow geographical distribution in only a few segments (companies of the third group), as we can see from the presented data, requires shifting priorities to interaction with consumers. In these relatively small companies, marketing activities should be extremely tailored regarding the priorities, hence the high variability of estimates. The significant differences we established between the elements of marketing in companies allow us to conclude that the hypothesis H1 has been confirmed. To test hypothesis H2, it was necessary to study the correlations between the variables and to estimate how strong they are.

The use of 28 quantitative variables characterizing the attitude of Russian companies' representatives to various aspects of the external and internal marketing environment, an average and strong correlation between the variables allowed us to apply the method of the principal components to reduce the dimension and to identify the relationship between the variables, which will further be used for a more efficient classification of the companies.

In the principal component method, we used the following variables:

1 – 5: The influence of trends – competition; socio-demographic factors; economic factors; regulatory (legal) factors; technological factors;

6 – 13: Directions of the company's activity – marketing; understanding of customers, Customer Relationship Management; product quality; brand power; pricing policy; sales management; management; human capital management;

14 - 21: Communication (effectiveness of communication programs) - with consumers; with partners; with vendors; with competitors; with staff; with the media; with sector association; with state bodies;

22 - 26: New products are developed using: customers' opinions; partners' opinions; market trends; new technologies; ideas provided by employees;
27 - 28: Programs for maintaining long-term relationships - with partners; with customers.

As part of the principal component method, we used the Varimax rotation. As a result, we obtained 8 factors (principal components) that characterized 69.7% of the variance of the initial data. The results of the factors interpretation received with factor loading are presented in Table 2.

Table 2. Relationship of factors (principal components) and original variables with factor loading applied

Factor number and name	Factor score in variance, %	Variables influencing the factor
1. Value creation	13.09	Direction - Brand power; Direction - Sales Management; Direction – Marketing; Direction - Pricing policy; Direction - Product quality; Direction – Management.
2. Innovative activity	12.92	For NPD - ideas provided by the staff Trends impact - Technological For NPD - New technologies Direction - Human capital For NPD - Market Trends Communications – Staff
3. PR activity	8.40	Communications - State bodies; Communications - Sector associations; Communications – Mass media.
4. Communication with business community	8.20	Communications – Competitors ; Communications – Vendors ; Communications – Partners.
5. Impact of business environment trends	7.63	Influence of trends – Economic; Influence of trends – Regulatory; Influence of trends – Competition.
6. Interaction with partners	7.59	Relationships with Partners; For NPD – Partners opinions.
7. Interaction with customers	7.06	For NPD - Customers opinions Directions - Understanding the customers, CRM Communications - Customers Relationships - with Customers.
8. Impact of socio-demographic trends	4.83	The influence of trends - socio-demographic

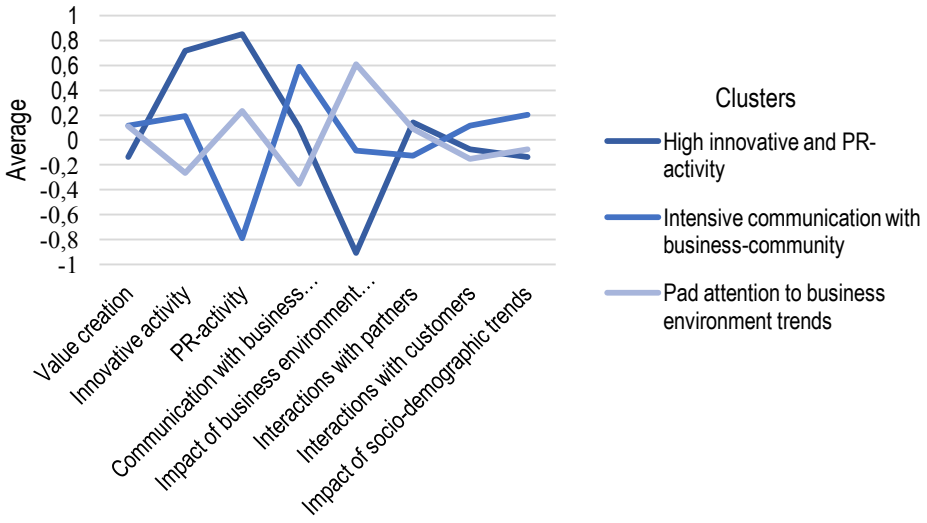
The conducted component analysis confirmed hypothesis H2 about the significant influence of the macro environment on the marketing orientation of companies: the cumulative contribution of macroeconomic factors (Factor 5 - Influence of business environment trends and Factor 8 - Influence of socio-demographic trends) estimated 12.46% in the variance of the initial data, which is comparable to the influence of the most significant factors: Factor 1 - Value creation (13.09%) and Factor 2 - Innovation activity (12.92%).

To classify the companies on the basis of 8 factors obtained in the course of the analysis of the principal components, we used a hierarchical cluster analysis according to the Ward's method. Having analyzed the dendrogram, we divided the companies into four clusters. The frequency analysis allowed us to determine the cluster sizes:

- 1st cluster - 24 observations (21%);
- 2nd cluster - 37 observations (32%);
- 3rd cluster - 51 observations (44%);
- 4th cluster - 4 observations (3%).

Thus, the first three clusters can be considered as significant. To interpret the obtained clusters, we carried out the analysis of means (Figure 5).

Figure 5. Graph of average values of factors for three clusters



Source: original authors' estimation using the results of companies' survey

Thus, clusters can be characterized as follows:

- 1st cluster - companies with high innovative and PR-activity (21%) (flagships);
- 2nd cluster - companies actively communicating with the business community (32%) (communicators);
- 3rd cluster - companies that focus on the study of the business environment (44%) (chameleons).

After further analysis, we established that the clusters have different sensitivity to price competition: flagships are the least sensitive (2.96 points out of 5), which is apparently due to the fact that these companies implement a differentiation strategy implying high innovative activity; communicators are the most sensitive (3.84 points) since they apparently adopt a cost leadership strategy implying active communication with vendors and partners; chameleons show average sensitivity to price competition (3,24 points).

Regarding the business size, representatives of the 3rd cluster have the largest share of large companies (41% versus 25% and 24% in the 1st and 2nd clusters, respectively). The maximum share of companies conducting market research can be found in the 3rd cluster (94% versus 79% and 84% in the 1st and 2nd clusters, respectively). The marketing department participates in the search for new markets in 71% of the representatives of the 3rd cluster, while in the 1st group this figure estimates 58%, and in the second – 51%. Marketing costs planning:

- by products is mostly done by representatives of the second cluster - 38% (21% - the first cluster, 20% - the third cluster);
- by brands is mostly done by representatives of the first (21%) and the third (22%) clusters (the second cluster - 11%).

Thus, we can consider hypothesis H3 confirmed. We identified the clusters, found and described significant differences between them.

Conclusion

One of the main marketing postulates states that all marketing tools are not only interrelated, but also interchangeable. In different conditions (the type and features of the market, the geography of the company business, the degree of innovation, the level and strength of the competitive impact, the potential of product differentiation, price sensitivity of demand, resources and competencies of the company, *etc*.), the degree of the

company's marketing orientation can be significantly different. What is more, the effectiveness of marketing tools used in various situations also differs.

Previously, numerous studies considered how strong the marketing orientation of a company is depending on the specifics of the business. At the same time, it is important not only to reveal the degree of the marketing orientation, but also to understand how the type of marketing orientation varies depending on the industry, the company geography, the size of the company, and other factors that influence the changes in and adaptation of the marketing orientation.

In this study, we identified 28 primary factors of marketing orientation, then using statistical analysis, we established 8 synthetic factors that had the greatest impact on the marketing orientation of companies. After conducted cluster analysis, we obtained four clusters of companies, three of which can be considered significant. These clusters were given the following names: Cluster 1 - flagships; Cluster 2 - communicators; Cluster 3 - chameleons.

As the research showed, Russian companies also have priorities in choosing the main direction of marketing tools effect – they can be primarily targeted at consumers, vendors, or intermediaries. Russian companies differ significantly not only according how fully their marketing activities are developed (Musatov and Musatova 2016), but also regarding its focus on various objects of the marketing microenvironment (customers, intermediaries, partners) and to what extent they account for macro-environment factors.

Eight synthetic factors identified by us in the course of the research can be used as the basis for studying various aspects of marketing activities of companies operating in different regions of Russia.

The study proved that it is viable to expand the number of elements of the existing Narver-Slater marketing orientation model by including factors that account for changes in the external environment (micro and macro). Marketing orientation, according to various researchers and the authors of this study, should be considered as a source of competitive advantage and business sustainability in the turbulent market environment. Detailed study and analysis of its influence in various sectors or depending on the company size and the market type should become issues for further research.

The research findings make it possible to assess the application of marketing orientation by Russian companies, as well as the formation of several common approaches to its implementation. These findings are consistent with the results of studies on marketing orientation conducted in different countries, but they have their own specifics the dynamics of which can become subject for further investigation.

This methodology can be applied by network business management companies or individual enterprises to assess the marketing orientation of business units or small and medium-sized businesses separately.

The findings can be applied in Russian enterprises when developing strategies for entering the Moscow market – the most attractive regional market in Russia, as well as in international companies that intend to create or expand their business in Russia.

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The Predictable Market and Mutual Fund's Superior Performance. The Evidence from the Higher Moment Method

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Abstract:

In this study, we inspected the market timing ability and stock selectivity of mutual fund in a high volatile market - emerging market. The high level of volatility - risk, mean and variance approach are not sufficient to estimate the portfolio risk and return. To match the model with the environment of high risk and high return, we apply the coskewness risk factor - which is an unavoidable skewness risk, as another important risk in emerging market study. Our finding showed that the factor effectively supports the market timing ability of mutual fund manager in Thai market. The outcome further supports the prior belief that the return in emerging markets are more predictable than the developed market. Therefore, we examine the positive and significant market timing ability in all portfolio regardless their performance. We discover that the mutual fund manager prefers the positive skewness, particularly the poor performance-fund.

Keywords: mutual fund performance; timing ability; coskewness; higher moment

JEL Classification: G11; G12; G21; G23

Introduction

The expansion of the mutual fund industry worldwide was contributed to the various benefits provided by a mutual fund comparing with the individual investment. For example, the individual investors could invest in a well-diversified portfolio at a cheaper cost by investing in a mutual fund. Mutual funds Industry also have a lower transaction cost comparing to the individual investor. Besides, the funds are highly regulated in most markets. However, one big advantage to invest in mutual fund is that mutual funds are managed by the high experience and very professional fund managers.

Traditionally, there are two superior abilities of mutual fund managers. The first one is the ability to manage idiosyncratic risks. Mutual fund managers are believed to have the ability to select an undervalue stock. Therefore, the managers who have this superior ability can create the higher fund's abnormal return. To measure a stock selectivity, Jensen (1968) offered a model to capture fund's alpha which is called Jensen's alpha. The other superior ability is a market timing which is an ability of fund managers to forecast the market movement - the market return. If the mutual fund managers are able to correctly predict the market movement, they will allocate their investment to the market before the market rise. Consequently, they create the higher fund's return. In order to capture this market timing ability, the traditional model was suggested by Treynor and Mazuy in 1966 and furthered developed by Roy D. Henriksson in 1984. Furthermore, the market volatility has been discovered to be other useful source of information to adjust the mutual fund portfolio since the market volatility is more persist than the market return. Additional, Busses (1999) suggested that the mutual fund managers use information obtained from the market volatility rather than the information from the market return.

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He also documented the evidence of market volatility timing gather from the daily market return. Prior literature reveals mixed evidence of the selectivity and timing ability of funds.

The prior studies are based on the mean and variance approach. În this study a mean-variance approach is not sufficient to characterize risk and return. Since the utility function of risk averse investor's wealth—denoted as U(W), is strictly increasing, $U'(\mathrm{W}) > 0$, $U''(\mathrm{W}) < 0$, and $U'''(\mathrm{W}) > 0$. The function indicated that the risk averse investor was able to have a positive skewness preference. As the result, the higher moment, a skewness, is one of significant risk factor in asset pricing. The skewness becomes necessary risk factor particularly in emerging market study. Because emerging market are characterized by the high volatility and high return which mean-variance approach is limited . Prior studies supported the important role of the skewness as an important risk factor. Furthermore, the skewness found to be one of systematic risk or unaviodance risk—coskewness. This coskewness is priced and plays a significant role in portfolio allocation (Moreno and Rodríguez 2009)

The skewness is not only a significant risk factor in emerging market, the emerging market study offered an opportunity to discover the mutual fund's performance for several reason. Firstly, the studies of emerging markets have important contributions. They were demonstrated the significant economic expansion are in both economics and saving. A rapidly growth contribute the expansion to an increasing of global economic share.

Secondly, there is the evidence of serial correlation of return in emerging market Comparing with the develop markets, the return in emerging markets are more likely to forecast. Although the results of market timing ability were inconclusive in developed markets, we expected that high performance funds could predict the return and could create the abnormal performance. Thirdly, the return distribution in emerging markets were discovered to be a non-normally distributed. This is because the emerging markets are characterized the incomplete market structure, high economic uncertainties, low transparency, political instability, regulatory changes, financial market liberation and so on. As a result, the study showed an important role of skewness as an important risk factor which was ignored by prior studies.

To further scrutinize the mutual fund manager's superior performance in emerging market, we focused our study on Thai market. This is because Thailand is one of the important emerging markets in the South East Asia and has exhibited a rapid economic expansion over last decade. In addition, Thai mutual fund industry has impressively expanded at an average 28.91% per year[3].

The remainder of the study organizes as follows, Section 2, provided a brief overview of literature. Section 3 discusses data and methodology used in this study. Section 4 provides the result and discussion of our finding, and the last section is conclusion and summary.

1. Literature review

Two types of traditional mutual fund's performance are stock selectivity and market timing. A stock selectivity based on the superior ability of mutual fund managers in order to find the undervalue stock. Consequently, fund managers who have stock selectivity is able to improve their portfolio abnormal return. Focusing on another fund's performance, a market timing ability based on the ability of mutual fund manager to forecast the market return. Therefore, fund managers who have market timing ability could adjust their portfolio exposure. They increase (decrease) market exposure if they think that the market is improved (slowdown) in the near future.

1.1 Stock selectivity model

Jensen (1968) introduced the model to measure stock selectivity of mutual fund managers. Jensen's alpha based on capital asset pricing model (CAPM). The managers who have stock selectivity performance or superior performance may increase their portfolio return higher than the others at the given level of risk. To find the alpha, the fund risk adjusted return was calculated. From the equation (1), If the mutual fund managers have the stock selectivity, it means that the alpha (α_{pt}) from regression will be positively and significance.

$$\mathrm{E}(\mathrm{R_{pt}}) - \mathrm{R_{ft}} = \alpha_{\mathrm{pt}} + \beta_{\mathrm{p}}(\mathrm{E}(\mathrm{R_{mt}}) - \mathrm{R_{ft}}) + \varepsilon_{\mathrm{pt}} \quad (1)$$

[3] *Sources*: Morningstar Direct database, as of Jan 2017.

Although, one advantage of investing in mutual fund is to earn the expected superior performance from their mutual fund managers, the results that were found on this stock selectivity are inconclusive. Many studies show both negative alpha and insignificant alpha. However, many found mutual fund managers improved their portfolio abnormal return. Recently evidences suggested that the fund managers have an ability to select stock that outperformed the market before deducting for expense.

1.2. Market timing model

The traditional model that was developed to measure the market timing was suggested by Treynor and Mazuy (1966). Furthermore, this model was further developed by Henriksson (1984). They showed that the mutual fund managers having stock selectivity and expecting the market to increase will increase allocation to market portfolio. Therefore, their portfolio can generate the superior performance comparing with the fund managed by the manager without market timing ability.

$$E(R_{pt}) - R_{ft} = \alpha_{pt} + \beta_p(E(R_{mt}) - R_{ft}) + \delta_p(I * (E(R_{mt}) - R_{ft})) + \varepsilon_{pt} \quad (2)$$

Form equation (2), $\alpha_{pt}, \beta_p, \text{and } \delta_p$ are selectivity, market beta, and market's timing ability.

where: I=1 if Rm; t is positive and zero otherwise; If δ_p is positively significance, it means the mutual fund managers have the market timing ability .

However, the result of market timing is also mixed. The prior literatures stated that there are no evidence of market timing ability. Furthermore, the mixed evidences for both market timing and stock selectivity are documented. Many evidences suggested that the fund managers do not have both market timing and stock selectivity ability. In addition, Malkiel (1995) also documented this insignificant selectivity . However, some evidence found the exist of timing and selectivity ability .

2. Data and methodology

2.1. Data

In this study, the data related to mutual fund are obtained from Morningstar direct database. These data include monthly net asset value (NAV), total asset under management, annual reported expense ratio. The data about the stock market, stock price, and risk free rate are gathered from Datastream database.

The period of studies starts from Jan 2000 to Dec 2016. For mutual fund sample, we excluded international funds, funds of funds, index funds, trigger funds, bond funds, fixed term fund, and money market funds. Our target is domestic equity mutual funds. If the new funds were registered, we included those funds in our sample. In addition, we excluded the fund from our sample in the year that particular funds are liquidated. Therefore, our sample frees are from survivorship bias.

Table 1 Shows the number of funds under study.

	Full Sample
Thai mutual fund industry	1509
Domestic equity fund in sample	253

To summarize, the mutual fund industry in Thailand has 1,509 funds available at the end of December 2016. Though 1,509 funds, there are 253 domestic equity funds. Table 1 shows the number of sample in this analysis. Hence, we included all of these 253 domestic equity funds.

2.2. Methodology

We firstly constructed the time series of mutual fund total returns from funds' NAV in each month

$$R_{p,t} = \frac{NAV_t - NAV_{t-1}}{NAV_{t-1}} \quad (3)$$

After we got the mutual fund total return according to equation (3), we formed funds' excess returns, $r_{p,t}$, from the difference between mutual fund total return , $R_{p,t}$ and Thailand 1 Day repurchasing rate (Repo). According to market return, we calculated the market return using an index of Stock Exchange of Thailand (SET). We further formed the market excess return, $r_{m,t}$ using the same method of funds' excess returns.

In order to control size, value and momentum, we form the three and four factor models. We compromised of the stocks that have the data of book-to-market ratio at the end of December 1999 and the stock that have the data of market equity size at the end of June 2000. Next we divided the stock into two portfolios. Accordingly, the stocks that have the market equity size higher (Lower) than median value of SET at the end of June 2000 were classified as Big (Small). After that, we divided the stock into three different portfolios named Low value, Middle value, and High value. The stocks that have book-to-market value ratio at the lowest 30th percentile were allocated to portfolio named low value, and the stock that have book-to-market value ratio at the highest 30th percentile were allocated to portfolio named High value. Besides, the remaining were - allocated to middle value portfolio. We finally formed the size (SMB) and value (HML) mimic portfolio as follow:

$$\text{SMB} = \frac{1}{3}(\text{Small Value} + \text{Small Neutral} + \text{Small Growth}) - \frac{1}{3}(\text{Big Value} + \text{Big Neutral} + \text{Big Growth}) \quad (4)$$

$$\text{HML} = \frac{1}{2}(\text{Small Value} + \text{Big Value}) - \frac{1}{2}(\text{Small Growth} + \text{Big Growth}) \quad (5)$$

We further controled momentum according to the following equation:

$$\text{MOM} = \frac{1}{2}(\text{Small High} + \text{Big High}) - \frac{1}{2}(\text{Small Low} + \text{Big Low}) \quad (6)$$

Finally, equation (7) shows Cahart four factor model.

$$\text{r}_{\text{p,t}} = \alpha_{\text{pt}} + \beta_m(\text{r}_{\text{m,t}}) + \beta_{smm}\text{SMB} + \beta_{hml}\text{HML} + \beta_{mom}\text{MOM} + \varepsilon_{\text{p,t}} \quad (7)$$

2.3. Stock selectivity and Market timing

Firstly, we followed the stock selectivity and market timing from Jensen (1968) and Henriksson (1984) as follow:

$$\text{r}_{\text{p,t}} = \alpha_{\text{pt}} + \beta_{\text{p}}(\text{r}_{\text{m,t}}) + \delta_{\text{p}}(\text{I} * \text{r}_{\text{m,t}})^2 + \varepsilon_{\text{p,t}} \quad (8)$$

If the mutual fund managers have the stock selectivity, their α_{p}should be positively and significance. Besides, the coefficient of market timing, δ_{p}, should be positively and significance. In particular, the mutual fund managers have an ability to predict the market. However, if δ_{p} turns to be negatively significance or insignificance, it means that the portfolio's managers have less ability to forecast the market return.

2.4. Coskewness risk factor

There are the evidences implied the non-normal distribution of return particularly in emerging markets (Baekert *et al.* 2000, 2004). This is because emerging markets are more likely to experience the structural change as well as other shock like political instability. As a consequence, the mean-variance-approach may not be sufficient to describe the characteristic of return in these markets.

Furthermore, as suggested by Harvey and Siddique (2000), the coskewness risk factor was found as a significant risk factor in emerging markets. To accommodate this unavoidable coskewness risk, we followed Harvey and Siddique (2000) to form the coskewness risk factor[4]. Embracing the coskewness risk factor in to the model, our market timing in the higher moment approach can be formed as follow:

[4] We form the coskewness risk factor, SKS according to Harvey and Siddique (2000). S^- is the lowest value-weighted mimic portfolio based on the past coskewness where S^+ is the highest value-weighted mimic portfolio based on the past coskewness.

$$r_{p,t} = \alpha_{pt} + \beta_m(r_{m,t}) + \beta_{smm}SMB + \beta_{hml}HML + \beta_{mom}MOM + \delta_p(I * r_{m,t})^2 + \gamma_p SKS + \varepsilon_{p,t} \quad (9)$$

3. Empirical result

Table 2. Shows the descriptive statistic for the sample under study

	Mean	STD
Fund return	1.100%	6.499%
Rm1D	0.277%	6.410%
SMB	0.101%	0.966%
HML	0.001%	0.974%
MOM	5.416%	1.187%
SKS	0.420%	1.134%
HM	2.484%	3.515%

On average, thai's equity fund performs better than the overall market return. Our sample of mutual funds provided about 1.1% of return per month while the market return was about 0.28% per month. On the risk perspective, the mutual funds in our sample have portfolios' total risk higher than the market risk. The risk factor was found to be positive for all risk factors. In addition to the descriptive statistic, we also noticed that the returns distribution of mutual fund in our sample departed from normality. We applied Jarque-Bera test in order to confirm the sample understudy. We found 177 of 253 funds' return were departed from normality distribution. This result further supported the essential of higher moment as an important risk factor.

Table 3 Shows the correlation matrix of the independence variable under study *,**,*** represent the significant level at 10%, 5%, and 1% respectively

	Rm	SMB	HML	MOM	SKS	HM
Rm	1.000	0.043	-0.026	0.060	0.431***	0.783***
SMB	0.043	1.000	-0.861***	-0.140**	-0.011	0.006
HML	-0.026	-0.861***	1.000	0.083	0.056	0.038
MOM	0.060	-0.140**	0.083	1.000	0.100	0.124***
SKS	0.431***	-0.011	0.056	0.100	1.000	0.430***
HM	0.783***	0.006	0.038	0.124	0.430***	1.000

Table 3 shows the correlation matrix of the independence variable under study. There is some significant correlation between the independence variables itself. For example, the market-exceed return, rm, shows significantly negative correlation with VOL, and strongly positive correlation with SKS and HM. Additionally, SMB found to have a strongly negative correlation with HML and MOM. These caused the multi-collinearity problem. To account this problem, we used variance inflation index, VIF, to quantify the magnitude of problem. Table 4 illustrates the VIF of our independence variable understudy. We found that all of VIF showed the value lower than 10 which means we are far and away from multi-collinearity problem.

Table 4. Reports the VIF index

	VIF
Rm1D	2.711
SMB	4.069
HML	4.084
MOM	1.052
SKS	1.080
HM	2.521

First, we estimated the Carhart four-factor model. Since the preliminary finding shows the non-normal of return distribution, we applied the generalized linear model technique which bases on the maximum likelihood approach. Additionally, to ease the serial correlation and heteroskedasticity problem, we followed the estimator

according newey-west (1984) procedure. As a consequence, our estimation methods minimized the serial correlation and heteroscedasticity problem. The results from Table 5 shows the marketing ability of mutual fund manager according to three different models. The result of marketing ability under the higher moment framework are shows in the model (3). We found that that the mutual funds' return can be explained by market risk, SMB, HML but not for MOM. We found that MOM cannot explained the mutual funds' return at aggregated level. According to model (2), we incorporated the coskewness risk factor to represent the high moment environment. Coefficient of all risk factors are positive. The market risk, SMB, and HML are positively and significant. Although, MOM found to be positive, it is insignificant different from zero. Table 5 shows the aggrate approach analysis. Model (1) is the cahart four-factor model (β_m, β_{smb}, β_{hml}, β_{mom}). The portfolio's α represent the stock selectivity of mutual fund manager. Model (2) included γ_p which is the coefficient of market coskewness. Lastly, the Model (3) include the market timing ability. The δ_p is the coefficient of market timing.

Table 6. Aggrate approach analysis

	Model 1	Model 2	Model 3
	Full sample	Full sample	Full sample
β_m	1.040***	1.034***	0.879***
	(44.25)	(42.72)	(39.39)
β_{smb}	0.320*	0.369**	0.212
	(1.73)	(2.16)	(1.25)
β_{hml}	0.351**	0.418***	0.206
	(2.24)	(2.83)	(1.59)
β_{mom}	0.00199	0.00357	-0.0850
	(0.02)	(0.04)	(-1.17)
δ_p			0.372***
			(9.31)
γ_p		-0.0726***	-0.0488**
		(-3.13)	(-2.46)
α	0.0117*	0.0119*	0.00793*
	(1.74)	(1.87)	(1.66)

Note: *, **, *** represent the significant level at 10%, 5%, and 1% respectively

Consistent with the prior literature, we discovered the negatively significant for the coskewness risk factor. This means, on average, mutual funds prefer positive skewness to negative skewness. When, the funds try to avoid the skewness risk, they pay overprice to hedge against the a negatively skewness security. Therefore, the coskewness risk premium shows a negative value.

The Jensen's alpha is found to be positive for both model. This fact provides the evidence to support the existing of mutual funds' stock selectivity. Then we included the market timing factor followed Roy D Henriksson (1984), HM. The coefficient of the coskewness factor remains unchanged. Also, the coefficient of market timing, HM, finds to be positively and significance. Otherwise, the mutual fund managers have an ability to forecast the market return. Therefore, they can better allocate to improve their portfolio returns. The positively significance of alpha remain preserved.

Conclusion

In this study, we further studied the market timing ability and the stock selectivity of mutual fund in emerging market. Matching the model with the environment of high risk and high return, we applied the coskewness factor as the high moment risk. Our finding supported the market timing ability of mutual fund manager in Thai mutual fund market particularly under higher moment analysis. This finding further supports the prior belief that the return in emerging markets are more predictable than the develop market. Therefore, we found the positive and significant market timing ability in all portfolio regardless their performance.

Furthermore, the studies indicated that the mutual fund manager prefer the positive skewness asset particularly the poor performance-fund. One possible explanation is they do not want to lose more because the lower the return they are, the lower the new-investment flow to them.

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Indicating the Impact of Changes in the Global Markets Environment on Russian Regional Processes

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Abstract:

The article considers issues related to taking into account the impact of tendencies of the global economy on the development of regional processes. It considers the nature of the dependence of the modern national economy on the environment of the global markets of raw resources sale. It reveals the inhomogeneity of regional processes reaction on changes of the global environment indicators. It offers the transmission mechanism of the impact of the global markets environment changes on regional processes. The analysis of indicators of the global economy allowed to form a system of basic indicators whose change identifies key global trends. The authors offered a methodic approach to estimating the reaction of regional processes on changes of the global environment based on the economic cycles' concept. Methodological tools of the research include cards of time lags. They allow to define the time lag of some regional processes reaction delay to changes of the global economy; the model of comprehensive estimation of the impact of global indicators on the regional process; and a matrix of differentiating reactions of regional processes on the change of the global environment according to the closeness of the interrelation and delay lags. The article offers a principle scheme of forming recommendations on managing regional processes based on the analysis of the dynamics of global markets. The methodological tools were tested through the example of the regional process "Change of the level of consumer prices" in 83 subjects of the Russian Federation. The subjects of the

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Russian Federation were classified according to two criteria: speed and power of the reaction of the level of consumer prices on the change of the global markets environment. According to the research results, practical recommendations have been formed. They enable state government to take preventive management decisions.

Keywords: reaction of regional processes; environment of global markets; time lags; differentiation of regional processes reactions; level of consumer prices; classification of subjects; preventive management decisions.

JEL classification: D40; O18

1Introduction

Social and historical conditions of the Russian economic development caused strong dependence of the modern national economy on the environment of global markets of raw resources sale. The characteristic example of this dependence is the impact of global economic crises (in particular, especially strong impact of global processes on the national economy is related to the periods of 1997-1998 (Gusev and Shirov 2009, Gaydar and Chubays 2011) 2008-2009, and 2014-2015). Herewith, it is important to note that for Russia the economic fall during these periods is related to the free fall of oil, natural gas and industrial metals on basic export markets rather than to the impact of macro-economic factors (crisis of the 1997 Asian market, 2008 crisis of the banking system, or the current sanctions pressure).

Now the Russian economy is vividly focused on export. It is proved by official statistics: the share of export in GDP for 2000-2014 is 30-40%; the income from minerals production tax that is the main article of the Russian export and customs duties for 2005-2014 give a half of the federal budget incomes (Official Website of the Federal Service of State Statistics). Consequently, the export focus stipulates the dependence of the Russian economy on the dynamics of global markets.

The issue related to accounting the impact of global economic tendencies on the national economy on the regional level is especially urgent because of the current change of the mode of the economic interrelation with the global community (Ekimova *et. al.* 2016).

The need in estimating the impact of global markets tendencies of regional processes in Russia is caused by the following objective factors (Zubarevich 2010):

- the position of economy of a certain region is defined by external economic conditions: during the stagnation of the global economy regions will suffer the economic fall regardless of the internal regional situation;
- the impact of changes in tendencies on global markets on internal regional social and economic processes; herewith, the level of interrelation is different for certain regions of the Russian Federation;
- the differentiation of the level of social and economic development of Russian subjects and their territorial separateness stipulate various reactions of separate regions' economy to the change of external economic situation in Russia as a whole.

Thus, taking into account the impact of global markets on the development of the regional economy and dynamics of separate regional processes is a basis of the research whose results are described in this article.

2. Methodology

Among specialists, there are many opinions about the degree of the interrelation of the Russian economy and the global market during the stable economic period. However, in the context of considerable negative changes of the global environment, the impact of external factors on the Russian economy prevails. The state government is challenged to counteract external negative impacts.

Besides, the modern Russia economy is peculiar of specific features that differentiate Russia from other states in terms of the economic and political weight on the global arena, which is related to unique territorial position and scales of the country.

The modern Russia is characterized by the territorial disintegration of economic processes, inhomogeneity of social and economic development of subjects of the Russian Federation, and deepening of territorial

disproportions. It is possible to single out the following most important peculiarities that come from the current economic and territorial position of Russia:

- in Russia there is the economic centralization in cities of the federal importance;
- Russia is characterized by strong differentiation of the level of social and economic development of regions;
- Russia is peculiar of the territorial separateness of certain social and economic centers that are not fully provided by the infrastructure.

These peculiarities of the modern Russian economy stipulate the inhomogeneity of the reaction to changes of the global economy of certain regions of Russia (Tsenina *et al.* 2016). Thus, cities of the federal value extremely quickly react economically to considerable changes of tendencies on the global markets, while in regional cities economic reaction is delayed in time.

For the state government it means that during the aggravation of the global crisis processes (or price fall on markets of raw materials) regional processes will undergo negative changes. Herewith, there is a time buffer between changes of the global situation and the situation on the regional market that can be used for developing preventive management decisions. The time buffer will be different for various subjects of the Russian Federation due to the differentiation of the territorial position, size and structure of the population, absolute value and structure of the regional GDP, and other social and economic factors.

The authors think that the changes in the global economy that are important for Russia as a whole and its certain regions in particular must be identified through revealing changes of the tendencies on global markets.

Changes on global markets through channels of the impact of the global economy on the national level cause changes of the regional economy environment. Herewith, this impact is inhomogeneous for various regional processes (Dudin *et al.* 2016).

Inhomogeneity of the reaction of regional processes to the changes of the global environment indicators defined the need to deepen the research in such areas as power and speed of regional processes reaction (Ekimovam *et al*. 2016). In this connection, not the fact of impact of the global market tendencies is important but the nature of this impact and defining the time frames during which the state government can take anti-crisis measures to stabilize economy. The time nature of the reaction of certain regional processes can be characterized by the lag of delay of this reaction to the global economy environment change (Kitova *et al.* 2016). The modern economic science interprets a delay lag (also defined as a time lag or merely a lag) as the duration of time that defines the reaction of the system under consideration (particularly, regional economy) on the previous impact (in particular, the impact of the environment) (Danko, Zarova, Bragin, Sekerin and Gorohova 2016).

In order to reveal lags of delay of certain regional processes reaction to global economic tendencies, the methodology of estimating the impact of the global economy change on regional processes was developed. It allows to research not only the current but also retrospective interrelations.

When developing the methodology, the authors based on the following provisions:

- the change of the global economic situation causes the change of the dynamics of the social and economic development of Russian regions especially during the crisis period;
- due to the territorial separateness and high economic differentiation of Russian regions, the impact of changes of the international economic situation on the regions' economy has an unequal and timely remote nature;
- the current state of the economic situation in certain regions is defined by consequences of the global environment changes that have taken place long before the current period;
- the interrelation of the social and economic situation in certain regions and changes of the global environment is defined by a comprehensive complex of factors of the global economy.

The estimation of the impact of changes of the global economy on regional processes is based on the concept of economic cycles (Danko, Ekimova, Bolvachev, Zarova, Shemetkova, Solovyova and Sekerin 2016) widely studied both by the national researchers (particularly in the works of Kondratiev (2002)) and by foreign authors (particularly, in works of Frisch (1933)).

It consists of four stages:

- formation of the system of indicators that show the impact of global markets on regional processes;
- revealing lags of the regional processes reaction delay to the global markets environment change;
- estimation of the reaction of regional process to the change of the global environment taking into account time lags;
- development of recommendations.

The analysis of the global economy indicators (Ekimovam *et al.* 2016) allowed to form a system of basic indicators whose change identifies key global trends.

1. Changes on the global energy market are identified through the dynamics of the price of 1 barrel of Brent oil in USD

The interrelation of the dynamics of prices on the oil products market and tendencies of the Russian economy is a generally acknowledged fact, because the revenues from oil and gas export form the basic share of the country's GDP (Impact of Global Prices, Production and Export of Oil on the Market, *n. d*.). The calculations are made on the basis of the Brent oil rather than Urals exported from the Russian Federation, because Brent is an etalon sort of oil on the European oil market. The price of the Russian Urals depends on its quotations. Thus, the forecasting of the Brent oil price is a more preferable indicator than the initial factor of Urals oil price formation. As for the indicators that characterize the dynamics of prices for natural gas, they were not included in the analysis because the formula of calculating the price of the exported natural gas took into account the change of process for oil products for the previous 6-9 months (Tsenina *et al*. 2016). It means that the change of price for natural gas is variable in relation to changes of the oil price. Thus, the price for the Brent oil is a comprehensive advance indicator of the global energy market that has an impact on the Russian economy.

2. Changes on the global financial market are identified through the following indicators: the rate of EUR in USD (EUR/USA), the price of 1 gold ounce in USD (Comex.GC)

Gold is included in reserve funds of the majority of developed countries, as well as in international reserves of the Russian Federation (that inter alia is a tool of stabilizing the national economy during the crisis period). According to the Central Bank of the Russian Federation, as on 01.06.2012 the monetary gold in the international reserves of the Russian Federation was USD 45,304 mln. or 8.88% of the total amount of reserves (Oil Contracts, *n. d.;* Official Website of JSC Gazprom; Official Website of the Central Bank of the Russian Federation).

The rate of the EUR/USD currency pair shows the change of rates of the two currencies that make up the basic part of the gold and Forex reserves of the Russian Federation. The gold and Forex reserves of the Russian Federation are highly liquid financial assets owned by the Bank of Russia and the Government of the Russian Federation. They consist of the foreign currency, monetary gold, and other reserve assets. Thus, the change in the rate of the EUR/USD currency pair shows the impact of the change of the global economic situation on the national economy as a whole and the national currency, in particular. The indicator "EUR rate in USD" characterizes the change of the currency market, and allows to take into account the impact of the European sector on Russia. The change of the USD rate means the change of Russian revenues from oil and other groups of export whose transactions are made in USD. The change of the EUR rate has an impact on the revenues from selling the natural gas to the European Union. Comprehensive change of the global rates on these currencies has an impact both on the revenues from export obtained in either currency, and on the price of the national currency on the global market. It is reflected on the level of the regional economy through inflation processes (the growth of prices in certain subjects of the Russian Federation).

The inhomogeneity of regions' reactions to changes of these currencies depends on the economic structure of the region. If the region revenues are made of export, the reaction of strengthening a specific currency depends on groups of the region export and the currency of transactions. As a whole, weakening of the national currency may cause the economic growth of a specific region. If the region economy is not based on export, weakening of the national currency as to EUR and/or USD means strengthening of inflation processes and appreciation of import. Therefore, economic decrease is observed.

3. Changes on the global market of investments are identified through the following indicators: values of the S&P 500 Index (the US market); the value of the EURO STOXX 50 Index (the EU market); the value of the Hang Seng Index (market of the Eastern Asia); and the price of 1 gold ounce in USD.

The S&P 500 Index shows the general development of the US economy. Since it was published in 1957, the S&P 500 Index has become the main indicator of the state of the US stock market acknowledged globally. Investment tools in the total amount of USD 4.83 tln. are focused on this index, and the tools in the amount of USD 1.1 tln. are directly attached to it. The index includes 500 leading companies in the leading sectors of the US economy. It covers 75% of the US shares market (London Metal Exchange *n. d.*). Besides, generalizing fund indices of other countries are formed under the impact of the S&P 500 Index change. That is why including of this indicator allows to take into account exchange changes and tendencies in the global economy.

The EURO STOXX 50 Index (STOXX Limited, *n. d.*) is a leading index in the European zone. This is a sector of the most important and large leading companies. The index covers 50 issuers from 12 countries of the Eurozone: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, the Netherlands, Portugal, and Spain (Standard & Poor's Financial Services *n. d.*). Thus, the index characterizes the basic economic tendencies of the market and economic situation in the European Union in the mostly economically important countries of the Eurozone.

The Hang Seng Index (HSI), the etalon indicator of the Hong Kong Stock Exchange, is one of the most famous indices in Asia, and is widely used by managed funds as the indicator that proved its efficiency. The Hang Seng Index is used for recording and studying daily changes of the largest Honk Kong companies at the stock exchange of the country. It is also the main indicator of the general market behavior. These 34 companies make up 65% of the total capitalization of the Hong Kong Stock Exchange. The Hong Kong Stock Exchange is among top ten of the largest exchanges of the world according to capitalization, and is considered as the second largest stock exchange in Asia. The largest Chinese companies including Industrial & Private Bank of China, PetroChina, HSBC Bank Holdings, China Mobile, Bank of China, China Life Insurance, China Construction Bank, Sinopec Corp. trade at the exchange (Hong Kong Exchanges *n. d.*).

Comprehensively S&P 500, EURO STOXX 50 and Hang Seng Index exchange indices show the tendencies in the sector of the global investment market that is important for Russia. Gold is selected as a resource that is an insurance and anti-crisis investment tool. It is stipulated by the fact that unlike companies' shares and other types of securities that are only documents fixing financial legal relations, gold is a value by itself.

4. Changes on the global food market are identified through the price of the contract for 5,000 bushels of wheat at the Chicago Board of Trade (CBOT Wheat)

The CBOT Wheat indicator is a future for soft red wheat, the most actively traded future at the Chicago Board of Trade that is among the largest North-American market of financial derivatives CME Group Inc. (CME Group Inc *n. d.*) CBOT Wheat is the global standard of the area and the most liquid futures contract for wheat in the whole world. Trading by CBOT Wheat contract in 2011 as expressed in the metric system was carried out in the volume of above 13 million daily. The importance of this index is stipulated by strong dependence of the Russian food market on import. Now Russia purchases beef, pork and poultry in the European Union, the USA, Canada, Brazil, Paraguay, Argentina, Uruguay, Chile, Australia, Mongolia, and CIS countries. Food import exceeds 50%, and for some types it reaches 80%. Consequently, the global situation on the food market is reflected on the national food market and on the internal Russian social and economic situation. Herewith, the change of the global prices of wheat reflects general global tendencies on the market of food of vegetable origin and indirectly (through tendencies for vegetarian feed) shows tendencies on markets of food of animal origin.

5. *Changes on the global metals market are identified through the price of 1 ton of copper in USD at the London metals Exchange (LME.Copper)*

The price of 1 ton of copper at the London Metals Exchange characterizes the global change of prices on the global market of metals as alternative indicators of the export activity of the Russian Federation in addition to export of oil products and natural gas. The selection of indices of the London Metals Exchange is stipulated by its

leading position on the global market of nonferrous metals (London Metal Exchange *n. d.*). Thus, quotations of metals in this trading area identify tendencies of the global metals market as a whole. The impact of the industrial metals market on Russia is defined by the fact that the export of industrial metals is the most important resources of the Russian revenues after exporting oil products and natural gas. Herewith, the change of price of these export groups, above all, has an impact on the economy of those regions whose revenues are formed at the expense of the metallurgic sector.

6. Changes on the global industrial market are identified through the price of 1 ton of copper in USD at the London Metals Exchange.

Change of global quotations related to the price of 1 ton of copper is acknowledged as one of the most important sectorial indicators of the global economy. Thus, John J. Murphy characterizes copper as one of the key industrial commodities. Thus, during the periods of economic power, the demand of three industries will maintain a high level of prices for copper. When the economy starts demonstrating weakness, the demand for copper in these industries decreases. It results in the tendency to decreasing prices for copper. The analysis of prices for copper on international markets is a sufficient ground for revealing tendencies on the global markets in the following areas: construction, motorcar construction, machine building, power, and electronics. It is stipulated by the copper as a material required in the production process in the above areas whose replacement is difficult technically or economically. Thus, the analysis of the copper price gives an idea about general tendencies on the global industrial market. The change of tendencies of the global industrial market has an impact on Russia through the price of production means. In particular, technically complicated equipment for developing deposits, production and processing of raw materials exported by Russia is mainly imported. Its purchase is reflected on the product cost.

The formed system of basic indicators can be supplemented depending on specific goals of the research. The list of regional indicators directly depends on the researched regional process and specific features of the regional economy, geo-political and territorial and climate peculiarities of a certain region of Russia under research.

In order to reveal time lags of delay achieved under the closest interrelations, the correlation estimation of the impact of basic indicators system changes on a specific regional indicator was made. The tool of structuring results of the correlation analysis is the card of time lags (Table 1). It allows to single out lags of the delay of the reaction of certain regional processes to changes in the global economy.

Table 1. Fragment of Card of Time Lags for indicator "Basic Index of Consumer Prices" in the Chelyabinsk Region in the system of basic global indicators *

Time lag / Indicator	Rate of currency pair EUR / USD	Price of barrel of Brent oil in USD	Value of "S&P 500" Index	Value of "EURO STOXX 50" Index	Value of "Hang Seng" Index	Price of contract for wheat at the Chicago Board of Trade in USD	Price of 1 t of copper at London Metals Exchange in USD	Price of gold ounce in USD
36 months lag	-0.2835	0.5493	-0.2217	-0.6624	-0.5388	0.5562	0.5262	0.7187
35 months lag	-0.3723	0.5484	-0.2391	-0.7229	-0.5822	0.5911	0.5065	0.6916
…	…	…	…	…	…	…	…	…
2 months lag	-0.7460	-0.1325	0.5125	0.6379	0.3247	-0.4564	-0.2896	-0.4453
1 month lag	-0.8190	-0.1197	0.4930	0.6463	0.3448	-0.4611	-0.2756	-0.4144
Without lags	-0.8579	-0.1003	0.4647	0.6382	0.3511	-0.4334	-0.2575	-0.3784
$\|k_{max}\|$	-0.8579	0.5493	0.6253	-0.7454	-0.5822	0.5911	0.5262	0.7187
$t_{\|k_{max}\|}$	0	36	15	34	35	35	36	36

Note: $|k_{max}|$ is a module of the maximum value of the correlation of the analyzed regional indicator and every global indicator;

$t_{|k_{max}|}$ is a time lag in months, when the relevant maximum correlation coefficient is achieved.

The maximum lag of data within the offered methodology is limited by the three years' period. This time limitation is explained by the three years' period of the budgetary planning. The analysis of longer periods would require to take into account the economic cyclicality of the global and regional economy.

In order to comprehensively estimate the impact of changes of *n*-number of global indicators that reflect the global economy tendencies on the regional indicator, and the general value of the lag of delay of the reaction to these changes, the authors offer to calculate the resulting indices of correlation (K_p) and time lag (t_p) by using the following formulas:

$$t_P = \frac{\sum_{i=1}^{n}\left(\left|k_{max}^{it}\right| \cdot t_{max}^{i}\right)}{\sum_{i=1}^{n}\left|k_{max}^{it}\right|}, \quad (1)$$

$$k_P = \sum_{i=1}^{n}\left|k_{max}^{it}\right| \cdot V^{i} \quad (2)$$

where: t_{max}^{i} is a time lag in months where the relevant maximum correlation index for I global indicator is achieved; $|k_{max}^{it}|$ is a module of the maximum value of the correlation index related to the analyzed regional indicator with the value of the *i* global indicator achieved in case of t-months lag, and is the weighing coefficient of the relevant correlation index.

Weighing coefficients (V^i) are defined by using the rule of Fishbone (Korovkin 2011) that reflects the fact that nothing is known about the level of indicators value except for the fact that they are located in a descending order. Formula 3 is used:

$$V^{i} = \frac{2(n - R^{i} + 1)}{(n+1)n}, \quad (3)$$

where: R^i is a rank of the *i* indicator; *n* is a number of indicators.

Reactions of regional process on the global environment changes according to the closeness of interrelation and delay lags (Table 2) are differentiated by two criteria: interrelation closeness (according to the Shaddock scale), and speed of reaction (with a year periodicity based on the cycle of the Russian budgetary process). In operative management, it is especially topical to take into account the external impact in regional processes. They are characterized as having "closely reactive", "strong reactive" reaction (strong reaction under small delay lags). The development of regional processes characterized by these types of reactions, which are strongly influenced by tendencies of the global economy, can be prevented by analyzing the advance indicators of the global economy revealed during the research.

Table 2. Matrix of differentiating regional processes reactions to the global environment changes

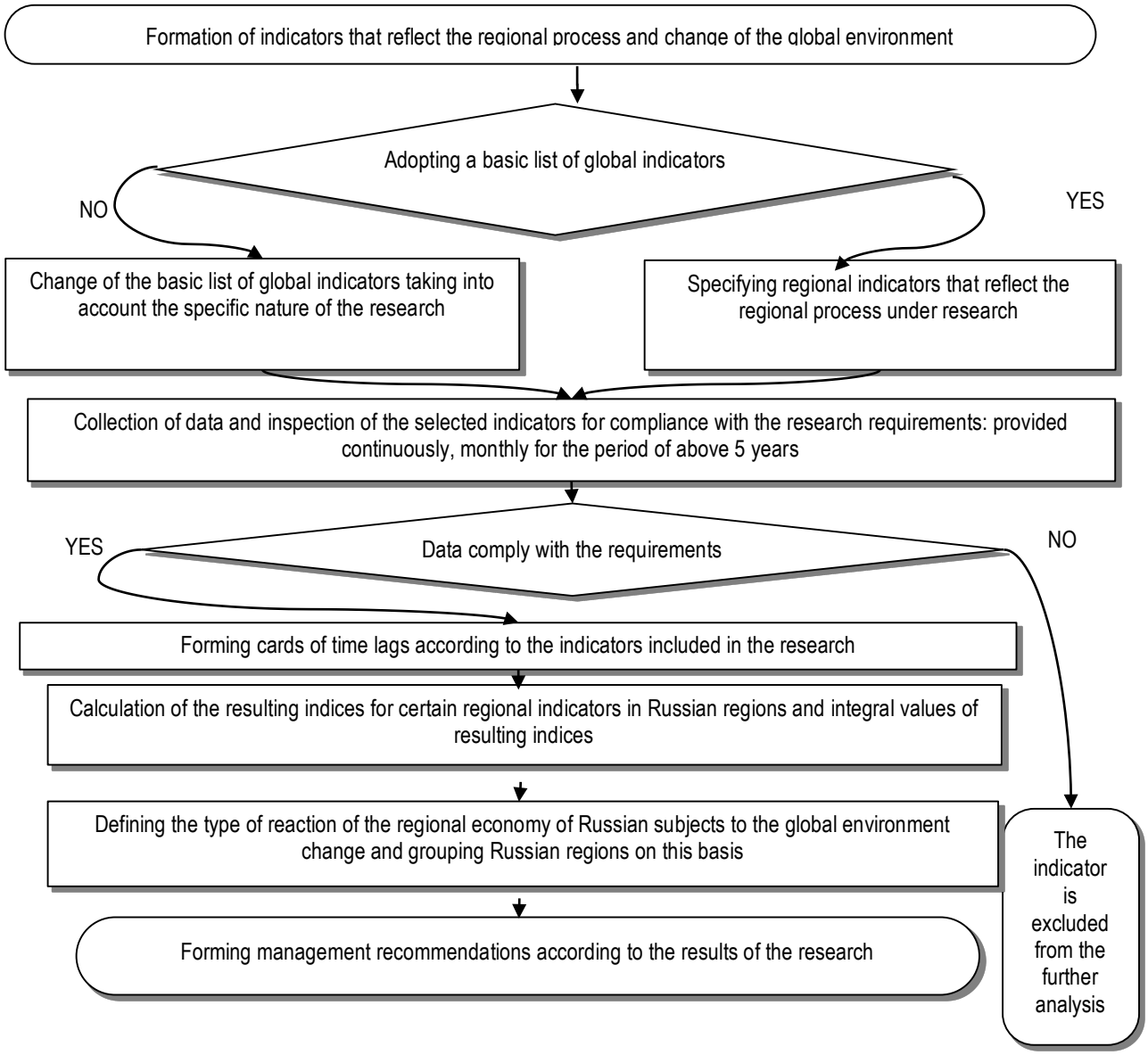
Power of reaction of the regional process to the global environment change	Speed of reaction of the regional process according to the lag duration		
	"reactive" (lag up to 12 months)	"delaying" (13–24 months lag)	"lagged" (25–36 months lag)
"weak" (correlation less than 0.3)	"weak reactive"	"weak-delaying"	"weak-lagged"
"moderate" (correlation 0.3–0.5)	"moderate-reactive"	"moderate-delaying"	"moderate-lagged"
"close" (correlation 0.5–0.7)	"close-reactive"	"close-delaying"	"close-lagged"
"strong" (correlation above 0.7)	"strong-reactive"	"strong-delaying"	"strong-lagged"

The completing stage is the development of recommendations on managing regional processes taking into account the type of reaction (Figure 1).

The offered methodic approach to estimating the impact of the changes of the global markets environment to regional processes was tested through the example of the regional process "Change of the level of consumer

prices". Data for 83 subjects of the Russian Federation were researched (for the research we selected the subjects whose data had been collected since 2012 till 2016).

Figure 1. Principle scheme of forming recommendations on managing regional processes based on analyzing dynamics of global markets



3. Discussion and results

The selection of the regional process under research is determined by the vivid differentiation in the dynamics of the prices levels in various regions. In particular, certain researches show social and economic inhomogeneity of the Russian economy and spatial differentiation of the growth of consumer prices. The authors think that the revealed differentiation cannot be explained by geographical peculiarities of the regions location, transportation remoteness or near-border status of the territory.

Herewith, among the indicators provided by the official statistical bodies of the Russian Federation (particularly, the Federal State Statistics Service), we think "Basic index of consumer prices for goods and services

in % as to the relevant period of the previous year" to be the most suitable one for researching price changes in separate regions. Besides, the selection of this indicator is related to the fact that according to the official methodic provisions, when calculating the basic index of consumer prices, the changes of prices for certain goods and services that are apt to the impact of administrative and seasonable factors are excluded (Indices of Consuming Prices and Average Prices for Commodities and Services, *n. d.*).

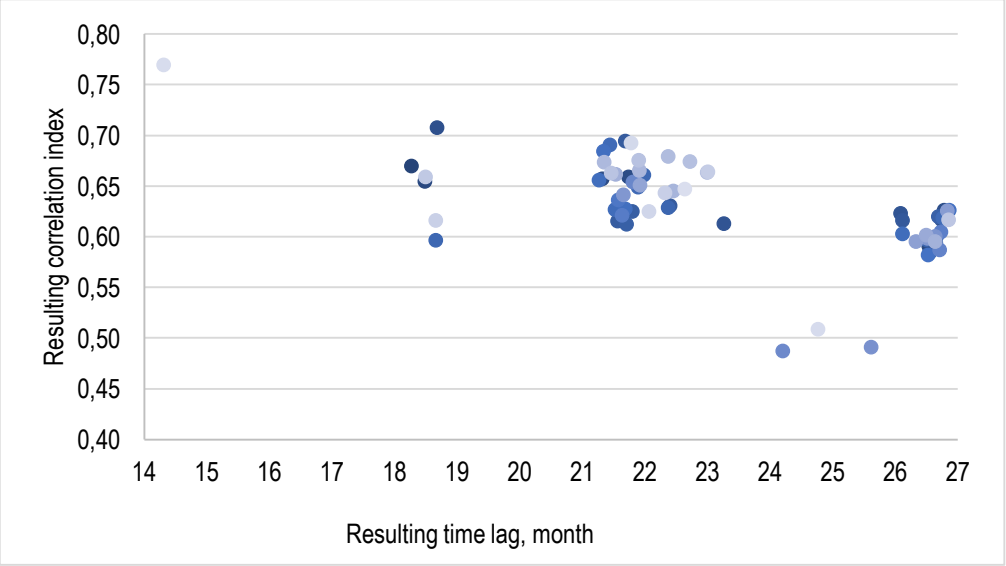
The comparative analysis of Russian regions according to this indicator was made based on the data of the Federal State Statistics Service (Saveleva and Tsalo 2012) for the period since January 2009 till June 2015. It allowed to reveal a different price reaction in Russian subjects to economic changes of the global economic situation.

For the research, the following global indicators that accurately reflect the changes of the global environment and comply with the specificity of the research were defined: the price of 1 barrel of the Brent oil in USD; the rate of EUR in USD (EUR/USD); value of the S&P 500 Index; value of the EURO STOXX 50 Index; value of the Hang Seng Index (HIS) index; the price of the contract for 5,000 bushels of wheat at the Chicago Board of Trade (CBOT Wheat); the price of 1 ton of copper in USD at the London Metals Exchange (LME.Copper); and the price of 1 gold ounce in USD (Comex.GC).

During the research 83 cards of time lags were formed. The latter allowed to reveal that the common tendency for all subjects of the Russian Federation was the close and strong interrelation with the USD rate (correlation index from 0.77 to 0.9): it is either not lagged in time, or lagged by 1-2 moths which can be considered as the calculation error. This interrelation is explained by the negative tendencies in the Russian economy related to the brisk fall of the RUR rate as to world currencies, which causes the instantaneous growth of prices.

The closeness of the relation of the basic index and time remoteness of this interrelation with the global economic indicators were determined using Formulas 1, and 2. Figure 2 shows the graphic interpretation of the obtained results.

Figure 2. Graph of allocating resulting indices of correlation of global indicators and basic index of consumer prices in subjects of the Russian Federation



Subjects of the Russian Federation react to changes of the global economy with a considerable delay (Business Cycle Indicators Handbook 2001). Herewith, time lags that characterize the delay of the regions' reaction are different for every subject of the Russian Federation. It is possible to observe a sort of a "tide" of time lags, or timely progressive reactions of the change of prices for consumer goods in certain regions under the impact of the external environment change. According to the results of analyzing the speed and power of reaction of the regional process to the change of the global environment, five groups of regions were singled out (Table 3).

Table 3. Matrix of differentiating regions according to power and lags related to delay of consumer prices reactions to the global environment changes

Power of reaction for regional process according to degree of interrelation with global environment change	Speed of reaction of the regional process according to the lag duration		
	"reactive"	"delaying"	"lagged"
"weak"	No regions	No regions	No regions
"moderate"	No regions	The Republic of Dagestan	The Republic of Kalmykia
"close"	No regions	Chukotka Autonomous District, Magadan Region, Kostroma Region, Jewish Autonomous Region, Karachay-Cherkess Republic, Khanty Mansiysk Autonomous District, the Republic of Adygea, Trans Baikal Region, Kemerovo Region, Novgorod Region, Orenburg Region, Lipetsk Region, Kaluga Region, Pskov Region, Komi Republic, Khabarovsk Region, Saratov Region, Yaroslavl Region, Murmansk Region, Republic of Tatarstan, Republic of Buryatia, Belgorod Region, Omsk Region, Arhangelsk Region, Bryansk Region, Vladimir Region, Tyumen Region, Moscow Region, Ryazan Region, Tomsk Region, Stavropol Region, Ulyanovsk Region, Sakhalin Region, Amur Region, Sverdlovsk Region, Tambov Region, Tver Region, Smolensk Region, Oryol Region, Nenets Autonomous District, Chuvash Republic, Kamchatka Territory, Altai Region	Kabardino-Balkaria Republic, Tyva Republic, Republic of North Ossetia, Irkutsk Region, Chechen Republic, Republic of Ingushetia, Krasnoyarsk Region, Primorsky Territory, Perm Region, Moscow, Republic of Bashkortostan, Astrakhan Region, Kurgan Region, Samara Region, Republic of Sakha (Yakutia), Rostov Region, Leningrad Region, Mari El Republic, Kursk Region, Republic of Karelia, Republic of Khakassia, Novosibirsk Region, the Altai Republic, Kirov Region, Kaliningrad Region, Saint Petersburg, Tula Region, Volgograd Region, Nizhny Novgorod Region, Krasnodar Region, Ivanovo Region, the Republic of Mordovia, Penza Region, Vologda Region, Chelyabinsk Region, Udmurt Republic
"strong"	No regions	Voronezh Region, Yamalo-Nenets Autonomous District	No regions

Practical recommendations for every group of regions are offered for preventive impact on the economic situation according to the results of the research (Table 4).

Table 4. Measures of Impact of State Government on the Level of Consumer Prices

Group of regions	Factors that induce the need of the state government to interfere in regulating the level of prices	Period after revealing negative tendencies that is rational for the interference of state government	Measures of the state government's impact on the level of consumer prices
"moderately delayed"	▪ Considerable long-term growth of the EURO STOXX 50 Index	In 1 year after the period relate to identifying negative tendencies of the external environment	Applying methods of indirect regulation: – Regulation of prices via state purchases made by administration of certain regions;
"moderately lagged"	▪ Considerable long-term growth of the EURO STOXX 50 Index. Considerable long-term decrease	When identifying negative tendencies of the global and national economy, it is	

Group of regions	Factors that induce the need of the state government to interfere in regulating the level of prices	Period after revealing negative tendencies that is rational for the interference of state government	Measures of the state government's impact on the level of consumer prices
	of the CBOT Wheat index and price of the gold ounce	recommended to interfere in market processes in 1.5 years	– Regulation of the level of maximum salary as a tool to compensate for growth of prices; – Regulation of level via tariffs and taxes defined on regional level.
"closely delayed"	▪ Considerable long-term decrease of the S&P 500 Index. ▪ Considerable long-term decrease of Brent oil price, wheat at Chicago Board of Trade and price of cooper at LME and gold ounce	In 1 year after the period related to identifying negative tendencies of the external environment	Applying methods of direct regulation: – Determining the limit of the one-time increase in prices; – Determining the limited level of prices; – Determining the limit of extra-charges to fixed prices; – Determining the limit of values of the retailing price elements.
"closely lagged"	▪ Considerable long-term ▪ Increase in the index of consumer regions of the closely delayed" group.	When identifying negative tendencies of the global and national economy, it is recommended to interfere in market processes in 1.5 years	
"strongly delayed"	▪ Considerable long-term decrease of the S&P 500 Index, price of cooper at LME and gold ounce.	In 1 year after the period related to identifying negative tendencies of the external environment	

The authors mean "considerable long-term decrease" or "considerable growth" as the change of the indicators values that last for above 3 successive months. Negative fluctuations of the indicators include a decrease – for indicators that are positively estimated (for example, prices for the energy carriers exported by Russia), and an increase – for indicators that are negatively estimated (*for example*, the food imported by Russia). The three months' period is selected in accordance with methodological materials of the Conference Board, whose researchers are globally acknowledged by large companies and political organizations (Savelieva, and Tsalo 2011).

Methods of the regional economy regulation are known to be divided into direct and indirect. Herewith, direct state interference is carried out by using administrative measures based on the state government power, and includes permission, prohibition and constraint. Indirect regulation is carried out by using various measures of the economic policy. Preventive management decisions depend on the power of impact of the global environment change on the regional economy: if the reaction of the managed regional process to the global environment change is defined as "moderate", it is reasonable to apply indirect measures. If the reaction is referred to as "close" or "strong", it is recommended to apply direct methods of regulating the region's economy.

Conclusions

During the research, it was stipulated that due to the differentiation of the level of regions' social and economic development, the reaction of the subjects of the Russian Federation to negative changes of the global economy was not equal. In order to improve the estimation of the regional economy state taking into account its demonstrativeness and lags of the delay of the regional economy reaction to changes of the global environment, the approach that allows to currently or retrospectively analyze the impact of indicators reflecting the dynamics of global markets on regional social and economic processes was developed.

The developed approach (Malliaris 2005) offers the algorithm of forming recommendations on managing regional processes on the basis of analysis of dynamics of global markets, and stipulates the possibility of applying it for certain functional regional markets in terms of the reaction to negative changes of the global markets environment.

The developed approach to classifying regions can be used by the state government to stipulate preventive measures related to stabilizing the regional economy (in particular, in relation to the level) in terms of negative changes of the global markets environment.

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Productivity Growth, Wages and Employment Nexus: Evidence from Nigeria

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Abstract:

The nexus amongst productivity growth, employment and wages have generated debate in literature. Nigeria has witnessed increase in economic growth rate in the last decade which some scholars termed as jobless as unemployment has been growing all along. Therefore, this study joins this debate to investigate the impact of the growth on labour market performance in Nigeria using auto-regressive distributed lag (ARDL). The main advantage of this approach lies in the fact that it can be applied irrespective of whether the variables are I (0) or I (1). The ARDL revealed that using the RGDP (productivity growth), E (employment) and RW (real wages) as dependent variable, there is an existence of long run relationship. Also, it was showed that the output growth does not translate into employment gains both in the short and long-run while the influence of wages is not statistically significant. The implication is that the wages do not adjust to reflect the cost of living both in the short and long-run. The work suggested amongst others that government should aim to integrate employment and wages into the growth system both in the short and long run through targeting variable such as interest rate.

Keywords: productivity growth; wages; employment; Auto-Regressive Distributed Lag (ARDL)

JEL Classification: E23; J01; J64; J21; C21

Introduction

Over the years there had not been consensus among economists, policy makers and government agencies regarding the nexus of productivity growth, wages and employment rate, because the relationship between these variables have not be ascertained widely in the literature with respect to the time frame perspective. Recent statistics provided by the Central Bank of Nigeria (2015) suggest that economic growth was on the increasing trend until the first quarter of 2016, when it was decreasing (trading economics 2016). Despite the fact that the growth rate of the economy was on the increase, the rate of unemployment has been increasing yearly. Thus, the Economic growth has not been inclusive.

Unemployment rate published by Nigeria National Bureau of Statistics (NBS) is 23.9% in 2011 up from 19.7% in 2009. In 2014, the unemployment rate was 6.4% and later increased to 7.5% in the first quarters of 2015 (it can be noted that the sharp drop in the unemployment rate is due to the redefinition of unemployment by the Nigeria Bureau Statistics, NBS). Despite the low unemployment rate between the period of 2014 and 2015, rate of

underemployment stands at 17.9% in 2014 and reduced to 16.6% in the first quarter of 2015. Various scholars in literature have focused on examining the relationship between macroeconomic performance and labour market performance with less emphasis on employment and wages. This paper investigates the relationship between productivity and labour market performance in respect to the time frame perspectives.

1. Literature review

This section focused more on evidence from empirical literature. Oloni, Asaleye, Abiodun and Adeyemi (2017) examine the relationship between inclusive growth and employment in Nigeria using vector autoregressive model. The findings of the scholars showed that agricultural output have negative effects on employment and poverty.

It was suggested by Oloni *et al.* (2017) that Nigerian government should aim at promoting pro-poor growth by investing in the agricultural sector. Tamasauskiene and Stankaityte (2013) evaluated the relationship between wages and labour productivity in Lithuania. Their results show that regional dissimilarities of labour productivity are greater than wages. Correlation analysis was carried out by the scholars and they found that the correlation coefficient between wages and productivity showed that dissimilarities of wages were higher than that of labour productivity.

Strauss and Wohar (2004) show that there is long-run relationship between real wages and productivity at the industrial level for a group of manufacturing industries in the United States over the period 1956 – 1996, and the increases in productivity were associated with a less than unity increase in real wages.

Using Geweke's linear feedback technique, Meghan (2002) estimated the relationship between wages and productivity for several industrialised countries to distinguish between conventional and efficiency wage behaviours'. The results suggested that efficiency wages were being paid in Canada, Italy and the UK. In contrast, Sweden, the US and France exhibited no efficiency wage setting, with very negligible wages and productivity feedback measures. The study also found that economic institutions such as worker unions played an important role on the wage-productivity settings for this group of industrialized countries.

Sobeck (2014) worked on wages and labour productivity across developed economies between the years 1999 to 2013. In his analysis, it was observed that relationship between wages, compensation, labour productivity and the labour income share often depends on how certain variables are measured. His work shows the trends in the relationship between these variables for developed economies between 1999 and 2013. The countries are Poland, Canada, Norway, Sweden, and Spain among others. In his work CPI (consumer price index) and GDP deflator were used. The scholar observed that, in half of developed economies, the relationship between wages, compensation and labour productivity depends on the concept of wages or compensation used and/or the type of deflator. And also in the other half of developed economies, the choice of deflator and concept (wages versus compensation) are irrelevant. In 5 of the 11 countries, wage and compensation growth with either inflator always exceeds that of labour productivity growth, the opposite is observed in 6 countries. Since wages represent a proportion of compensation which varies from country to country, the relationship between wages and labour productivity may not be the same compared to compensation and labour productivity. The scholar also stresses that in most cases, trends in wages (deflated by the GDP deflator) and labour productivity serves as a reasonable proxy for trends in compensation. In other words, trends in wages and labour productivity generally follow trends in the labour income share.

Ho and Yap (2001) analysed both the long-run and short-run dynamics of wage formation in the Malaysian manufacturing industry as a whole and also for 13 selected sub-sectors of the industry using the Engle-Granger co integration test. They found a positive long-run relationship between labour productivity and real wages and a negative relationship between unemployment and real wages, and no significant relationship of union density on real wages. Furthermore, the short-run dynamic model revealed a negative relationship between real wages and labour productivity suggesting that labour productivity gains did not bring about higher wages in the short run. The main drawback of the methodology applied in this study is that the authors used the Engle-Granger two step procedure to test the co integration relationship among four variables, namely, real wages, productivity, unemployment and union density.

Marika and Hector (2009) studied the role of wage-productivity gap in economic activities. It carried out this study using some developed countries and a few developing countries such as France, Germany, Spain, Japan, United States of America (USA) and others. The scholars' find out that the labour share is negatively associated with employment even when the conventional assumption of a unitary long-run elasticity of wages with respect to productivity holds.

Sharpe, Arsenault and Harrison (2008) studied the relationship between labour productivity and real wage growth in Canada and OECD countries and in their work it was observed that the most direct mechanism by which labour productivity affects living standards is through real wages, that is, wages adjusted to reflect the cost of living. Between 1980 and 2005, the median real earnings of Canadians workers stagnated, while labour productivity rose 37%.

Malley and Molana (2007) studied the relationship between output, employment and efficiency wages using the G7 countries to observe this relationship. They constructed a stylized model of the supply side with goods and labour market imperfections to show that an economy can rationally operate at an inefficient, or 'low-effort', state in which the relationship between output and unemployment is positive. Data was used from the G7 countries over 1960-2001 and their findings reveal that only German data strongly favour a persistent negative relationship between the level of output and rate of unemployment. The consequence of this is that circumstances exist in which market imperfections could pose serious obstacles to the smooth working of expansionary and/or stabilization policies and a positive demand shock might have adverse effects on employment.

Andres Bosca, Domenech and Ferri (2009) worked on Job creation, productivity growth and labour market reforms in Spain using Dynamic Stochastic General Equilibrium (DSGE). The DSGE model was used with price rigidities, and a labour market search frictions Mortensen-Pissarides, to assess the effects of the change in the growth model on unemployment. It was assumed by the scholars that the vigorous demand shock that has been mostly responsible for recent low growth of the economy and Spain will be successfully substituted by a productivity shock as the main driver of Spain's economic growth in the future. They analyse the impact of several reforms in the labour market and evaluate their interaction with the new growth model. Their work concludes that changes in the economic structure do not make labour reforms any less necessary, but rather the opposite if employment will be increased.

Deepankar and Duncan (2011) studied the dynamics of output and employment in US economy. Real output is conventionally measured by the scholars as value added corrected for price inflation. The scholars noted that there are some industries in which no independent measure of value added is possible and existing statistics depend on imputing value added to equal income. Indexes of output that exclude these imputations are closely correlated with employment over the whole period, and remain more closely correlated during the current business cycle. The work by the scholars' offer insights into deeper structural changes that have taken place in the US economy over the past few decades, it shows economically significant reduction in the coefficient relating employment growth and output growth over the business cycles since 1985. Some of this change is due to sectoral shifts toward services, but an important part of it shows a reduction in the coefficient or the goods and material value-adding sectors.

Gros (2010) examines the relationship between wages and productivity growth. The scholar findings show long run positive relationship between wages and productivity. Mishel and Shierholz (2011) describe that there is a widening gap between growth rates of productivity and wages. Mishel and Shierholz show that labour compensation growth was particularly low in the private sector, while the growth of average wages was particularly weak for college educated public sector workers.

Harrison (2009) reports a similar divergence between the growth of real earnings and productivity in the US and Canada. From the empirical review of developing countries, the following conclusions are also drawn, in developing countries empirical studies by scholars show that growth in real wage suppresses employment creation (Nir Klein 2012, Fafchamps *et al.* 2008, Gilaninia, Monsef and Mosaddegh 2014, Barletta, Castillo, Pereira, Robert and Suarez 2014).

In conclusion, evidence from both developed and developing economies have shown that the relationship among productivity growth, wages and employment differs across regions and the effects are attributed to different

time perspectives. This study aimed at investigating the relationship among these variables in Nigeria using Auto Regressive Distributed Lag (ARDL). The increases in unemployment rate in Nigeria have motivated the study to examine the nexus among wages, productivity and employment. Unlike, other studies, the inclusion of wages distinguished the study from previous studies in Nigeria. Real wages have been identified in literature as the channel in which living standards can be affected through the productivity growth (Bruce 2002, Sharpe, Arsenult and Harrison 2008). Though some studies in Nigeria have used ARDL to examine economic growth, employment and trade openness among others. For example: Lawal, Nwanji, Asaleye and Ahmed (2016) that examined the nexus of economic growth, financial development and trade openness. Nigerian government have introduced different programmes and policies to improve labour market performance and welfare. Despite all these attempts, unemployment and low income still remain macroeconomic issues for policy makers. So the question is, given the dynamic nature of these programmes and policies, what is the impact of productivity growth on labour market performance? This is main thrust of this study.

2. Theoretical framework and research method

2.1. Theoretical framework

The theoretical framework of this study is built on the Phillips curve. Friedman (1968) stated that if employees bargain over real wages, there could not exist, a long-run trade-off between inflation and unemployment. Algebraically, it starts from the following equation:

$$w_t - P_t^e = w_{t-1} - P_{t-1} + \Delta prod + a - b_1 u_t \quad (1)$$

where: w_t is the wage rate at time t; P_t^e is the equilibrium price at time t; *prod* is the output; u_t is the unemployment rate; w_{t-1} and P_{t-1} are pervious wage rate and prices respectively; a is the inflation rate.

From equation (1), the accelerationist Phillips curve can be written as:

$$\Delta P_t = \Delta P_{t-1} + a - b_1 u_t \quad (2)$$

Inflation rate is the function of unemployment and steady if and only if the unemployment equals to 'Non-accelerating increasing rate of unemployment' (u*). This can be defined as:

$$u^* = \frac{a}{b_1} \quad (3)$$

Nigel and Stefan (2011) established equilibrium in relation to real wages, unemployment, inflation and productivity as follows:

$$(e - p) = b_1 + b_2 u + b_3 prod + b_4 \Delta e \quad (4)$$

where: $(e - p)$ is the real wage; u is unemployment.

The classical theory of the firm justifies the relationship between productivity and real wages. Insider-outsider models of wage bargaining would consider unemployment as non-significant ($b2$=0) except for the case that it was included in the objective function of the labour unions. ($b2$<0), the relationship between inflation and real wages depends on the nature of the wage contracts. Increases in real wages could lead to unemployment growth if firms financed the cost of these increases exclusively. The wages' growth would increase the participation of the population in the labour force thus leading to unemployment growth even with a stable number of jobs. Productivity through 'specialization' affects unemployment through two different mechanisms: an increase in productivity leads to a decrease in the demand for labour for a fixed output level. An increase in unemployment would lead to a

decrease in the aggregate demand; also, an increase in productivity leads to a decrease in the cost of production and lower product prices.

In the equation below, increase in aggregate demand with lower prices could increase employment as stated.

$$u = b_1 + b_2(e - p) + b_3 prod \tag{5}$$

Okun's law specified a positive relationship between employment and output; standard output model also specified a positive relationship between output and the factor inputs (labour and capital); finally, marginal productivity of labour equals to the wage rate.

Equation (5) can be rewritten as follows;

$$E = b_1 + b_2 w + b_3 prod \tag{6}$$

where: E is employment and w is wages, based on okun's law, standard output model and marginal productivity of labour: the three variables of interest (productivity, real wages and employment) can be used as dependent variables.

2.2. Empirical model formulation

The empirical models of the study are derived from the theoretical framework. Model specification begins with a set of structural equations made up of three models of system equations as follows: using employment as dependent variable (Model 1); using wages as dependent variable (Model 2) and using productivity as dependent variable (Model 3). The Auto Regressive Distributed Lag (ARDL) Model using bounds test approach with unrestricted error correction model (UECM) was employed to examine the short and long run relationship between labour market performance (using wages and employment as metrics) and productivity growth in Nigeria. Other variables to be considered in the models included exchange rate, consumer price index and interest rate. The ARDL modelling approach, the unrestricted error correction model for model 1 to 3 is stated in the equations below:

Model 1 Using Employment (E) as dependent Variable

$$\Delta E_{1t} = \alpha_0 + \delta_{11} E_{t-i} + \delta_{12} RGDP_{t-i} + \delta_{13} RW_{t-i} + \delta_{14} XD_{t-i} + \delta_{15} IR_{t-i} + \delta_{16} CPI_{t-i} + \sum_{i=0}^{q} \beta_{1j} \Delta RGDP_{t-j}$$

$$+ \sum_{i=0}^{q} \gamma_{1l} \Delta RW_{t-l} + \sum_{i=0}^{q} M_{1j} \Delta XD_{t-j} + \sum_{i=0}^{q} \psi_{1k} \Delta IR_{t-k} + \sum_{i=0}^{q} \rho_{1n} \Delta CPI_{t-n} + \varepsilon \tag{7}$$

Model 2 Using Wages (RW) as dependent Variable

$$\Delta RW_{1t} = \beta_0 + \delta_{21} RW_{t-i} + \delta_{22} RGDP_{t-i} + \delta_{23} E_{t-i} + \delta_{24} XD_{t-i} + \delta_{25} IR_{t-i} + \delta_{26} CPI_{t-i} + \sum_{i=0}^{q} \beta_{2j} \Delta RGDP_{t-j}$$

$$+ \sum_{i=0}^{q} \gamma_{2l} \Delta E_{t-l} + \sum_{i=0}^{q} M_{2j} \Delta XD_{t-j} + \sum_{i=0}^{q} \psi_{2k} \Delta IR_{t-k} + \sum_{i=0}^{q} \rho_{2n} \Delta CPI_{t-n} + v \tag{8}$$

Model 3 Using Productivity (RGDP) as dependent Variable

$$\Delta RGDP_{1t} = \omega_0 + \delta_{31} RGDP_{t-i} + \delta_{32} E_{t-i} + \delta_{33} RW_{t-i} + \delta_{34} XD_{t-i} + \delta_{35} IR_{t-i} + \delta_{36} CPI_{t-i} + \sum_{i=0}^{q} \beta_{3j} \Delta E_{t-j}$$

$$+ \sum_{i=0}^{q} \gamma_{3l} \Delta RW_{t-l} + \sum_{i=0}^{q} M_{3j} \Delta XD_{t-j} + \sum_{i=0}^{q} \psi_{3k} \Delta IR_{t-k} + \sum_{i=0}^{q} \rho_{3n} \Delta CPI_{t-n} + \mu \tag{9}$$

In equations (7) to (9), the summation terms represented the Error Correction Model (ECM) dynamics and δ_1 are the coefficients of the long run multipliers (Poon 2010). Where α_0, β_0 and ω_0 are constant for Model 1, Model 2 and Model 3 respectively: ε, *v* and μ are the white noise.

The symbol Δ represents the first difference operator and *q* represents the lag length. F statistics will be used to test joint significance of the variable which will be compared with the critical value bounds. The variables are; E represents the level of employment; RGDP represents productivity; RW represents real wages; XD represents real effective exchange rate index; CPI represents consumer price index; IR represents the interest rate.

2.3. Method of research

This section presents the method of research which explains the technique of estimation. This includes the following, unit root test and ARDL (auto-regressive distributed lag).

Unit Root Test

It is necessary to check the Stationarity of the time series of the variables used, without the test of the unit root (if variables are non-stationary), it will give spurious result. The paper employed both the Augmented Dickey Fuller (ADF) and Phillips-perron unit root tests. The equation for the test is as follows:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon \quad (10)$$

where: Y_t is the variable that is been examined; ε is the white noise error term.

The test involving whether δ is equal to zero or not. The number of lags to be used was determined using Akaike Information Criterion (AIC) to avoid serial correlation in the error terms.

Auto-regressive Distributed Lag (ARDL)

The main advantage of this approach lies in the fact that it can be applied irrespective of whether the variables are I (0) or I (1). This approach also allows for the model to take a sufficient number lags to capture the data generating process in a general-to-specific modelling framework. Another advantage of the ARDL is that it is not affected by the pre-testing problem implicit in the standard co-integration techniques (*i.e.* the Johansen maximum likelihood or the Phillips-Hansen semi-parametric fully-modified OLS procedures).

Data Sources and Measurement

The data used are obtained from Central Bank of Nigeria statistical bulletin (2015) and Nigeria National Bureau of Statistics. All variables except the employment rate are obtained from Central Bank of Nigeria statistical bulletin while the employment rate is obtained from National Bureau of statistics. Quarterly data are available for CPI, exchange rate, interest rate and GDP. Wages are also transformed into quarterly date using Quadratic match sum, this approach have also been used in literature by the study of Lowe and Grosvenor (2016) that estimated quarterly indicators of economic activity for the states of Eastern Caribbean Currency Union. GDP and RW are in log form. Data for real wages are not available. Wages is then computed using recurrent expenditure minus transfers, social and community cost.

3. Result and discussion

3.1. Unit Root Test

The Augmented Dickey-Fuller test and the Philips-perron test were conducted for each of the variables in the model in order to test for the stationarity and non-stationarity of the data used.

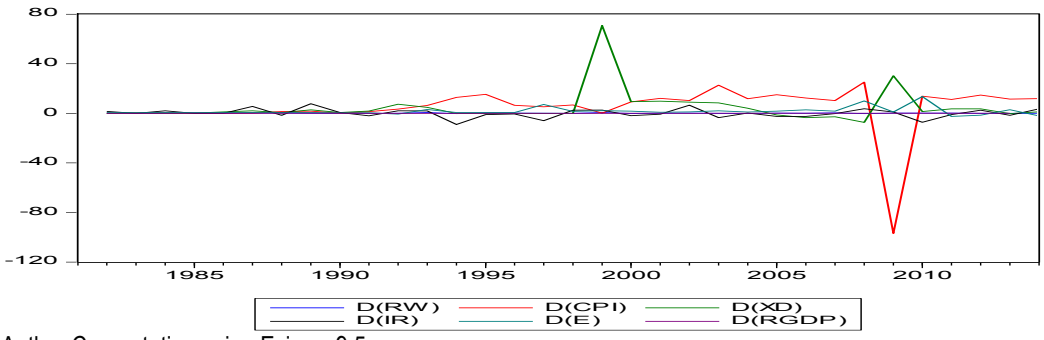
Table 1. Phillips-Perron and Augmented Dickey Fuller Unit Root Result for the variables

Variables	ADF Test Statistics at Levels	ADF Test Statistics at First Differencing	P-P Test Statistics at Levels	P-P Test Statistics at First Differencing	Order of Integration
CPI	-0.641061	-11.65872	-0.555386	-11.72094	I (1)
RGDP	1.168109	-11.34536	1.901508	-11.34534	I (1)
RW	-0.861372	-8.060668	-0.824874	-8.148445	I (1)
XD	-0.097165	-10.46387	-0.145576	-10.40387	I (1)
IR	-3.761159	-11.57059	-3.560311	-12.41976	I (0)
E	0.450155	-12.20939	0.637025	-12.57831	I (1)

Source: Author's computation (2016)

Table 1 above presents the Phillips-Perron and Augmented Dickey Fuller unit result of the variables used. All variables are integrated of order one except variable IR which is stationary at 5% significant level both for Phillips-Perron and Augmented Dickey Fuller Test.

Figure 1. Graph of variables (after first differencing)



Source: Author Computation using Eviews 9.5

The graphical illustration of the variables used after first difference is presented in Figure 1, all variables are integrated of order 1 except interest rate (IR). Though, in the figure above, all the series were integrated of same order.

3.2. Bound Testing for existence of a long-run relationship in Model 1

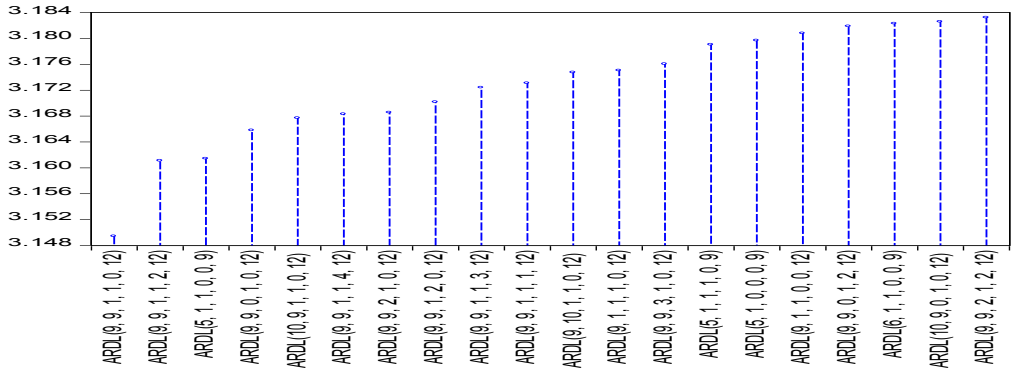
Table 2. ARDL (9, 9, 1, 1, 0, 12) for Model 1

Significance Levels	Critical Value Bounds		F-Statistic Value	K	Hypothesis Testing
	IO Bound	II Bound			
10%	2.08	3.00	5.227570	5	Cointegration exist
5%	2.39	3.38	5.227570	5	Cointegration exist
2.5%	2.70	3.74	5.227570	5	Cointegration exist
1%	3.06	4.15	5.227570	5	Cointegration exist

Source: Author's Computation using Eviews 9.5

Table 2 presents the ARDL bound test, shows the presence of long run relationship between the variables, long run relationship exists when the value of f-statistics is greater than the upper bound. From the table the f-stat is 5.227570, this is greater than the upper bound value which is 3, this means that there is long run relationship between the variables using E as the dependent variable at 10%, 5%, 2.5% and 1% significance level.

Figure 2. Model Selection Criteria for Model 1



Source: Author's computation using Eviews 9.5

Figure 1 presents the 20 model results of the ARDL, from the result, ARDL (9, 9, 2, 1, 2, and 12) has the highest Hannan-Quinn (HQ) Criterion value and ARDL (9, 9, 1, 1, 0, and 12) has the lowest Hannan- Quinn Criterion value. The lower the HQ value of the model, the more appropriate the model. The most appropriate model for this analysis is ARDL (9, 9, 1, 1, 0, and 12).

Table 3. Breusch-Godfrey Serial Correlation LM for Model 1

F-Statistic	0.697410	Prob. F(2,84)	0.5007
Obs* R-Squared	2.025388	Prob. Chi-Square (2)	0.3632

Source: Author's computation using Eviews 9.5

Table 3 presents the Breuch-Godfrey serial correlation LM, from the result the prob. Chi-Square is 0.3632 which is greater than 0.05, therefore the null hypothesis that there are no serial correlations between the variables cannot be rejected. Hence, there is no serial correlation in model 1

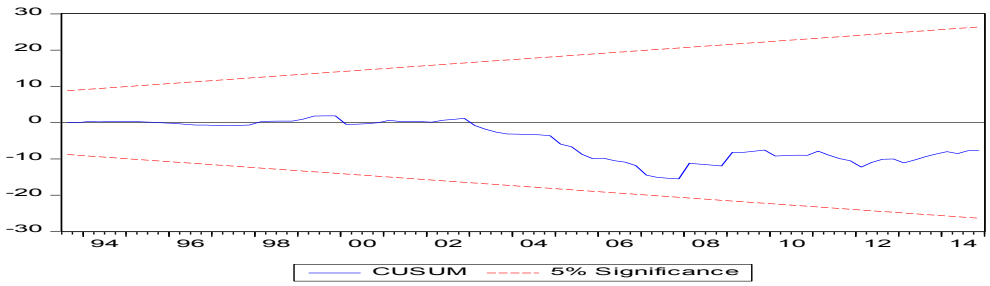
Table 4. Heteroskedasticity Test: ARCH for Model 1

F-Statistic	0.001021	Prob. F(1,121)	0.9746
Obs* R-Squared	0.001038	Prob. Chi-Square (1)	0.9743

Source: Author's computation using Eviews 9.5

Table 4 above presents the Heteroskedasticity, from the result the prob. Chi-Square is 0.9743 which is greater than 0.05, therefore the null hypothesis that there is no Heteroskedasticity between the variables will be cannot be reject.

Figure 3. Stability Test for Model 1



Source: Author's computation using Eviews 9.5

The graph above shows the stability test for Model 1, using CUSUM test, when the line of the variables is in-between the upper and the lower boundaries this means that is stability at 5% level of significance; therefore, the graph above satisfies the above stated condition.

3.3. Bound Testing for existence of a long-run relationship in Model 2

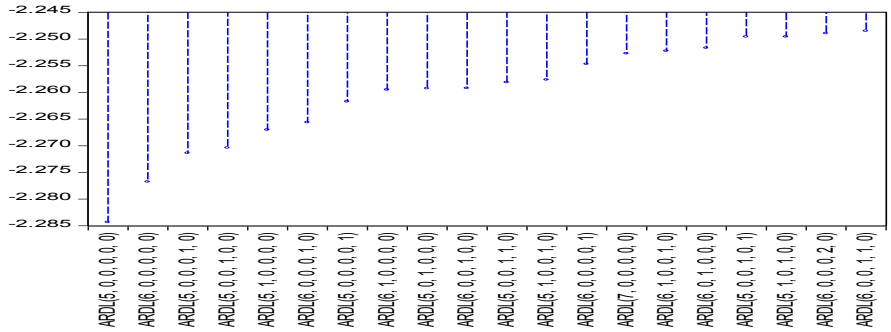
Table 5. F-Statistics for Testing Existence of Long-run in Model 2

Significance	Critical Value Bounds		F-Statistic Value	K	Hypothesis Testing
	IO Bound	II Bound			
10%	2.08	3	3.296199	5	Cointegration exist
5%	2.39	3.38	3.296199	5	Inconclusive
2.5%	2.7	3.74	3.296199	5	Inconclusive
1%	3.06	4.15	3.296199	5	Inconclusive

Source: Author's computation using Eviews 9.5

Table 5 shows the ARDL result using RW as dependent variable, with 5 lags for RW and (0, 0, 0, 0, 0) lag for CPI, RGDP, XD, IR, E respectively. The appropriate Lag length strength was selected by using Hannan-Quinn Criterion. From the table, it can be deduced that Cointegration exists at 10% level of significance. The value of the f-statistic is 3.296199 which is greater than the upper bound value which is 3, this shows that there is long run relationship between the variables using RW as the dependent variable. At 5%, 2.5% and 1%, the result of the inference is inconclusive since the computed F- statistics value is between the lower and upper bound.

Figure. 4 Model Selections for Model 2



Source: Author's computation

Figure 4 presents the 20 model results of the ARDL, from the result, ARDL (5, 0, 0, 0, 0, and 0) has the highest Hannan-Quinn Criterion value and ARDL (6, 0, 0, 1, 1, and 0) has the lowest Hannan-Quinn Criterion value. The most appropriate model for this analysis is ARDL (5, 0, 0, 0, 0, and 0).

Table 6. Breusch-Godfrey Serial Correlation LM for Model 2

F-Statistic	0.725040	Prob. F(2,118)	0.4864
Obs* R-Squared	1.590293	Prob. Chi-Square (2)	0.4515

Source: Author's computation using Eviews 9.5

Table 6 above presents the Breuch-Godfrey serial correlation LM, from the result the prob. Chi-Square is 0.4515 which is greater than 0.05, therefore the null hypothesis that there is no serial correlations between the variables cannot be rejected.

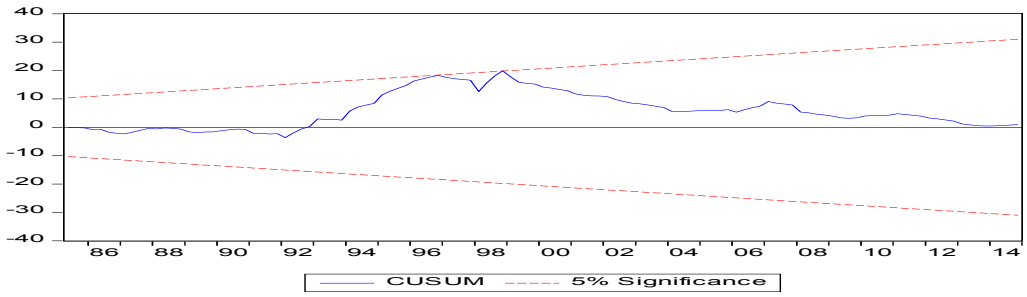
Table 7. Heteroskedasticity Test: ARCH for Model 2

F-Statistic	0.533026	Prob. F(20,90)	0.9448
Obs* R-Squared	11.75553	Prob. Chi-Square (20)	0.9242

Source: Author's Computation

Table 7 above presents the Heteroskedasticity, from the result the prob. Chi-Square is 0.9242 which is greater than 0.05, therefore the null hypothesis that there is no Heteroskedasticity between the variables cannot be rejected.

Figure 5. Stability Test for Model 2



Source: Author's computation using Eviews 9.5

From the graph above, it can be shown that using CUSUM test, the line is in-between the upper and the lower boundaries this means that there is stability at 5% level of significance; therefore, the graph above satisfies the above stated condition, therefore it is significant at 5% level of significance.

3.4. Bound Testing for existence of a long-run relationship in Model 3

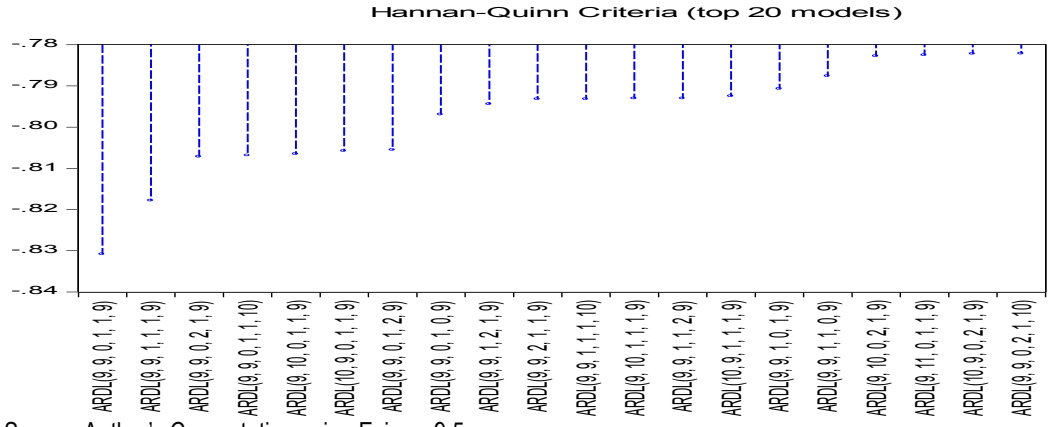
Table 8. ARDL Result (ARDL 9, 9, 0, 1, 1, 9) for Model 3

Significance	Critical Value Bounds		F-Statistic Value	K	Hypothesis Testing
	IO Bound	II Bound			
10%	2.08	3	3.078088	5	Cointegration exist
5%	2.39	3.38	3.078088	5	Inconclusive
2.5%	2.7	3.74	3.078088	5	Inconclusive
1%	3.06	4.15	3.078088	5	Inconclusive

Source: Author's computation using Eviews 9.5

Table 8 shows the ARDL result using RGDP as dependent variable, with 9 lags for RGDP and 9, 0, 1, 1, 9 lags for CPI, RW, XD, IR, and E respectively. The appropriate Lag length strength was selected by using Hannan-Quinn Criterion. The results of Model 2 and Model 3 are similar. Cointegration exists at 10% level of significance. The value of the f-statistics is 3.078088, greater than the upper bound value which is 3, this show that there is long run relationship between the variables using RGDP as the dependent variable at 10% level of significance. At 5%, 2.5% and 1%, the result of the inference is inconclusive since the computed F- statistics value is between the lower and upper bound.

Figure 6. Model Selection Summary Result for Model 3



Source: Author's Computation using Eviews 9.5

Figure 5 above presents the 20 model results of the ARDL, from the result, ARDL (9, 9, 0, 2, 1, and 10) has the highest Hannan-Quinn Criterion value and ARDL (9, 9, 0, 1, 1, and 9) has the lowest Hannan-Quinn Criterion value. The most appropriate model for this analysis is ARDL (9, 9, 0, 1, 1, and 9).

Table 9. Breusch-Godfrey Serial Correlation LM for Model 3

F-Statistic	0.046611	Prob. F(2,90)	0.9545
Obs* R-Squared	0.131411	Prob. Chi-Square (2)	0.9364

Source: Author's Computation using Eviews 9.5

Table 9 above presents the Breuch-Godfrey serial correlation LM, from the result the prob. Chi-Square is 0.9364 which is greater than 0.05, therefore, there is no serial correlations between the variables.

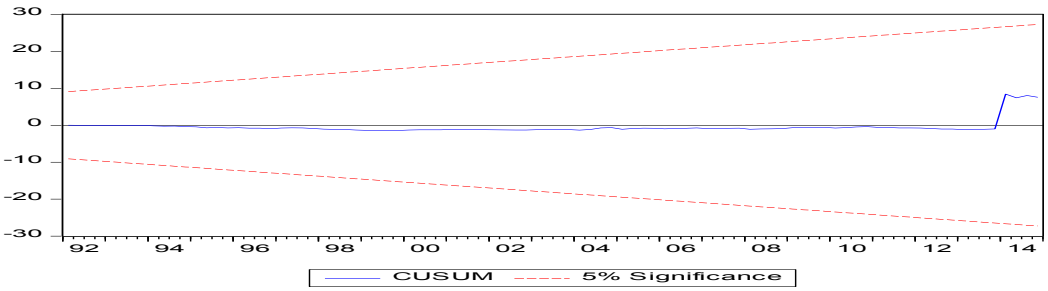
Table 10. Heteroskedasticity Test: ARCH for Model 3

F-Statistic	0.163765	Prob. F(1,124)	0.6864
Obs* R-Squared	0.166187	Prob. Chi-Square (1)	0.6835

Source: Author's Computation using Eviews 9.5

Table 10 above presents the Heteroskedasticity, from the result the prob. Chi-Square is 0.6835 which is greater than 0.05, therefore, there is no ARCH effect among the variables.

Figure 7. Stability test for Model 3



Source: Author's computation using Eviews 9.5

From the graph above, the CUSUM line is in-between the upper and the lower boundaries this means that the model is stable at 5% level of significance.

3.5. Estimated Long-run and Short-run using the ARDL for Model 1, 2 and 3

The bound test results presented above show the existence of long-run relationship in the model examined, since the cointegrating vector is identified. The ARDL model of the cointegrating vector is reparameterized into Error Correction Model (ECM). With the specification of ECM by this study, both the long-run and short-run information are incorporated. The result is presented below (in Table 11). The reparameterized result shows the short-run dynamics and the long-run relationship of the variables for Model 1, 2 and 3.

Table 11. Estimated Long-run and Short-run Parameters

Regressors	Dependent Variable (Coefficients and Probability Value)					
	Model 1 - E		Model 2 - RW		Model 3 - RGDP	
	LR	SR	LR	SR	LR	SR
E			0.0000401 (0.6995)	-0.001134 (0.7609)	-0.079891*** (0.0000)	-0.080471*** (0.0000)
RGDP	-4.078490*** (0.0000)	-4.057743*** (0.0000)	-0.002139 (0.9153)	-0.005306 (0.8927)		
IR	0.080355*** (0.0413)	0.081519 (0.0208)	0.002950** (0.0811)	-0.000500 (0.8621)	0.014292*** (0.0073)	0.013689*** (0.0046)

Regressors	Dependent Variable (Coefficients and Probability Value)					
	Model 1 - E		Model 2 - RW		Model 3 - RGDP	
	LR	SR	LR	SR	LR	SR
XD	0.019646 (0.2535)	0.021525 (0.1827)	1.74E-05 (0.9600)	0.001060 (0.3596)	0.005063*** (0.0285)	0.004346*** (0.0499)
RW	0.640503 (0.1562)	0.260235 (0.8009)			-0.41572 (0.4486)	0.092628 (0.4946)
CPI	0.060784*** (0.0000)	0.060309*** (0.0000)	0.000245 (0.4654)	-0.000220 (0.7449)	0.009196*** (0.00000)	0.009265*** (0.0000)
ECM		-0.030798*** (0.0000)		-0.032492*** (0.0000)		0.251623*** (0.0000)
LR represent Long-run: SR represent Short-run * indicates significance at 10%; ** indicates significance at 5%; *** indicates significance at 1%						

Source: Author's computation using Eviews 9.5
*Note: Probability value are presented in angle brackets

From Table 11 above, in Model 1, the ECM with the value of -0.030798 and a probability value of less than 5%. The coefficient is negative and significant. The ECM shows the speed of adjustment, this implies the existence of convergence in long-term equilibrium. Also, both in the short and long run, there are negative relationships between employment and output. This result contradicts the standard growth theory, Okun's law and the theoretical framework of this study. The implication of the result is that the output gains have not improved employment performance in Nigeria. The growth otherwise can be referred to as jobless growth. This result is in line with the study of Oloni *et al.* (2017) that examined the relationship between Inclusive growth and employment in Nigeria. Wages in short and long-run is not significant; contradicts the work of Andrew *et al.* (2008) that examined the relationship between wages and productivity in Canada and OECD countries.

In Model 2, The ECM value is -0.032492 and a probability value less than 5%. From the result, the coefficient is negative and significant. From this, it can be depicted that there is an adjustment from short run to the long run equilibrium among the variables (RGDP, CPI, RW, XD, IR and E) using RW as the dependent variable. This result was not in line with some of the studies in literature, for example: Gros (2010) shows there is no long-run relationship between wages and productivity; Mishael and Shierbolz (2011) show that there is divergence between wages and productivity in US and Canada. RGDP and E are not significant in Model 2.

In Model 3, ECM value is 0.251623 and a probability value of less than 5%. From the result, the coefficient is positive and significant; this positive coefficient indicates divergence in the long-run using RGDP as the dependent variable. There is a negative relationship between RGDP and E (employment) both in the short and Long-run and no significant relationship between wages both in the short and long run. This result contradicts the result of Ho and Yap (2001) that stressed a positive relationship between output and wages in the long-run and negative relationship in the short-run. Though, using wages as dependent variable, it was observed that there is existence of long-run relationship which was in line with the study of Strauss and Wohar (2004) that examined the long-run relationship between real wages and productivity at industrial level for a group of manufacturing companies in United State. In Model 3, the economic implication of the result is that minimal or no impact has been observed in promoting the wages that adjust to reflect the cost of living, since the channel in which productivity affect living standard is through real wages.

Conclusion

This study examines the relationship between productivity growth (RGDP) and labour market performance in Nigeria. The metrics used for labour market performance are wages (RW) and employment (E). Empirical studies have shown that impact of productivity on wages and employment varies both in developed and developing economies. This study uses autoregressive distributed lag (ARDL) as analytical tool. The augmented dickey-fuller and Philips-Perron technique were used in testing the unit root properties of the series. The unit root tests show that all the series used are non-stationary at 5% level of significance except the interest rate. However, the non-

stationary attained stationary after the first difference. The study specified the Error Correction Model (ECM) to capture both the short-run and long-run dynamics; the associated ECM model takes a sufficient number of lags to capture the data generating process to the specified framework using Hannan-Quinn Criterion. This is necessary to prevent Gaussian error in the ARDL model.

The results from the auto-regressive distributed lag (ARDL) revealed that using the RGDP, E and RW as dependent variable, there is an existence of long run relationship between the variables. Convergence in the long-run equilibrium using E and RW as dependent variables was noted while divergence was noted using RGDP as dependent variable. The sign of relationship between output and employment is negative and vice-versa both in the short and long-run. From the ARDL results the influence of the value of wages is not statistically significant both in the short run and long run. It has been observed in literature that the most direct mechanism by which productivity affects living standard is through real wages. Series of tests was also done to ensure the stability of the data and models respectively. The economic implication of the result is that minimal or no impact has been observed in promoting the wages in adjusting to reflect the cost of living and also, the output growth does not translate into employment gains both in the short and long run.

Based on the findings, it can be concluded that Nigerian government should focus on long term goals especially in trying to promote employment opportunities and increasing level of income. The following suggestions are given: the government should focus on long run policies for employment and wages and also ensure consistency between the policies in order to avoid the complication that occurs as a result of inconsistency in policy making. So there might be need for the government to develop an institutional framework that will ensure this; Government should create appropriate enabling environment to promote a sustained effective aggregate demand in order to maintain the required level of domestic production through targeting variable such as interest rate. Government should aim to integrate employment and wages into the growth system both in the short and long run through their policies; the Government should also be able to maintain competitive and favourable real exchange and interest. Finally, Government should deliberately promote labour- intensive method of production in order to generate more employment particularly in the real sector.

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Economic Growth Quality of Metallurgical Industry in Russia

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Abstract:

The author researched the empirical assessment of sustainable economic growth of the metallurgical industry in Russia. We systemized the main approaches to the sustainable growth assessment. We offered the evaluation algorithm, based on the objective quantitative statistical data. The advantages of the method are availability of indicators, simplicity and complexity of assessment, the implementation possibility of these tools for any industries and complexes. The results of the research reveal the low quality (unsustainability) of the economic growth of the Russian metallurgical complex, which is due to both macroeconomic shocks and the multi-vector strategies of the industry. We found out that the Russian metallurgy is currently in the situation of 'catching up growth'.

Keywords: sustainable development; growth quality; industrial management; metallurgical industry; institutional environment

JEL Classification: O11; O47; L61

Introduction

The achievement of economic growth, its determinant and patterns is one of the key but poorly studied problems of market development and its individual subjects. Most economic schools focus on macroeconomic growth. But we can interpret growth as "the process of aggregating individual decisions and results at the micro level" (Sandler 2006, 324). At the same time, the strategies and decisions, made at the micro level, derive from the parameters of the institutional environment, innovative externalities and many other factors of the external environment Khotinskaya (2015, 12) Global and regional economic changes determine the need to transform the mechanisms for the sustainable development of industries, shift the goals of companies from maximizing profits to finding strategies, oriented toward their continued existence on the market.

The object of the research is the metallurgical complex, including the industries of ferrous and nonferrous metallurgy. The importance of the industry for the Russian and world economy is impossible to overestimate. The share of metallurgy in the country's industrial production is about 15% (Federal State Statistics Service). Metallurgical enterprises consume 28% of the world's electricity, more than 5% of natural gas and their share in freight rail traffic is 23% (Steel Association).

We chose the object on purpose. The reforming experience of the industry is great interest. On the one hand, the activities specificity of enterprises of traditional heavy industries significantly complicates the use of flexible, dynamic business models, *i.e.*, it limits the choice of sources for sustainable growth. The sustainable development of such enterprises is usually due to their resources, mainly, production technologies and physical assets.

On the other hand, in 2014 the adoption of Law No. 488 "On Industrial Policy" gave a powerful impetus to the change in the vector of Russian industrial policy. The need for a new industrialization, which is a synchronous process for the creation of new high-tech sectors of the economy, an effective innovation upgrade of its traditional sectors, with agreed qualitative and consistent changes between the technical, economic and socio-institutional spheres (Romanova 2014, 46). This fact also predetermines the relevance of the study.

The modern Russian metallurgy formed itself under the influence of three major processes. (Budanov 2015) Firstly, in the 1990s, Russia exported a great number of domestic resources. Secondly, in the 2000s, metallurgy underwent significant institutional changes. In order to reduce transaction costs, large management companies started. They now comprise almost 100% production of aluminum, titanium, nickel and about 80% production of cast iron and steel in the Russian Federation. After that, domestic integrated companies attempted to create

transnational corporations, optimizing the production and supply of metals to foreign markets. Thirdly, in the late 2000s there was an attempt to strengthen inter-branch relations on the supply of metals inside the country. Pipe companies achieved the greatest success because they focused on the needs of the fuel and energy sector, as well as manufacturers of bulk types of metal products used in construction.

These steps, according to Budanov (2015, 108) allowed the Russian metallurgy to adapt successfully to the conditions of the global market and the specifics of the domestic economy. In the 2000s, it was able to restore pre-crisis production volumes of the 1980s, to play a significant role in the world market.

But the effectiveness of the industry significantly worsened in the 2010s. This is due to financial difficulties and production technological level of some large companies, as well as with a high attraction of imported materials and components of the domestic metal turnover system. At the same time, the economic departments and the non-governmental mass media report on the successful and sustainable growth of metallurgy. The finding out of the actual state of the industry, sources and quality (sustainability) of its economic growth are the tasks of this research.

1. Research background

The foundations of the concept of sustained development are in the works of Lindahl (1938) and Hicks (1939) The term "sustainable development", introduced in the International Commission on the Environment and Development of Brundtland in 1987, is more relevant to the national economy, but they have recently applied it to microeconomic systems. Synthesizing the basic elements of all previous paradigms of economic growth, this concept presupposes the need to achieve three types of goals: economic (efficiency and sustainability of growth); social (the promotion of investment in human capital, the preservation of cultural traditions and the achievement of the rights equality for different population classes to participate in decision-making) and environmental (the different generations equality for meeting their needs by the diversity of environmental objects).

Despite the fact that in the proposed research, we subject the analysis to the entire industry, it seems appropriate to project the available approaches to assessing the quality of economic growth of an individual enterprise. According to Limitovsky (2010, 36), we can argue that we can achieve the sustainable economic growth by balancing financial results, the capital of the enterprise and the resources required for its activities.

The task of assessing the sustainable growth is a poly-criterion and closely related to issues of effectiveness, performance and efficiency of activities. Oiner divides all the diversity of performance indicators into two groups:

- efficiency (efficiency – "to do things right") are internal standards and indicators of resource use per unit of output;
- effectiveness (effectiveness – "to do right things") is achievement of a long homeostasis of the company in interaction with the external environment, *i.e.,* indicators of adaptability, sustainability of results, abilities to develop. (Oiner 2012, 17-21)

An essential condition for sustainable growth is the balance of individual indicators of its activities. The achievement of efficiency and effectiveness creates performance, *i.e*., the fulfillment of plans, goals, standards and turning them into certain results.

Corporate growth abroad is the growth in business value, while in Russia an absolute dominant is the growth in sales. In addition, a lot of Russian enterprises have extensive growth, *i.e.,* the expansion of the activity scale along with a declining effectiveness in the use of advanced capital.

According to the study by Davidson and co-authors (2005), enterprises, which excessive focus is on growth, are not characterized by the indicators of high business profitability. Loss of effectiveness can also take place as a result of "growth diseases", due to the excessive orientation to sales and the lack of management accounting. Growth, understood as an increase in accounting profit, can turn into a trap for an enterprise. (Ivashkovskaya 2004) Growth, focused on the exploitation of assets, is also much more primitive than a quality benchmark.

The main factors that determine the positive or negative dynamics of growth are:

- sectoral factors: specifics of the industry and geography of the enterprise's presence (Davidsson, Kirchoff, Hatemi, Gustavsson 2002, Kuzmin, Guseva 2016); financial restrictions imposed by the industry (government subsidies, the possibility of obtaining loans) and access to foreign markets (Almus, Nerlinger

1999); size and concentration of resources in the industry (Acs and Audretch 1990); the level of enterprises' integration in the industry (Acs and Audretch 1990); uncertainty of the economic systems (Kuzmin 2015, Kuzmin 2017);

- in-house characteristics: the age and size of the enterprise (Davidsson, Kirchoff, Hatemi, Gustavsson 2002); organizational and legal form (Beccetti and Trovato 2002); management style (Littunen and Virtanen 2005) and some others.

Economic literature knows a lot of approaches to assessing the sustainable growth, among which the most significant ones are the concept of Penrose (1959), Higgins model (1977), the achievable growth model of J. Van Horn (1998), the matrixes of BCG, Ivashkovskaya (2004) and Vigheri, Smith and Bagai (2009). To measure the growth quality of an enterprise, they often apply profitability indicators, including the added profitability index, based on the concept of economic added value by Stewart (2013). The added profitability is the excess to actual profitability of investments over its minimum admissible level, which is the weighted average cost of the industry's capital.

2. Materials and methods

The empirical assessment of the prospects for the growth of all metallurgy is a priori somewhat simplified.

Firstly, this is due to the fact that a number of resources (in particular, social or organizational capital) cannot be the aggregate capital of the industry. Defining industry indicators, it is more important to determine the change in the volume of two resources, which are labor and capital. As an indicator of the effectiveness of resource use, we can use total factor productivity, which is the ratio of output to the indicator of the use volume of production factors (OECD Productivity Manual 2001). The dynamics of factor productivity may indicate a degree of growth sustainability of an enterprise or the industry in general. In the work of Avdasheva (2003, 55) the modified Tornquist index formula allows to characterize the change in the effectiveness of resource use:

$$\Delta TFP = \Delta Q - \Delta F, \quad (1)$$

$$\Delta Q = \ln\left[\frac{Qt}{Qt-1}\right] \quad (2)$$

$$\Delta F = \ln\left[\frac{Ft}{Ft-1}\right] = \frac{1}{2}\sum_i (a_{it} + a_{i,t-1}) \ln\left[\frac{x_{it}}{xi_{,t-1}}\right], a_{it} = \frac{w_{it}x_{it}}{\sum_j w_{jt}x_{jt}}, \quad (3)$$

where: Qt is release of the enterprise at time t in value terms, adjusted for inflation; X_{it} is the amount of use of the resource i acquired at the price wit at time t; a_{it} is share of the cost of resources in the costs of the firm.

Secondly, one of the research tasks is the development of a methodology, based on available quantitative statistical data.

Table 1. Algorithm for the empirical assessment of sustainable growth in metallurgy

№	The task of the stage	Analysis tools
Stage 1	Assessment of the general state and trends of the metallurgical complex development in Russian economy and the world economy	Indicators of the general condition and structure of the assortment of produced products in value and in physical terms
Stage 2	Assessment of industry-wide indicators of the efficiency of the metallurgical complex	Indicators for assessing the efficiency of use and the status of the resources of the industry
Stage 3	Assessment of industry-wide performance indicators of the metallurgical complex	Indicators of financial performance and various types of profitability
Stage 4	Assessment of sustainable growth of the metallurgical complex	1) Calculation of the sustainability of industry growth by the "golden rule of the economy" method; 2) Assessment of the dynamic effectiveness of the industry; 3) Calculation of the Tornquist index.

№	The task of the stage	Analysis tools
Stage 5	Interpretation of results	Place determination of metallurgical enterprises in the Ivashkovskaya matrix

We introduce the requirements of hierarchy, complexity, objectivity, transparency to the system of tools for assessing the sustainability of the industry growth (Table 1).

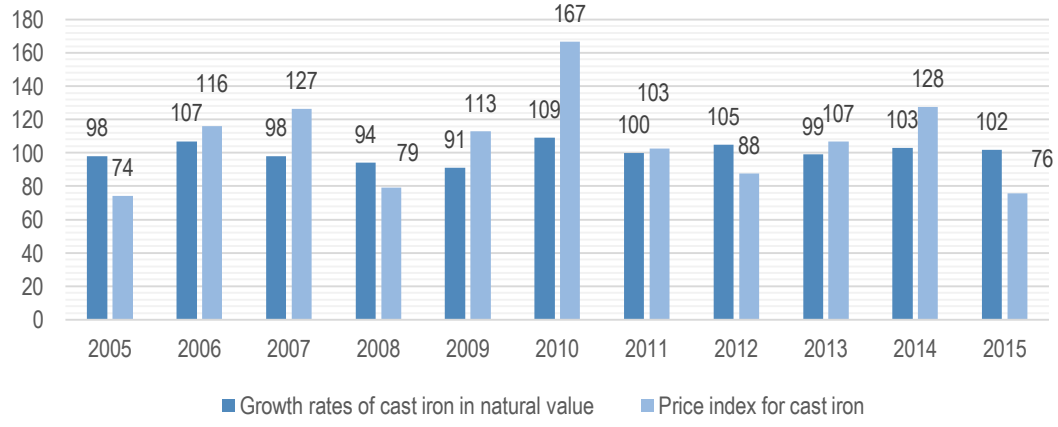
3. Results

The change in the institutional context and macroeconomic conditions in the newest economic history of Russia caused a number of major changes in the structure and basic indicators of the metallurgy. In the beginning of 2016, about a quarter of the industry's output was made of ferrous metallurgy, and more than 75% was made of non-ferrous metallurgy (including 17% aluminum, 19% copper, and 17% zinc).

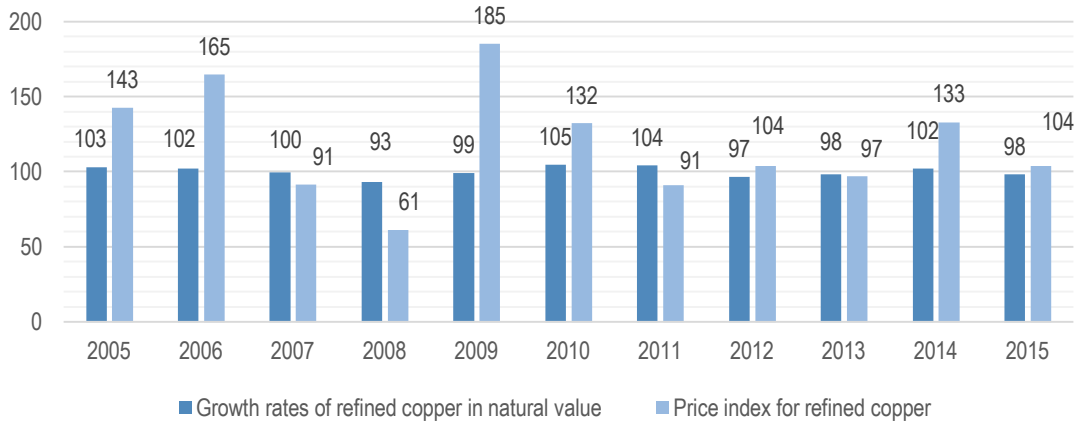
The structure of exports differs significantly from the overall structure of the Russian metallurgy. Ferrous metals (61%) and aluminum (16%) are mainly in demand on the world market. At the same time, in recent years there has been a decrease in demand for cast iron from the main consumers of Russian products (USA), which is explained by the dumping policy of China.

The structure of output in various industrial markets of ferrous and non-ferrous metallurgy is not heterogeneous. However, in general, there is a trend towards an increase in the volume of production. At the same time, there is a significant difference in the dynamics of natural and cost indicators on the market (Figure 1). The results of the analysis show the weak correlation between the tonnage values of production and macroeconomic shocks. Such a low production flexibility, the lack of rapid mechanisms for strategic adaptation of metallurgy enterprises can be due to the long-term portfolio of contracts, the high threshold of the minimum effective output in the industry, the use “non-stop” human capital.

Figure 1. Dynamic ratio of production growth rates cost and physical indicators for two types (iron and copper) of metallurgical products, 2005-2015



a) Iron indicators



b) Copper indicators

The key indicators dynamics of the metallurgy development (Table 2) does not allow making unambiguous conclusions as well. On the one hand, in the industry there is a double increase in the number of operating organizations, the volume of shipped goods also demonstrates double growth. At the same time, employment in metallurgy for the same period decreased by 24.1%. With about triple revenue growth, the deflated earnings growth is no more than 50%.

Table 2. Dynamics of the main economic indicators of the metallurgy development in the Russian Federation 2005-2015

Indicators	2005	2007	2009	2011	2013	2015
Share of industry in GDP,%	8.39	8.53	5.95	6.42	5.43	6,.43
Share of industry in industrial production,%	29.91	32.41	24.73	28.44	24.11	27.69
Number of organizations, thousand pieces	16.60	18.50	23.60	25.80	30.00	31.20
Revenues, bln. rub.	1,813.00	2,835.00	2,308.00	3,834.00	3,856.00	5,353.00
Volume of goods shipped, bln. rub.	1,903.00	2825.00	2,260.00	4,045.00	3,955.00	5,388.00
Production index, in % to the previous year	107.00	104,50	85,30	107.00	100.00	93,50
Average annual number of employees, thousand	1,220.00	1154.00	998.00	998.00	991.00	926.00
The index of changes in employed in industry, % to the previous year	102.40	98.50	88.30	102.90	99.60	97.10
Balanced financial result, bln. rub.	337.00	719.00	207.00	289.00	148.00	506.00
Price Index	105.40	105.00	104.10	104.70	97.20	112.00

Source: Federal State Statistics Service of the Russian Federation: Industry of Russia 2008, Federal State Statistics Service of the Russian Federation: Industry of Russia 2010, Federal State Statistics Service of the Russian Federation: Industrial production in Russia 2016.

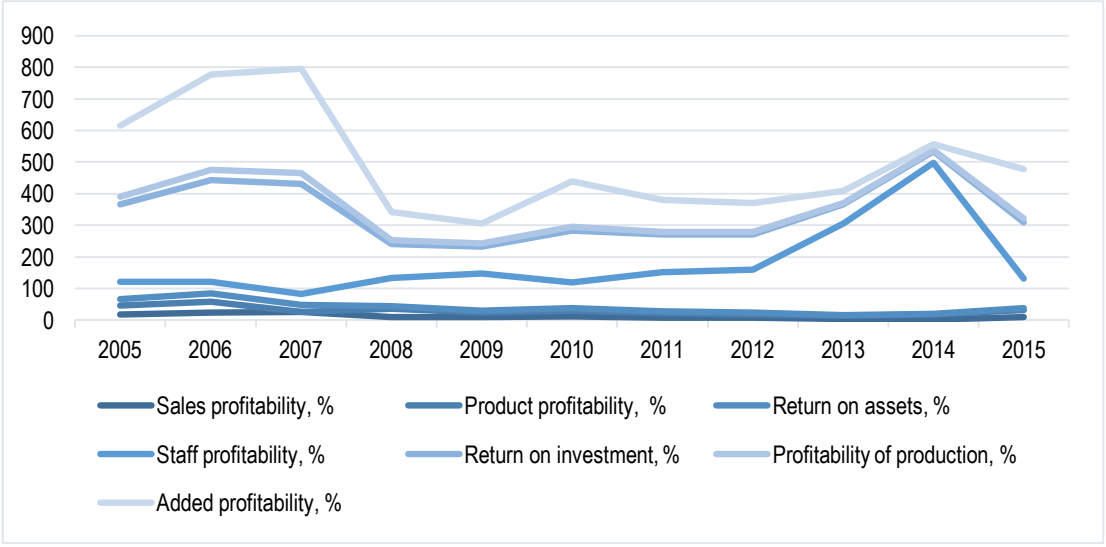
The next step is the analysis of economic efficiency (effectiveness of resource use). This analysis there is in Appendix 1. The capacity utilization rate is the main indicator of the production development in developed countries as and it is in connection with the dynamics of the technological progress level. (Berndt and Morrison 1981, Belton and Cebula 2000, Brown and Earle 2000) One of the reasons for the low effectiveness of traditional industries is the technological and technical backlog. The screening results of material, financial resources and human capital allow us to make non-trivial scientific conclusions:

- Despite the growth in the value of fixed assets, the indicators of their use in the dynamics dramatically worsened. The renewal coefficient is 10-20% less than the specific weight of completely depreciated fixed assets. At the same time, the retirement ratio of fixed assets is on average 10 times less than the indicator of the retirement of completely depreciated fixed assets. This means that the equipment remains in operation even in case of its complete depreciation.

- The use of production capacity in metallurgy during 2005-2015 remains low. This fact explains the constant volumes of production, even during periods of global prices fall for metals.
- Along with the indicated trends in the use of fixed assets, the indicators of the effectiveness of their use are paradoxically high. This fact reveals that even with obsolete equipment, enterprises are financially efficient which significantly reduces their incentives for investments.
- The results of fixed assets use in general correlate with the dynamics of assets turnover. The industry demonstrates a decrease in the rate of improvement in 10 years on average by 35%. The financial analysis attests worsening indicators of liquidity and assets structure of enterprises of the Russian metallurgy.
- Along with the indicated trends in the use of material and financial resources, the assessment results of the effectiveness of the use of human capital seem "surprising". During the considered period, labor productivity increased almost 4 times. This growth is most likely due to a wage increase of less than 3 times (including deflation) and a reduction in the number of employees by almost a quarter. We should note that metallurgical enterprises actively use all possible types of adjustments in the labor market (quantitative, price, temporary).

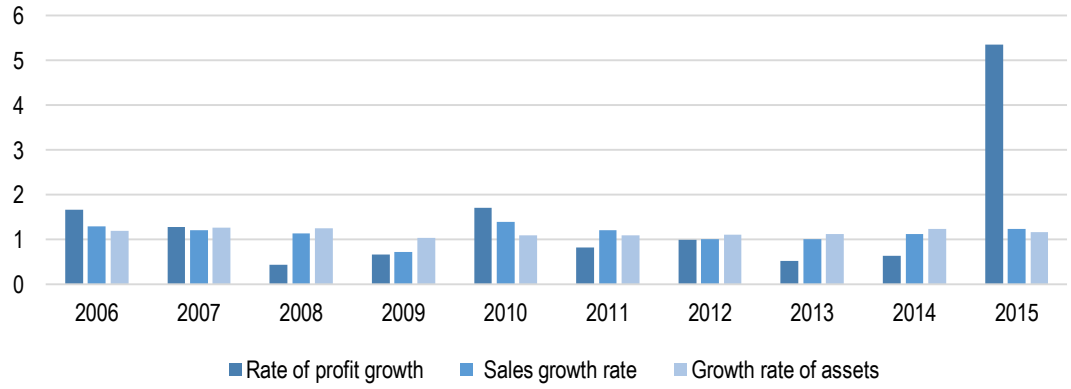
To sum up, we can state that for the ten years studied, the Russian metallurgy demonstrates the efficiency of all types of resources. At the same time, the industry's effectiveness indicators, based on the calculation of various types of profitability (Figure 2), are practically unrelated to the investment in resources and the efficiency coefficient in general. They directly depend on macroeconomic shocks, crisis phenomena, and, as a consequence, price level for metals.

Figure 2. Dynamics of profitability indicators of the metallurgical complex 2005-2015



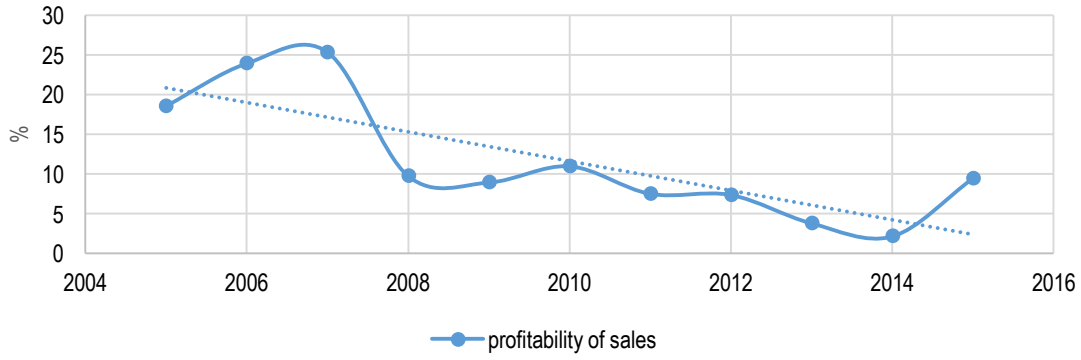
The fourth stage of the methodology summarizes the analysis results. It identifies the prospects for sustainable development of metallurgy. One of the basic methods is the "golden rule of the economy", the essence of which is to compare the growth rates of profits, sales and assets. (Figure 3) Such an assessment shows the volatile situation of the industry in most periods. High quality of metallurgy growth took place only in 2006, 2010 and 2015. These are the periods of general economic recovery and post-crisis recovery.

Figure 3. Assessment of the sustainability of growth in the metallurgical industry by the method of "golden rule of the economy" 2006-2015

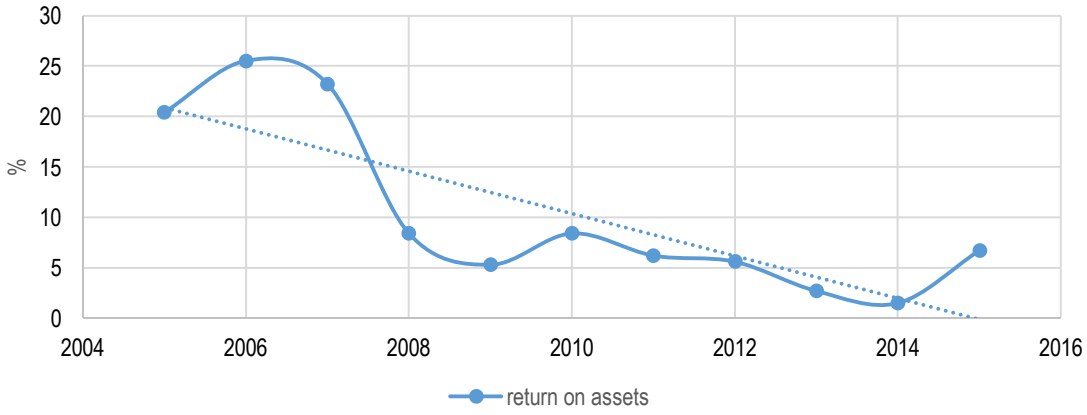


We can make the similar conclusions using the dynamic analysis method of various types of average industry profitability (Figure 4). Trends in the growth rates of profitability of sales and return on assets show a sharp decline in the effectiveness of investments in resources and returns on capital in general.

Figure 4. Trends in the growth rate of industry-average values of return on sales (a) and return on assets (b) 2005-2015



a) Return on sales



b) Return on assets

The final step in assessing the sustainable growth is the calculation of the Tornquist index (Appendix 2). We need to consider several circumstances. Firstly, during the period under review, we see significant fluctuations in the change in the overall factor productivity, which indicates the low quality (sustainability) of the economic growth of metallurgy. Secondly, the positive values of the Tornquist index (that is, the increase in the effectiveness of resource use) in most cases coincide with the sustainability estimates calculated by other methods. Thirdly, the metallurgy achieved the greatest growth in factor productivity in 2014, which is due to the growth of the financial results of the industry while reducing the real (deflated) costs of resources.

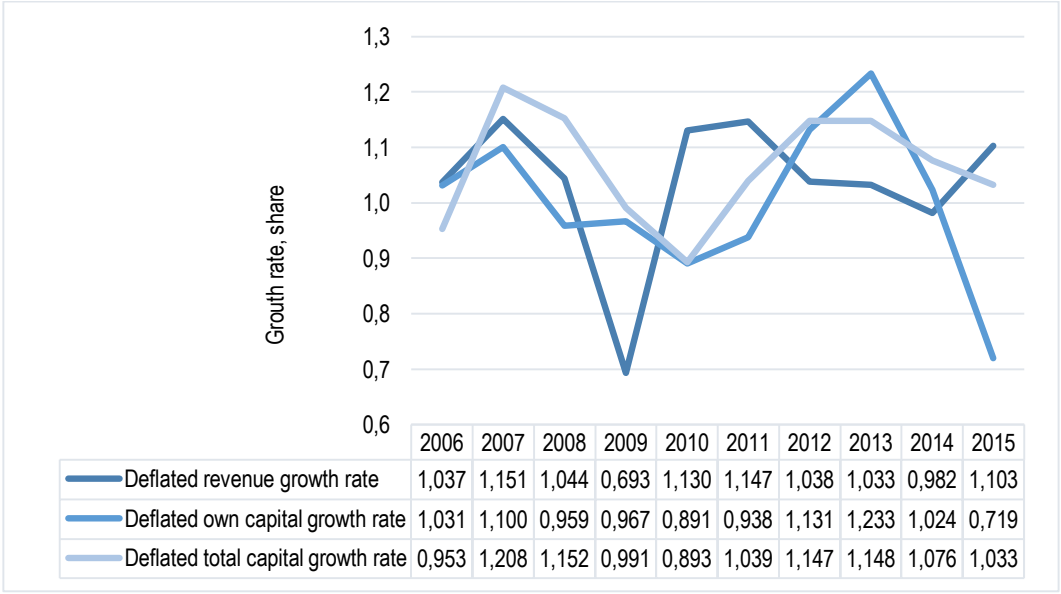
4. Discussion

The obtained results of the analysis do not allow making unambiguous conclusions. We can state that the metallurgical industry has a trend of short-term "right" growth, based on a balanced combination of investments in resources and returns from them.

One of the recognized tools for analyzing the growth quality in the Russian economic community is Ivashkovskaya's matrix "the average growth rate of capitalization of total capital" and "the average growth rate of sales over several years for competing companies within the industry or one enterprise over a long period". (Ivashkovskaya 2004) The data are the average geometric value over a certain period. All data on the industry are compared with average general economic data.

We modify the matrix and determine not only the value of the total, but also of own capital. It is necessary, because the preliminary screening of financial ratios indicates a poor position of metallurgical companies. Dynamic analysis of the growth rates of revenue, the value of own and total capital (Figure 5) presents the different vectors of the industry in different years.

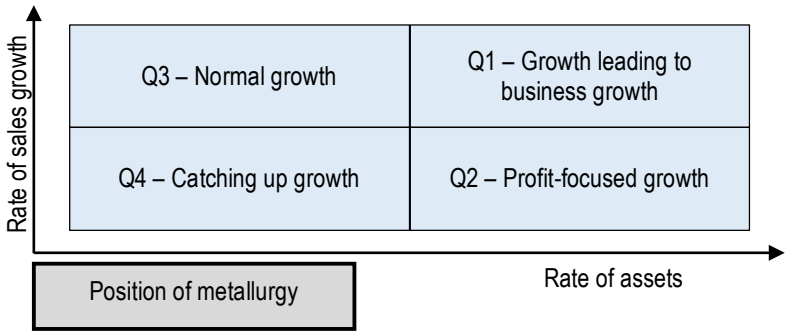
Figure 5. Dynamics of the growth rates of revenue and the cost of capital in metallurgy in 2006-2015



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Deflated revenue growth rate	1,037	1,151	1,044	0,693	1,130	1,147	1,038	1,033	0,982	1,103
Deflated own capital growth rate	1,031	1,100	0,959	0,967	0,891	0,938	1,131	1,233	1,024	0,719
Deflated total capital growth rate	0,953	1,208	1,152	0,991	0,893	1,039	1,147	1,148	1,076	1,033

Calculation of the values of the geometric mean shows that in 2006-2015 the revenue growth rate was 1.026, the growth rate of own capital was 0.99, and the growth rate of total capital was 1.06. In Russian economy the revenue growth rate was 1,136, the growth rate of own capital was 1.17, and the growth rate of total capital was 1.12. According to the matrix (Figure 6), the metallurgical industry is located in cell Q4.

Figure 6. The place of metallurgy in the matrix of the quality of economic growth by Ivashkovskaya (2004)



According to the method of Ivashkovskaya (2004, 127-128), cell Q4 indicates growth due to aggressive sales policies (catching up growth). These conclusions are consistent with those obtained earlier and suggest that the Russian metallurgy has low growth sustainability, aimed at extracting a momentary, conjuncture, short-term effect.

Conclusion

Thus, the current state of the industry possesses a low quality, an orientation toward a momentary financial result, weak controllability due to constant adjustment to macroeconomic conditions without taking into account available resources and a clear strategy. Despite the whole list of programs and scenarios for the development of metallurgy throughout the latest economic history of Russia, we should note that the Russian industry is weakly manageable, subject to the global crisis much more than institutional reforms and industrial policies.

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APPENDIX 1

Dynamics of the main indicators of efficiency (effectiveness of resource use) of metallurgy in Russian Federation (2005-2015)

Indicators	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Indicators of the use of material resources											
Use of production capacity,%	81.75	85.50	86.75	79.75	58.00	81.25	81.50	80.50	81.00	83.25	82.00
Fixed assets, bln. rub.	692	812	953	1120	1285	1426	1600	1796	2110	2421	2616
Depreciation of fixed assets,%	45.0	41.7	40.8	40.2	38.2	39.2	40.9	42.1	43.7	44.1	46.6
Renewal coefficient of fixed assets,%	12.6	16.6	14.7	14.8	17.4	11.6	11.3	12.4	11.9	10.6	8.1
Retirement coefficient of fixed assets,%	1.2	1.2	1.1	1.0	0.9	0.8	0.8	0.9	0.9	1.1	0.9
Specific weight of completely depreciated fixed assets,%	15.5	12.9	11.6	12.6	11.9	11.4	11.6	13.6	13.2	13.0	15.2
Physical volume index of investments in fixed assets,% to previous year	120.1	117.5	100.0	118.2	79.6	85.9	104.9	102.1	92.1	96.1	97.3
Capital productivity	2.62	2.89	2.97	2.86	1.80	2.24	2.40	2.14	1.83	1.79	2.05
Capital ratio	0.38	0.35	0.34	0.35	0.56	0.45	0.42	0.47	0.55	0.56	0.49
Ratio of tangible assets and number of employees, million rubles / person	0.57	0.69	0.83	0.99	1.29	1.47	1.60	1.81	2.13	2.54	2.83
Current assets, bln. rub.	834	1002	1348	1745	1670	1804	1914	2094	2230	2925	3568
Indicators of human capital use											
Advancing of growth in the number of employed in relation to growth in shipment of products	1.04	1.14	1.06	1.00	0.97	1.16	1.04	1.05	1.00	1.05	0.96
Labor productivity, million rubles / person.	1.49	2.00	2.46	2.83	2.31	3.29	3.84	3.86	3.89	4.54	5.78
Staff costs, bln. rub.	183.9	209.6	242.6	281.4	245.2	286.3	354.9	387.8	429.1	450.3	476.1
Profit per employee, million rubles / person	276.43	479.29	622.76	276.79	207.22	362.18	289.82	285.92	149.34	98.96	546.06
Specific weight of personnel costs in production costs	0.13	0.12	0.12	0.11	0.13	0.11	0.11	0.12	0.13	0.12	0.11
Average wage, thousands rubbles/person	10.3	12.0	15.0	18.2	17.9	21.2	29.9	26.6	28.5	30.4	33.1
Indicators of financial resources use											
Turnover	2.17	2.34	2.10	1.83	1.38	1.77	2.00	1.83	1.73	1.48	1.50
Duration 1 turn, days.	165.6	153.8	171.2	196.4	260.5	203.4	179.7	196.2	208.2	242.9	240.0
Coefficient of current liquidity	178.6	192.5	167.2	151.2	166.3	165.9	150.8	143.8	142.0	142.6	142.9
Coefficient of self-sufficiency	16.8	18.2	7.3	-6.5	-8.3	-6.8	-22.1	-28.7	-36.6	-40	-42.6

Source: Federal State Statistics Service of the Russian Federation: Industry of Russia, 2008; Federal State Statistics Service of the Russian Federation: Industry of Russia, 2010; Federal State Statistics Service of the Russian Federation: Industrial production in Russia, 2016.

APPENDIX 2

Change in factorial productivity (ΔTFP) of metallurgy in comparison with the previous year 2005-2015

Indicators for calculation	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Deflator	105	132	138	149	155	190	199	192	187	214	240
Deflated revenue	1720	1783	2053	2142	1485	1678	1925	1999	2064	2026	2234
ΔQ	0.0362	0.1405	0.0426	-0.3663	0.1225	0.1370	0.0377	0.0320	-0.0183	0.0976	-
Deflated value of fixed assets	657	617	690	750	827	750	803	934	1129	1132	1092
Deflated staff costs	174	168	231	260	236	234	339	402	441	393	425
Total value of factors of production (labor and capital)	831	785	921	1010	1062	983	1142	1336	1571	1525	1517
Δ F	-0.0567	0.1595	0.0927	0.0500	-0.0771	0.1497	0.1569	0.1617	-0.0296	-0.0053	-
The Tornquist Index (ΔTFP)	0.0928	-0.0190	-0.0501	-0.4164	0.1996	-0.0126	-0.1192	-0.1297	0.0113	0.1029	-

Source: Federal State Statistics Service of the Russian Federation: Industry of Russia 2008, Federal State Statistics Service of the Russian Federation: Industry of Russia 2010, Federal State Statistics Service of the Russian Federation: Industrial production in Russia 2016.

Influence of Monetary Policy on Economic Growth in Russia

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Abstract:

Objective. The purpose of the study is to estimate the impact of the modern monetary policy of the Bank of Russia on economic growth in the country.
Methodology. The authors applied correlation and regression analysis, which allows constructing a regression equation with the values of independent variables (factors).
Findings. The paper analyzes the main indicators characterizing the effectiveness of monetary policy implementation in Russia in 2000-2016. The undertaken correlation and regression analysis of the impact of monetary policy tools on economic growth in Russia according to empirical evidence (2006-2016) revealed the dependence of GDP on funds of credit institutions on correspondent accounts at the Bank of Russia.
Application area. The obtained results can be used by the Central Bank of Russia in the development of the main directions of monetary policy and by the Ministry of Economic Development of the Russian Federation in preparing a forecast of socio-economic development in the long run.

Keywords: monetary policy; economic growth; transmission mechanism; gross domestic product

JEL Classification: R 11; L8; L 83; M 31

Introduction.

Problem statement

The economic policy of any country is aimed at stimulating economic growth, maintaining the pace of its development at a stable level. One of the main economic tools of the state, providing favourable conditions for the national economic growth, is monetary policy, which is an integral part of the national economic policy. The financial and economic crisis of 2008-2009 significantly changed the parameters of the development of the world economy: the pace of economic growth became more restrained; uncertainty increased significantly. So, in 2009-2015 the average annual growth rate of the world economy was about 3.5%, and in Russia – less than 1%. According to the IMF forecasts, in 2017 growth rates in China are expected at 6.5%, in the US – 2.3%, in the EU – 1.6%, in Russia – 1.1%, the Brazilian economy will decrease by 3.8%, and the largest growth rate in developing countries are projected in India – 7.2% (IMF 2017).

Simultaneously with the low growth rates of the economy, in most countries there is an increase in public debt and overheating in the stock markets amid negative interest rates of many financial instruments. The current economic situation has actualized the problem of assessing the impact of monetary policy on the economic growth rate in various countries of the world (Chen *et al.* 2017, Georgiadis and Mehl 2016, Anowor and Okorie 2016, Glazyev 2014, Goryunov *et al.* 2015, Gudmundsson 2017, Davis and Presno 2017, Drobyshevsky *et al.* 2016, Lopez-Buenache 2017, Moiseyev and Pantina 2016, Mishkin 2017, Sokolova 2015).

Scientific hypothesis

Monetary policy instruments play a key role in stimulating economic growth in the country. In the next paragraph, we summarize the main trends in scientific literature on the impact of monetary policy on economic growth.

1. Literature review

The problem of economic growth is one of the key issues in modern economic science. Economic growth characterizes the level of economic development in the country for a certain period of time. The most important indicator of the economic growth of any country is the GDP growth rate. In the economic theory, there are different models of economic growth, considering the interaction and mutual influence of a significant number of factors that cause economic growth. Thus, Domar's model examines the dual role of investment in increasing aggregate demand and in raising the production capacity of long-run aggregate supply in time (Domar 1947). The model of Harrod (1939) is based on the theory of the accelerator, which allows determining the ratio of investment growth to the resulting increase in income. Solow's (1997 and 2007) model reveals the mechanism of impact of savings, growth of labor resources and scientific and technical progress on the standard of living of the population and its dynamics.

Representatives of a number of schools and directions of economic thought were engaged in a theoretical study of the monetary policy of the state. Their insights are widely represented in the Keynesian and monetarist theories of monetary regulation. The key factors for the development of the Keynesian theory of monetary regulation were the aggravation of the contradictions of the market economy and the largest world economic crisis of the 1930s (Mishchenko 2010). J. Keynes believed that by influencing the preference for liquidity through changing the amount of money in circulation, the state can regulate the rate of interest by stimulating or restraining investment processes. In his opinion, in the issue of additional means of payment and the management of inflationary processes, the interest rate plays the key role (Keynes 1937). An important part of the Keynesian analysis is the rationale for the transmission mechanism of monetary policy. The transmission mechanism was characterized by J. Keynes as the system of variables describing the behavior of firms and consumers in various sectors of the national economy through which money supply affects economic activity.

The structure of the monetary transmission mechanism consists of channels through which the central bank influences the economy by monetary policy instruments (Svensson 2002, Uusküla 2016). As Walsh (2009) and Geremew (2017) put it, the concept of monetary regulation of the economy has been developed significantly after the publication of I. Fisher's work The Purchasing Power of Money, its Determination and Relation to Credit, Interest and Crises (1911), which is, according to Walsh (2009) and Geremew (2017), a deep and detailed study of monetary theory. Fisher's theory is based on the equation of exchange MV = PQ. He believed that for short-term periods, the velocity of money turnover (V) and the quantity of real goods sold (Q) are stable, so there is a directly proportional relationship between the money supply (M) and the price level (P) (Fisher 1911).

For researchers of the problem of the impact of monetary policy on economic growth, issues related to the principles of the operation of the money transmission channels are of greatest interest, since the impetus given by changing the value of the instrument is gradually transferred to the entire economy. It should be noted that modern economic science has not yet developed a unified approach to the structure of the transmission mechanism of monetary policy and a set of its channels, which has led to differences in practical approaches to its implementation in various countries of the world. Without taking into account the national peculiarities of certain countries, the following channels of the transmission mechanism of monetary policy, which are most frequently studied, can be identified: the interest rate channel, the credit channel, the exchange rate channel, the money channel and the

welfare channel (Moiseyev 2002). The interest rate channel corresponds to the traditional Keynesian model of money transmission. The essence of the interest rate channel is as follows: the growth of the nominal money supply reduces the nominal interest rate due to the liquidity effect, which in turn leads to an increase in the expected investment and total costs in general; as a result, increase in real income and changes in nominal net national product take place (Ireland 2004). Ando and Modigliani (1963) generally support this approach, and on its basis they have characterized the welfare channel, which suggests that an increase in the interest rate leads to a decrease in welfare and a drop in household consumption.

Household consumption should be viewed not only as current expenditure on goods and services, but also as their investments in financial assets (primarily in securities). Prices for financial assets also play an important role in the credit channel of the transmission mechanism of monetary policy (Bernanke and Gertler 1995, Montes and Machado 2013, Stojanović and Stojanović 2017). It is often called the financial accelerator channel (Bernanke and *et al.* 1996). Its essence lies in the fact that monetary policy can influence banks and companies' own capital by indirect methods of regulation, changing the value of shares, real estate and asset prices, or by increasing cash flows to firms, reducing nominal interest rates. The exchange rate channel is typical for any open economy. The purpose of the transmission in this case is to transfer the impulse of the impact from interest rates to the exchange rate through the uncovered interest rate parity that binds the boundaries of interest rate fluctuations to the expected changes in the exchange rate (Goldfajn and Werlang 2000, Potjagailo 2017). Modern monetarist followers have justified the monetary channel of the transmission mechanism of monetary policy (Moiseyev 2002). They describe the direct effect of monetary supply on asset prices. At the same time, the interest rate plays a secondary role, and the impact is exercised through a monetary base. It should be noted that money transfer mechanisms operating in developing countries are significantly different from the transmission mechanism in advanced economies (Ganev and *et al.* 2002, Cao and Chollete 2017). This is related to the underdeveloped institutions in the financial market, the lack of independence of the Central Bank and the high degree of politicization of monetary authorities' decisions, as well as to constant structural changes in the economy.

Over the past decades, foregein scholars as Bernanke and Gertler (1995), De Fiore (1998), Ganev and *et al*. (2002), Belke and Rees (2014), Coutiño (2016), Yeh (2016), El-Shagi and Kelly (2017), Bi and Anwar (2017) and Russian economists as: Moiseyev (2002), Drobyshevsky *et al*. (2008), have been conducting studies to assess the efficiency of the channels of transmission mechanism of monetary policy and its impact on economic growth. However, despite the large number of scientific papers devoted to this problem, the current and discussive issue is the choice of indicators as a variable characterizing the impact of monetary policy on economic growth. So, Ka-Fu Wong (2000), considers changes in non-borrowed reserves of commercial banks as a variable of monetary policy. Drobyshevsky, Trunin and Kamensky (2008) suggest that monetary aggregates can be used as such a variable. In order to identify the impact of the interest rate channel on the economy, the bank credit channel and the money transfer rate channel, de Fiore (1998) includes in the model such variables as real monetary balances, total loans issued, loans in domestic and foreign currencies, nominal and real exchange rates, trade balance deficit. According to Walsh (2009), advanced methods of assessing monetary policy instruments should, first of all, help resolve the problem of asymmetric information in financial markets. According to Bernanke and Blinder (1992), the monetary policy of the USA is adequately reflected by the federal funds rate, which is an indicator for the main macroeconomic indices and directly influencing the real sector of the economy. As an alternative variable, they also offer a spread between the federal funds rate and long-term government bond yields.

It is worth emphasizing that at present there is no single methodology for assessing the impact of monetary policy on the pace of economic growth. To investigate the impact of monetary policy shocks on the real economy, some scientists use the vector autoregression model (Drobyshevsky *et al.* 2008, Precious and Palesa 2014, Cyrus and Elias 2014, Brancaccio *et al.* 2015). De Fiore (1998) applies descriptive analysis to estimate the impact of monetary policy on economic growth given the impact of a large number of exogenous variables on it. In his opinion, it can be supplemented by the method of expert assessments. Ma and Lin (2016) assess the impact of monetary policy on the country's financial development on the basis of econometric models of panel data. Most researchers employ correlation and regression analysis grounded on various quantitative data to identify the factors that

contribute to the manifestation of the economy's particular reaction to instruments of monetary policy (Moiseyev 2002, Nouri and Samimi 2011, Muzhzhavleva and Speranskaya 2012).

2. Methods of Investigation

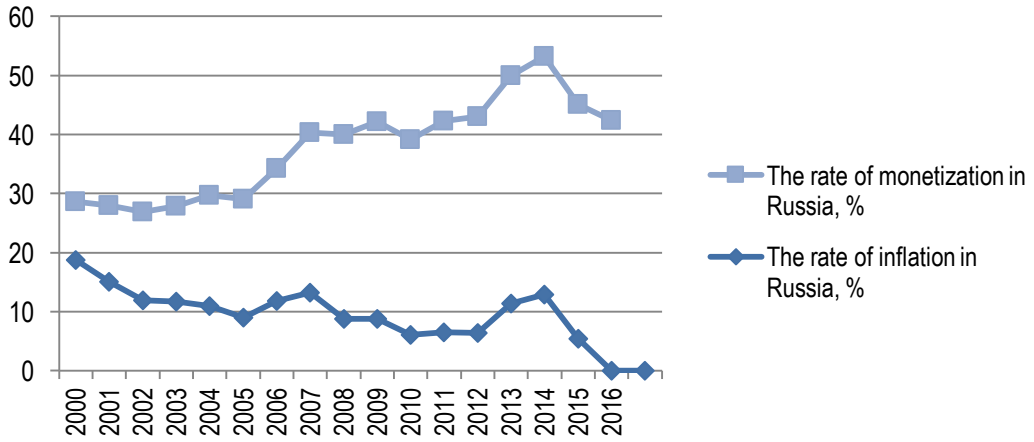
In order to assess the impact of the monetary policy of the Bank of Russia on the GDP growth, a correlation and regression analysis was carried out that allows the construction of an economic and statistical model and develop an economic and mathematical regression equation, taking into account the values of independent variables and the dependent variable (GDP). At present, correlation and regression analysis is one of the main tools for investigating the dependencies between economic variables.

Statistical data from the Bank of Russia, the Federal Service of State Statistics of the Russian Federation, and the Ministry of Finance of the Russian Federation were used for the survey.

3. Results

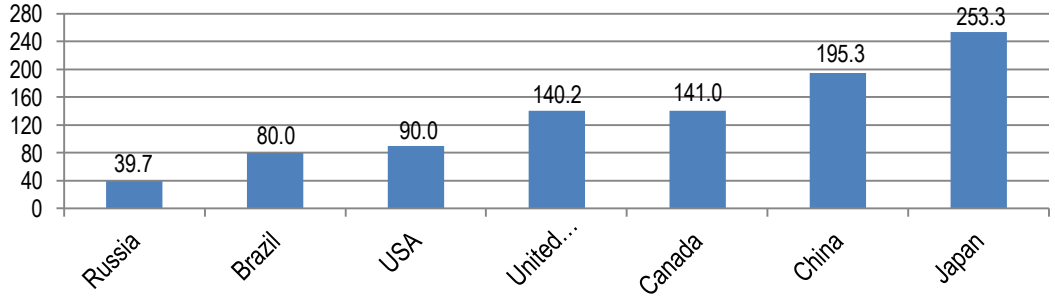
The functioning of the Russian economy in 2000-2016 was characterized by a rapid growth in the money supply (the amount of the monetary aggregate M_2 increased from 714.6 billion rubles in 2000 to 38,447.9 billion rubles in 2016), associated with significant revenues in the country's currency in the form of export earnings, which contributed to the national currency devaluation. Expansion of the money supply was carried out by the Bank of Russia simultaneously with the growth of the country's international reserves. As a result, this led to an increase in the rate of inflation against the backdrop of a low level of monetization of the economy (Figure 1).

Figure 1. Dynamics of the rate of inflation and monetization of the economy in Russia, %



It is worth emphasizing that the current rate of monetization of the economy in Russia is lower than in most developed and developing countries of the world. So, in Brazil, the monetization of the economy is 80%, in the US – 90%, in China – 195.3%, in Japan – 253.2% (Figure 2). With such a high monetization of the economy in Japan and China, in 2015 inflation was 0.8% and 1.4%, respectively. The average world rate of monetization of the economy is 125%.

Figure 2. The rate of monetization of the economy in different countries of the world in 2015, %



In order to reduce inflation and stimulate economic growth, in September 2013, the Bank of Russia introduced a key rate indicator at 5.5%, which has become one of the main instruments of the country's monetary policy. The Bank of Russia considers the interest rate on the liquidity-absorbing operations on an auction basis for a period of 1 week as the key interest rate. In such a case, the refinancing rate (its value was 8.25%) was applied as a reference in tax practice (for reference: since 01.01.2016 the value of the refinancing rate is equal to the value of the key rate of the Bank of Russia and the independent value of the refinancing rate is not established). Owing to a number of negative factors (ruble devaluation, rise in inflation rate, introduction of sanctions against Russian companies and others) in spring and summer 2014, the key rate increased six times and reached 17% per annum. Reduction of inflationary expectations and consumer demand of the population contributed to a gradual decrease in the key rate (10% in 2016 against 17.0% in 2015). There was also a decrease in lending activity in the economy amid a significant increase in the free funds of credit institutions on the correspondent accounts of the Bank of Russia (in general, they increased 14 times in 2000-2016).

Note that in 2014, the Bank of Russia supplemented the system of monetary policy instruments with fine-tuning operations to provide liquidity, conducted in the form of repo auctions for periods of 1 to 6 days, and also improved the mechanism for refinancing credit institutions. Undoubtedly, the abovementioned measures helped slow inflation and revive economic activity in the country.

As part of our study, using the Statistica application package and taking into consideration empirical data for 2006-2015, a correlation and regression analysis of monetary factors affecting economic growth in Russia was conducted. The indicator of GDP (Y) is the resulting index underlying the research. To conduct multifactor correlation and regression analysis, twelve factors were selected, which affect the value of the indicator under study from an economic point of view: refinancing rate (from 2013 the key rate), %(X_1); monetary base, billion rubles. (X_2); mandatory reservation norms averaged by types, %(X_3); average annual rate of the Bank of Russia on repo auctions, %(X_4); money supply (M_2), billion rubles (X_5); credit market volume, billion rubles (X_6); deposit market volume, billion rubles (X_7); dual currency basket, rubles (X_8); currency interventions volumes (balances), billion rubles (X_9); monetary funds of credit institutions on correspondent accounts of the Bank of Russia, billion rubles (X_{10}); inflation rate, %(X_{11}); provided / absorbed liquidity volumes, billion rubles (X_{12}).

It is well known that the basis for estimating the relationship between indicators is the matrix of paired correlation coefficients, from which one can judge the tightness of the connection of factors with the resultant attribute and among themselves. Although all these indicators are related to paired relationships, the matrix can still be used to pre-select factors for inclusion in the regression equation. The matrix of paired coefficients of indicators correlation which are used to analyze the level of GDP is presented in Table 1.

Table 1. Matrix of pairwise correlation coefficients

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	Y
X_1	1												
X_2	-0.234	1											
X_3	-0.154	0.699	1										
X_4	0.711	0.425	0.130	1									
X_5	-0.119	0.986	0.685	0.532	1								
X_6	-0.261	0.968	0.672	0.382	0.928	1							
X_7	-0.039	0.966	0.662	0.602	0.986	0.930							
X_8	0.379	0.710	0.429	0.859	0.813	0.592	1						
X_9	0.156	-0.288	-0.337	-0.018	-0.229	-0.440	-0.272	0.067	1				
X_{10}	-0.129	0.981	0.739	0.420	0.925	0.804	0.889	0.777	-0.134	1			
X_{11}	0.539	-0.335	-0.192	0.272	-0.322	-0.240	-0.211	-0.136	-0.334	-0.539	1		
X_{12}	0.069	0.077	0.502	-0.157	0.045	0.134	0.059	-0.119	-0.177	0.224	-0.049	1	
Y	-0.144	0.994	0.699	0.506	0.996	0.949	0.980	0.777	-0.256	0.908	-0.306	0.076	1

As can be seen from Table 1, multicollinearity is observed between factors other than X_2, X_4, X_5, X_6, X_7, since pairwise coefficients between them are greater than 0.8. To build a qualitative and accurate regression model, we will skip these factors and construct a stepwise regression. The matrix of pairwise correlation coefficients is presented in Table 2.

Table 2. Matrix of Pairwise Correlation Coefficients

	X_1	X_3	X_8	X_9	X_{10}	X_{11}	X_{12}	Y
X_1	1							
X_3	-0.154	1						
X_8	0.379	0.429	1					
X_9	0.156	-0.337	0.067	1				
X_{10}	-0.129	0.739	0.777	-0.133	1			
X_{11}	0.539	-0.192	-0.136	-0.334	-0.538	1		
X_{12}	0.069	0.502	-0.119	-0.176	0.224	-0.049	1	
Y	-0.144	0.699	0.777	-0.256	0.908	-0.306	0.076	1

Based on the values of mean and standard deviations and correlation coefficients, it is possible to identify the most suitable indicators to be included in the regression model: X_{10} (Table 3).

Table 3. Regression results for the dependent variable

	β-coefficient	Standard error β	B	Standard error B	t(8)	p-value
Free term			5,369.184	9,244.797	0.580779	0.577380
X_{10}	0.908458	0.147777	44.886	7.301	6.147503	0.000275

Applying the data of Table 3, we will write the regression equation of the dependence of GDP change on the independent variable X_{10} as follows:

$$Y = 5{,}369.184 + 44.886\ X\ 10 \quad (1)$$

The coefficient of determination $R_2 = 0.826$ indicates that the rate of economic growth in Russia is explained by 82.6% with the factor used in constructing the model. The correlation coefficient, equal to 0.908, indicates a strong relationship between the variables. F-test at significance level of 95% indicates the statistical significance of the equation obtained and the possibility of its use for the implementation of predictive analytics.

Thus, the undertaken study of the impact of monetary factors on economic growth in Russia revealed a strong dependence of GDP on monetary funds of credit institutions on correspondent accounts of the Bank of Russia.

4. Case studies/experiments/ demonstrations/ application functionality

The performed analysis showed that major changes in the Russian financial system in recent years (transition from a liquidity deficit to a surplus, weakening of currency regulation, an increase in banks' investments in bonds, excessive volatility of money market rates, a large number of unused free cash in the national economy) reduce the effectiveness of interest and credit channels of monetary policy, which, in turn, adversely affects economic growth. We suppose that the monetary policy of the Bank of Russia should be more focused on activating the interest and credit channels of the money transmission. In our opinion, in order to improve the monetary policy of the Bank of Russia as the basis for creating the conditions to ensure economic growth in the country, it is necessary:

- to lower the key rate for the purpose of increasing the money supply and stimulating the development of the real sector of the economy;
- expand the ability concerning the admission of credit institutions to long-term refinancing to broaden their resource base;
- to form a mechanism for concessional funding (with the use of Bank of Russia loans) to enterprises in the real sector of the economy, recognized as growth points on a competitive basis;
- differentiate the regulatory norms of banks taking into account their credit investments in the real sector of the economy;
- to create a mechanism for issuing long-term money to finance the innovative development of the Russian economy through the acquisition of securities of state-controlled investment funds.

Conclusion

Currently, the implementation of monetary policy in Russia is carried out under the influence of both a number of negative external factors (deterioration of the situation in the leading commodity markets, a reduction in the volume of export earnings, capital outflows, technological and financial sanctions of Western partners, etc.) and internal factors (structural disproportions in the economy, de-industrialization of productive forces, dependence on imports in the basic sectors of the economy, etc.) that do not allow the Russian economy to fully utilize potential for economic growth. The current monetary policy of the Bank of Russia does not fully provide the conditions for stimulating economic growth. During the period under analysis, interest and credit channels did not have a significant impact on the real sector of the national economy.

In this regard, the most important conditions for ensuring the rates of economic growth and improving the welfare of society are to reduce the vulnerability of the Russian economy to changing external conditions and to solve internal structural problems. They became evident not only during the economic recession that followed the fall in oil prices in 2014, but also in the decaying economic dynamics that preceded it (even with a favorable environment in world commodity markets). In conditions when the needs of the country's socioeconomic development are oriented towards achieving its growth and modernization of the economy, increase in the effectiveness of the instruments of the state's monetary policy is of paramount importance.

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Stock Market Performance and Macroeconomic Fundamentals in the Great Nation: A Study of Pool Mean Group

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Abstract:

The study examines the influence of macroeconomic variables interest rate, economic growth, inflation and exchange rate on stock market performance in G7 countries over the period 1980-2015. We employ the estimating technique of Pooled mean group estimation (PMG) to reveal the short run and long run impact of explanatory variables on dependent variable. The study established that long run interest rate and GDP affect the stock market performance positively. Moreover, in short run all the variables are found to be statistically insignificant. The outcomes suggest formulating comprehensive and effective policies to ensure stable macro-economic environment for G7 countries.

Keywords: economic growth rate; interest rate; exchange rate; inflation rates and stock market

JEL Classification: F3; F4; G1; C5.

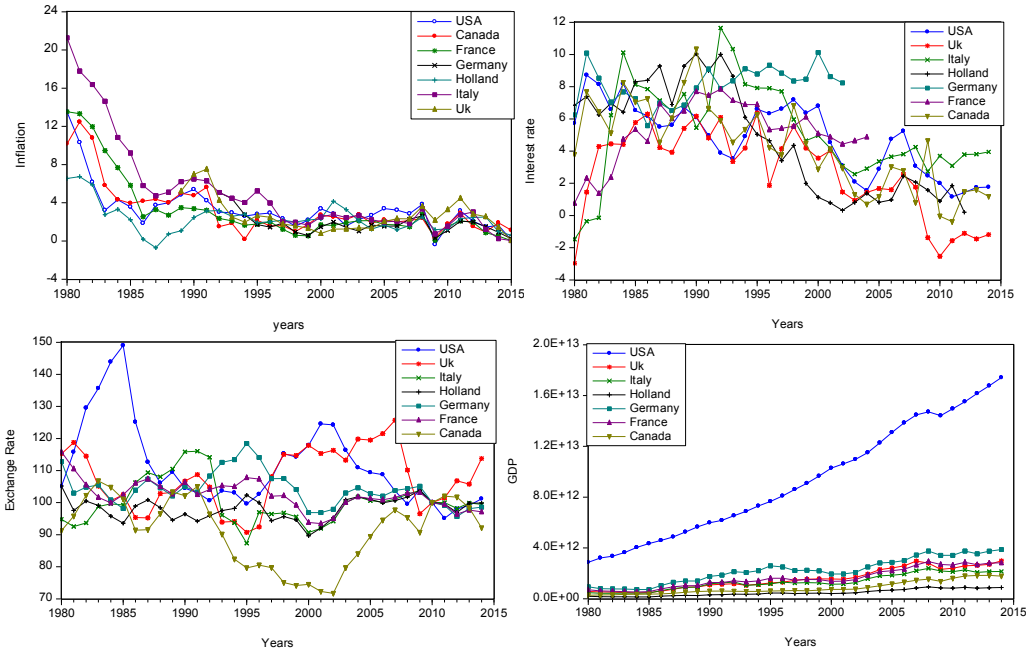
Introduction

Concerns over the performance of stock markets globally and in particular developed countries increased after the massive losses suffered by financial markets in the wake of the global financial crisis of 2007-2009. According to Fynn (2012) indicates that within 14 months, the market lost over $15 trillion in value and wealth triggering an economic decline in all major economies from which many have not fully recovered. The June 2013 year-to-date performance of the stock market in great nations indicates that only the US and Japan recorded double digit performance while Canada recorded negative at -0.42%. Italy was 2.57%, Netherlands, 2.91%, while Britain, Germany and France were all less than 10%, suggesting a decline for Canada and weak performances for the others apart from Japan and the US (Bespoke investment Group 2013). The trend continued in 2014 with slow growth in the great countries.

In 2015, reports show that US companies continue to face declining earnings. For instance, a report by CNBC in February 2016 indicates that declining earnings between October and December 2015 in the US show a third straight quarter of fall in companies' performances compared to the previous year for all S&P 500 firms. Such experience took place last in the US during the global financial crisis. While stocks appeared to rally in March, 2015,

the outlook was not encouraging. Specifically, growth projections by the IMF for 2016 fell to 3.4% from its 3.5% level in 2015 while Citi Bank in the US even projected lower rate at 2.7%. This suggests a slow economic recovery at the global level and it could have negative impacts on the economy of both developed and developing nations and through that influence stock market performance. This decline could be linked to slow growth and macro-economic changes in inflation, exchange rate and interest rate in the US and other developed and emerging economies particularly China as shown in Figure 1.

Figure 1. Slow growth and macro-economic changes in inflation, exchange rate and interest rate in the US and other developed and emerging economies particularly China



In the US, reports indicate that at least 33 companies on the S&P Index issued negative earnings per share (EPS) guidance as at first quarter of 2016 while projection for the year is mixed (Elite Fund Managers 2016). Reports released by Hang Seng Investment indicate that uncertainties hang on the stock and investment climate in Europe. For instance, European equities faced massive sell-offs in the beginning of 2016 with the Europe Stoxx 600 price index falling by 7% in the first quarter. This is connected with variabilities in inflation, exchange rate and interest rate with slow growth, especially in big economies like Germany and uncertainties surrounding the proposed 2016 referendum on the European Union (EU) in the United Kingdom (UK). The weak outlook is also linked with the unstable macro-economic variables in China. In March 2016, Bloomberg reports that a GDP growth rate of 6.4% is expected from China 2016 compared to 10.1% in 2013 and above 18% level attained in 2010. Along with rising debt to GDP ratio, the report suggests that the Chinese economy would contribute far less than usual to global economic growth in 2016 and it could have further negative effects on stock performance in the industrial countries. In the UK, the economy was expected to grow faster in 2016 than other G7 members, but at a low rate of 2.2%, which further shows the trend in weak growth in the advanced economies. The weakness has already been reflected in stock performance with about $8 trillion wiped off from the global stock market value at the beginning of 2016 (Her Majesty Treasury (HMT) 2016). The foregoing shows that stock markets in the developed nations are undergoing stress while economic growth and macro-economic variables such as inflation, exchange rate and inflation remain unimpressive. Therefore, the need arises to determine which factors contribute to the losses being experienced in the stock markets and to determine if macroeconomic factors such as inflation, exchange rate and interest rate are contributing to the decline.

Sharif, Purohit and Pillai (2015) attribute changes in stock market performance to both internal and external factors in firms. The internal factors are endogenous and subject to company control while the external factors are exogenous and beyond organizational control. Among the external factors are the macroeconomic characteristics of a country's economy. Khan *et al.* (2012) list variables such as gross domestic product (GDP), inflation, interest rates and exchange rates as likely factors that could influence stock market performance. Interest rates represent the cost of funds and it is applied to discount future cash flows in the financial markets. When interest rate rises, investment in stocks is expected to fall given that funds are moved to other assets with higher returns such as fixed deposits, treasury bills and savings certificates (Lobo 2000, Toraman and Basarir 2014). Interest rates could also be used to control inflation, which could hinder investment in stocks. Thus, Fama (1981) suggests a negative relationship between inflation and stock market performance.

Research indicates that inflation could have a dual effect on stock market performance (Patel 2012). First, inflation that arises from increase in money supply could cause lower stock prices as investors move away from stocks. On the other hand, it could also lead to rising stock price if expected dividends due to increased cash flow to firms (Barakat *et al.* 2016). Thus the ambiguous nature of this bidirectional causal relationship demands more investigation.

Similarly, Barakat *et al.* (2016) note that the relationship between exchange rate and stock prices remains unsettled. If a currency depreciates, it leads to the promotion of exports, which could favor industrial output for exports and boost the stock of firms in that sector.

However, depreciation could also lead to rise in the cost of imports with negative effects on import dependent firms and their stocks. Thus, the exact impact of exchange rate change remains unclear and may need further examination.

1. Literature review

1.1. Stock prices and inflation nexus

Research interest on the relationship between inflation and stock price movement is stimulated by the search for a causal relationship between the two variables and also to discover the direction of the relationship. Thus, several studies have been generated by the contending issues while the argument remains unresolved.

Inflation is a signal that an economy is facing uncertainties and it could have much impact on investment decisions. This is because investors would monitor the trend of inflation to determine whether to invest or to move for more favorable destinations. Rising inflation often suggest lower real income and this could lead to sale of assets by individuals to improve their purchasing power and living standard. Thus, inflation could influence changes in the prices of stock. Early studies such as Homa and Jaffe (1971) pointed to a possible association between inflation and stock price movement and their position agrees with Hamburger and Kochin (1972).

Similar view is shared by Hernadez (1999) in a research conducted on the stock markets of the USA, UK, Canada, Germany, France and Japan. While no causality exists for five of the countries, they find in the case of Japan that stock price movement has a positive association with changes in money supply. It suggests that expected inflation is likely to influence stock prices thus making it possible to adopt stock as a hedge against inflation.

Solnik (1983) examined the association between inflation and stock price movement in the USA, UK, Japan, France, Germany, Netherlands, Canada, Belgium and Switzerland from 1971-1980. The study finds that lower expected inflation is associated with movements in stock prices which indicate that a negative relationship exists between them. A positive relationship between stock returns and inflation is rooted in the idea that equities are hedges against inflation because they represent claims on real assets (Geske and Roll 1983). However, Empirical evidence, in large part, has documented a negative relationship between stock returns and inflation (see, inter alia, Bodie 1976, Fama 1981, Adams *et al.* 2004). Only a few studies have found evidence that is consistent with theory as (inter alia, Luintel and Paudyal 2006).

1.2. Stock market and exchange rate nexus

Exchange rate movement has become a major determinant of changes in the internal economies of nations around the world especially where there is rate volatility. When exchange rate depreciation is associated with inflation, it could lead to capital flight as investors seek for a more stable environment for their funds. This could cause the sale of stock in order to move the funds to a less volatile economy. Thus, developments in the foreign exchange market could influence movements in the prices of stock.

Barakat, Elgazzar and Hanafy (2016) examine several macro-economic variables which include exchange rate in their study of Tunisia and Egypt. The investigation covered the period from 1998-2014 and the finding indicates that exchange rate moves in the same direction as the changes in the price of stock and would not likely move away from each other. Thus, they conclude that relationship exists between the two variables and changes in exchange rate could likely predict changes in the price of stock.

Hsing, Budden and Philiph (2012) and Pal and Mitta (2011) examine the co-movements in the exchange rate and stock prices for the Argentina and Indian stock market respectively. In the test for a long-run relationship, they find that a positive association exists between exchange rate and stock price movement in the two countries.

Also, Vanita and Khushboo (2015) who investigate the BRICS nations of Brazil, Russia, Indian, China and South Africa in the period spanning 1997-2014 find a negative relationship. They conclude that for Russia, India and South Africa, exchange rate exchange rate changes and stock price movement are in opposite directions. However, there is no established trend in the finding of Morley and Pentecost (2000) for the USA, UK, Germany, Italy and Japan in their study that spanned 1982-1994. The result suggests that exchange rate movement in the G7 countries may not likely have an influence on stock price behavior. Pan *et al.* (2007) examine dynamic linkages between exchange rates and stock prices for seven East Asian countries, excluding China. Yau and Nieh (2009) investigate the exchange rate effects of the New Taiwan dollar against the Japanese Yen (NTD/JPY) on stock prices in Japan and Taiwan and find a long-term equilibrium and asymmetric causal relationships.

1.3. Interest rate and changes in stock prices nexus

Interest rate is another factor that is considered as capable of influencing stock price movement. Interest rate is the opportunity cost of investing in stock. When interest rate on government bonds and treasury bills become attractive, investors could shift away from stock especially since treasury bills and bonds are considered less risky. If investors sell stock and invest the funds in government securities, the price of shares could fall. Thus, interest rate changes could have influence on the changes in the prices of stock.

Dritsaki (2005) examines the stock market of Greece using the quarterly data for the period of 1989-2003. The study investigates three macro variables which include interest rates, inflation and industrial production. The Granger causality result show that positive and significant causal associations exist between the three variables and stock price movement. It suggests that interest rate has a positive and significant relationship with stock price movement.

The study of Humpe and Macmillan (2009) on the US and Japanese stock prices present contrasting findings. While the movement of stock prices is reported to be positively related to industrial production in the US, interest rate and industrial production show a negative association. In the case of Japan, there is no significant relationship between stock price movement and interest rate. Pilinkus (2010) investigate data from 2000-2008 for Latvia, Estonia and Lithuania. They report that both short and long-run relationships exist between stock price movement and the selected macro variables which include interest rate. They further conclude that investors need to take cognizance of changes in macro-economic variables as these could serve as predictors of movement in the prices of stock.

Contrary to the finding of Pilinkus (2010), Sohail and Zahir (2010) report a mix result for exchange rate, money supply, industrial production and interest rate in the Karachi Stock market. While a positive association is reported for exchange rate and industrial production, they find a negative relationship for interest rate. This suggests that interest rate and stock price changes could be moving in opposite directions.

Mohi-U-Din and Mubasher (2013) investigate the Indian stock market with data between 2008 and 2012. The macro variables in the study include interest rate. They report that a positive association is found between stock price movement and changes in interest rate, inflation, exchange rate, money supply and industrial production. They however suggest that further research is necessary given that other factors could still play some roles other than macro variables. However, Naik (2013) find an insignificant relationship while Zakaria and Shamsuddin (2012) find no relationship between interest rate and changes in the prices of stock.

By employing a two-index factor model (including both market and interest rate factors) on the stock returns under the assumption of constant variance error terms, the empirical findings were dissimilar regarding the direction and magnitude of the effect. The empirical findings of Lloyd and Shick (1977) and Chance and Lane (1980), which provided a weak evidence of interest rate impact on the return generating process of the stocks of financial institutions, were challenged by the results of Lynge and Zumwalt (1980), Flannery and James (1984), Booth and Officer (1985), Scott and Peterson (1986), and Bae (1990). The latter authors reported that stock returns of financial institutions were negatively affected by interest rate changes.

2. Empirical methodology

2.1. Data

The study intends to observe the influence of interest rate, economic growth and inflation on the stock market performance of G7 countries, namely United States, Canada, Australia, UK, Germany, Netherland and France for the period`1980 to 2015. The data for all the above mentioned variables are obtained from the world development indicators and International Monetary Fund data bank.

2.2. Model specification

The following econometric model is used in the study to measure the stock market performance in the seven developed countries of G7:

$$Stock_{it} = \beta_{0\,it} + \beta_1 Intr_{it} + \beta_2 GDP_{it} + \beta_3 Infl_{it} + \beta_4 Exch_{it} + \varepsilon_{it} \quad (1)$$

In the above stated model. By taking the log of the dependent and independent variables, the results can be explained as elasticity (% change).

$$logStock_{it} = \beta_{0\,it} + \beta_1 LogIntr_{it} + \beta_2 LogGDP_{it} + \beta_3 LogInfl_{it} + \beta_4 LogExch_{it} + \varepsilon_{it} \quad (2)$$

where: $Stock_{it}$ = The Value Traded *i.e* value of the trades of domestic exchanges over the year divided by GDP countries *i* at period *t*; $INTL_{it}$ = Real Interest Rate in countries *i* at period *t*; GDP_{it} = Real Gross Domestic Products of countries *i* at period *t*. Git = The growth rate of GDP of countries *i* at period *t*; $INFL_{it}$ = Inflation = Consumer Price Index in countries *i* at period *t*; $EXCH_{it}$ = Real Exchange Rate in countries *i* at period t; E_{it} = stochastic error term in countries *i* at period *t*.

2.3. Estimation method

2.3.1. Panel unit root tests

Panel unit root tests are quite popular among the researchers due to their efficiency and power over the unit root tests for time series analysis. The study employs four panel unit root tests like Im *et al.* (2003) (hereafter IPS), Levin *et al.* (2002), (hereafter LLC), Choi (1999) PP-Fisher, and Maddala and Wu (2001) ADF-Fisher to examine the order of integration of the variables used in study. These four different unit root tests are employed in order to conclude the decisive evidence of integration level for the aforementioned explanatory variables. Levin *et al.* (2002) in a related study proposed an ADF unit root test that assumes homogeneity in autoregressive coefficients for all cross sections in a panel. The LLC model within the framework of panel can be shown as:

$$\Delta z_{it} = \delta_{it} + \gamma z_{it-1} + \sum_{i=1}^{m_i} Q_{ij} \Delta z_{it-j} + \varepsilon_{it} \quad (3)$$

where: $i = 1,2,3 \ldots N$ denotes the cross sections and $1,2,3 \ldots N$ is used for time.

In the above equation γ is assumed to homogeneous across all cross sections, z_{it} shows the series of explanatory variables, m_i indicates the number of lags and varies across over each cross section and ε_{it} is the error term with zero mean and constant variance. In contrast to the LLC test, the IPS (2003) can assume the heterogeneity for autoregressive coefficients across all the cross sections.

Maddalla and Wu (2001) following the Fisher (2003) established a non-parametric test that assumes the maximum heterogeneity across the cross sections as it can. The ADF-fisher (2003) can is shown as:

$$P = -2\sum_{I=1}^{N} \ln P_i \tag{4}$$

In the above equation N indicates the cross sectional units, P_i is the unit root value for cross section i and -2ln P_i shows the chi-square distribution with two degree of freedom. Choi (1999) proposed another panel unit root test as:

$$y = \frac{1}{\sqrt{N}} i = 1 \sum^{N} \omega^{-1} \ (\varphi_i) \cong N(0,1) \tag{5}$$

where: ω^{-1} indicates the opposite of normal cumulative distribution function.

2.4. Mean group (MG) and Pooled Mean group (PMG) estimators

Once the order of integration is examined the study proceed with mean group (MG) and pooled mean group (PMG) estimators to estimate the influence of explanatory variables on the explained variable used in panel data model.

2.5. Mean group (MG)

Mean group estimators are popular estimators in panel data analysis. MG estimates the consistent averages of coefficients for each cross section distinctly in panel (Pesaran and Smith 1995). For a large sample size these estimators provide efficient long run estimates too (Pirotte 1999). In addition, MG does not take into account the potential homogeneity across groups and permits the parameters to vary among groups. It assumes the Auto regressive distributive lag (ARDL) as:

$$\gamma_i(L) z_{it} = \alpha_i(L) y_{it} + d_i X_{it} + \varepsilon_{it} \tag{6}$$

In equation (4) i= 1.2.3….N for cross section unit i and the parameters of cross section for long run are:

$$\varphi_i = \frac{a_i(1)}{b_i(1)} \tag{7}$$

And the MG estimators for the entire panel would be stated as:

$$\varphi = \frac{1}{N}\sum_{i}^{N} \varphi_i \hat{} \tag{8}$$

The mean group (MG) produces highly consistent estimators for the long run parameters by neglecting the order of integration of the variables due to considerably high lag order (Pesaran 1999). Such assumption makes MG powerful estimators as the cross section specific parameters are independently distributed across the regressors.

2.6. Pooled Mean Group (PMG)

Pesaran *et al*. (1999) developed Pooled mean group (PMG) estimators that consider the parameters to vary across cross sections in short run but restrict homogeneity of the parameters in long run. PMG estimators assume the short run dynamic to vary over cross sections; however, in the long run coefficients are restricted to be same. These estimators also demonstrate the adjustment between short run and long run dynamics unlike the fully modified ordinary least square (FMOLS) or dynamic ordinary least square (DOLS) estimators.

More specifically, the unrestricted specification for the Auto regressive distributive lags (ARDL) equations, for i =1.2.3…T, time intervals and i = 1.2.3…N cross sections for the explained variable *z* is given as follow:

$$z_{it} = \sum_{j=i}^{n} \gamma_{ij} z_{i,t-j} + \sum_{j=0}^{m} \partial_{ij} y_{i,t-j} + \mu_i + \varepsilon_{it} \quad (9)$$

In the above equation (7) y_{it} is (k * 1) vector of independent variables for cross section i and μ_i shows the fixed effects. This model can also be stated as vector error correction model (VECM) system as:

$$\Delta z_{it} = \sigma_i \left(z_{i,t-1} - \beta_i y_{i,t-1} \right) + \sum_{j=1}^{n-1} \delta_{ij} \Delta z_{i,t-j} + \sum_{j=0}^{m-1} \delta' ij y_{i,t-j} \mu_i + \varepsilon_{it} \quad (10)$$

where: σ_is are the error corrections; $\beta_i s$ show the long run parameters.

PMG assumes that $\beta_i s$ are homogenous across each cross section in the long run. The recommended method to employ these estimators is maximum likely hood method. MG and PMG estimators should select reasonable lag lengths for each cross section equation through employing Akaike Information criterion (AIC). According to Pesaran (1995), efficiency and inconsistency of the MG and PMG would be determined by employing Hausman's (1978) test.

3. Results and discussion

The study conducted four different panel unit root tests to determine the order of integration of the dependent and independent variables.

Table 1. Unit Root Test Results Unit Root Test Results

Variable	LLC		IPS		ADF-Fisher		PP-Fisher	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
Stock	0.027**	0.000*	0.235	0.000*	0.389	0.000*	0.364	0.000*
Interest rate	0.122	0.000*	0.338	0.000**	0.435	0.000*	0.003**	0.000*
Inflation	0.999	0.638	0.645	0.000*	0.334	0.000*	0.439	0.000*
GDP	0.000*	0.000*	0.610	0.000*	0.688	0.000*	0.668	0.000*
Exchange	0.057	0.000*	0.001**	0.000*	0.006*	0.000*	0.009*	0.000*

Note: * and ** shows the significance; level at 1% and 5 %

Table 1 reports the results of the panel unit root tests. It is evident from the outcomes that the variables have mixed integration level; some are integrated at level and some at fist difference. This gives us validity to move for mean group (MG) and pooled mean group (PMG) estimation techniques for further panel data analysis. The Hausman's test outcome will determine either MG or PMG results are to be accepted.

Table 2. Results of Mean Group (MG) estimation dependent variable: Stock

Variable	Mean Group (MG)			
	Long Run		Short Run	
	Coefficient	P-value	Coefficient	P-value
Interest rate	0.43	0.80	-0.30	0.21
GDP	-0.25	0.80	-0.60	0.29
Inflation	-0.68	0.80	0.18	0.01*
Exchange	-1.84	0.40	1.87	0.50**
Error correction(-1)			-0.69	0.00*

Note: * and ** show the significance level at 1 % and 5%

Table 3. Results of Pooled Mean Group (PMG) estimation dependent variable: Stock ARDL (1.1.1.1.1). Model Section Criteria: Akaike Information Criterion (AIC)

Variable	Pooled Mean Group (PMG)			
	Long Run		Short Run	
	Coefficient	P-value	Coefficient	P-value
Interest rate	0.36	0.00*	0.12	0.51
GDP	1.17	0.00*	-1.03	0.91

Variable	Pooled Mean Group (PMG)			
	Long Run		Short Run	
	Coefficient	P-value	Coefficient	P-value
Inflation	-0.34	0.00*	-0.05	0.93
Exchange	-0.49	0.01**	0.20	0.80
Error correction(-1)			-0.34	0.00*
Hausman test Result	Chi2 = 2.25 Prob=0.690			

Note: * and ** show the significance level at 1 % and 5%

After estimating the MG and PMG, the Hausman's (1978) test is conducted. The p-value of the Hausman's test (0.690) is insignificant and suggesting to accept the outcomes of PMG estimation. The leg length of the estimated model is determined by Akaike information criterion (AIC). The AIC suggests that ARDL (1.1.1.1.1) is the appropriate lag selection for all cross sections.

The results of PMG are more consistent and efficient than MG, so the PMG estimations can be used for explaining the impact of dependent variable of independent variables in long run and short run and this verifies the Hausman's test's decision. PMG results reported in Table 3 show that the error correction term is significant and negative, indicating that in the long run all the explanatory variables have relationship with the dependent variable. For instance, the coefficient of interest rate shows that 1% change in interest rate positively impacts the stock market performance in the G7 countries by 3.6%.

In addition, the GDP influences the stock market performance positively by 11.7%. However, inflation and exchange rate are found to have negative impact on the dependent variable in the long run. It shows that 1% change in inflation and exchange rate negatively influence the stock market performance by 3.4% and 4.9% respectively.

However, in short run no variable is statistically significant revealing no relationship between dependent and independent variables. As by employing the PMG, the coefficients in short run are restricted to vary across each cross section and it's not possible to get a single pool of all the cross sections in panel.

Conclusion

Stock markets are the institutions to generate funds for the investment projects in order to accelerate economic growth. The current study intends to examine the influence of macro-economic variables as interest rate, inflation, exchange rate and GDP on stock market performance in G7 countries for the period since 1985 to 2015. Interest rate in the G7 countries is showing downward trend and this low interest rate is found to have positive impact on the stock market performance. This shows there is an inverse relationship between interest rate and stock market performance which is consistent with the findings of previous researches.

Economic growth of G7 countries is also increasing although with slow pace. However, this increasing trend in economic growth showed positive association with the stock market performance. On contrary, the empirical findings of this study reveal the negative relationship between inflation and stock market performance in the developed countries of G7. Moreover, the exchange rate is also found to have negative impact on stock market performance. The findings encourage to policy makers in G7 countries to formulate prudent economic policies in order to have stable macroeconomic environment. The stable macroeconomic environment through stability in interest rate, inflation, exchange rate and economic growth can ensure the maximum benefits from stock markets of G7 countries. Particularly these developed economies need to tackle the downward trend of inflation that is negatively impacting the stock market performance and focus more interest rate and GDP growth stability.

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Macroeconomic Factors' Impact on the Volume of Household Savings in the Visegrad Four Countries

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Abstract:

In the last decade the domestic financial environment was affected by a number of important factors that allowed increase of household indebtedness. From a macroeconomic perspective the Visegrad Four Group of countries belongs to the less indebted countries in the European Union, but tracking of the volume of savings showed the opposite effect. Submitted article evaluates development in household income, consumption, and savings in the V4 countries in 2005-2016. Impact of selected macroeconomic factors by multivariate panel regression analysis that solves linear relationship between savings and disposable income, gross domestic product, unemployment rate, and inflation rate, was evaluated. The analysis confirmed, that a statistically significant parameter of the model, and the most important determinants that have strongly positive impact in all the surveyed countries were inflation rate and unemployment rate. They had similar negative impact to modelling of the value of savings. Indicator increase by 1 percentage point caused decline in savings by 11.6743 units in case of unemployment and 12.5727 units in case of inflation.

Keywords: savings; household consumption; unemployment rate; macroeconomic factors

JEL Classification: E17; E21; E27

Introduction

The paper is concentrated on the macroeconomic integrating forecasting with use of predictive simulation and econometric estimation of a given variable into a standard moving average process (Dobrescu 2014). That is a linear algorithm with constant positive weights of distributed lags. The empirical search relates to the Visegrad Four countries data. Since the mid-nineties, the Central and Eastern Europe (CEE) has shown considerable economic dynamics. The cooperation of the Visegrad Four group of post-communist countries started in the February 1991 with the aim to harmonize activities and to shape cooperation and close contacts with the European institutions as well as to hold regular consultations on the matters of their security. It was established as a platform for countries of similar situation and similar economic, social and security problems (Brazova *et al.* 2013). Since its establishment the Visegrad Four Group (also known as the „Visegrad Four" or simply the „V4") of countries (Poland, Czech Republic, Slovakia and Hungary) have undergone remarkable economic transition.

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1. Literature review

The V4 countries chose, in spite of geographical proximity and historical links, different reform strategies, especially with respect to inflation stabilisation and privatisation (Staehr 2004). After several decades of planned economy and manufacturing-oriented economic policy, the V4 countries have been experiencing a shift towards a market economy combined with intensification of services activity (Hudakova 2011, Mura 2011, Glova 2014, Modrakova *et al.* 2014, Kocisova 2015, Mirdala 2015, Melikhova *et al.* 2015). With a population of over 64 million inhabitants representing 13% of the EU 28 was to the total economic output in 2003 only about 3,7% of the EU28 (Uhrova 2015). The economic reforms, privatization, and international support especially in form of foreign direct investment helped to create SME sector, and increased the competitiveness of these countries in the international scale (Capik and Drahokoupil 2011, Banociova and Raisova 2012, Michalski 2013, Soltes and Gavurova 2014, Dubravska *et al.* 2015, Spirkova *et al.* 2015).

Thanks to the continued "catch-up" dynamics, consisting of lower wage costs, well trained labour force, healthier banking sector, and less public and private debt, the V4 economies are expected to continue growing faster than countries of the Western Europe. The combined GDP of the V4 countries already makes them the world's 15th-biggest economy (Nič and Świeboda 2014). Over the last decade, the V4 countries have experienced strong income convergence. The GDP per capita of the V4 measured in purchasing power standards has increase from 49% of that of the EU15 in 2003 to 65% in 2013. Thus, the income gap between the V4 and the old EU members has narrowed by 1/3 (Jedlička *et al.* 2014).

2. Macroeconomic factors influencing the volume of households' savings

Standard consumption theory implies, that the changes in net worth that permanently alter households' resources should cause consumption to change in the same direction. This posited relationship is consistent with the strong positive correlation between asset prices and consumption across developed countries. Permanent changes in household resources result in higher consumption, while transitory changes leave spending little changed (Cooper and Dynan 2016).

The degree to which past adverse income shocks increase the saving rates of affected households is consistent with history-dependent dynamics: more experience of past crises tends to increase household saving (Aizenman and Noy 2015). Households' incomes, education levels, occupation, place of residence (rural/urban), car ownership and household size are found to be significant variables in explaining the variation in households' saving and portfolio choice behaviour (Temel Nalin 2013, Dobrescu 2014).

The global financial crisis and following recession in 2007-2009 raises many questions regarding the long-term response to crises. It was characterized by a rise in household saving to household disposable income ratios. A negative correlation between risk and private saving in cross-country comparisons, particularly in developing countries was found (Aizenman *et al.* 2015). Risk sharing is more effective (higher) for individuals whose savings are more flexible, while it is less effective (lower) for individuals characterized by more stable savings rate, regardless of their economic conditions (Balli *et al.* 2016). Nevertheless, the V4 economies experienced an increasing savings rates just in the year 2009 (Zahumenska 2014).

Economic growth and performance of the EU countries in the period the crisis were generally associated with a reduction in household income. Increasingly, individuals and households were in charge of their own financial security and showed evidence that many of them are not well-equipped to make sound saving decisions (Lusardi 2015). Households with low income and less financial education did not adjust their financial behaviour and are thus likely to face difficulties in bridging the gap arising in future pension income (Borsch-Supan *et al.* 2015).

Multilevel studies across several countries demonstrated that as societal poverty increases, well-being decreases, but even in high-poverty societies, saving greatly improves well-being. The lives of the poor can be improved through formal saving mechanisms that are grounded in their lived experiences (Martin and Hill 2015). In an open economy the interaction between growth differentials and household credit constraints (more severe in fast-growing countries) can explain three prominent global trends: a divergence in private saving rates between advanced and emerging economies, large net capital outflows from the latter, and a sustained decline in the world

interest rate (Coeurdacier *et al.* 2015). Based on an extended post-Keynesian model, the association between the savings rate and income inequality is negative if savers' funds are borrowed by spending households for consumption, but positive if savings are channelled to investing firms for production (Sheng 2015).

Most of the scientific research, focused to personal and household financial management is based mainly on fundamental approach and do not specifically target the decision making mechanisms in a specific household affected by current, permanently changing conditions on global financial markets or macroeconomic processes in a specific country (Taujanskaite and Milcius 2012). A sound knowledge of the cyclical behaviour of the household saving ratio and of the determinants of this cyclicality is crucial to understand how recessions affect the economic environment and to understand the options that policy makers have to affect this environment. Investigation of the household saving to household disposable income ratio for 16 OECD countries (1969-2012) has shown, that the household saving ratio is countercyclical. Standard consumption theory implies that changes in net worth that permanently alter households' resources should cause consumption to change in the same direction (Cooper and Dynan 2016).

Increasing household debt was found to be significantly affected by positive changes in consumer price index, gross domestic product and household consumption (Meniago *et al.* 2013). Net disposable income, cross-cultural dynamics, inflation rate, saving rate as a proportion of household income, and social globalization index have significant impact on household spending (Verter and Osakwe 2014).

Determinants that influence the volume of household savings may be considered unemployment and its components (seasonal, cyclical and structural) (Tvrdon 2014, Pereira and Andraz 2015), unemployment risk, household wealth and credit constraints (Adema and Pozzi 2015), and income inequality (Ryoo 2016). Causality was indicated between saving rate and household spending, as well as between the inflation rate and household spending (Verter and Osakwe 2014).

Aim of our research was to assess and evaluate the impact of selected macroeconomic factors using multivariate regression panel analysis which solves linear relationship between savings and disposable income, gross domestic product, unemployment rate, and inflation in the Visegrad Four countries in the period 2005-2014.

3. Methodology

The data used in the analysis came from the Eurostat (2015) and OECD database (2015), and have been processed in R programming environment (R Core Team 2012). The analysis was carried out in the Visegrad Four countries: Czech Republic (CZ), Hungary (HU), Poland (PL) and Slovakia (SK).

For assessment of macroeconomic situation in terms of our analysis, it was necessary to know the disposable income, household consumption and, consequently, the amount of household savings, so in the first part of the article we discuss the development of these parameters.

Within the households, the citizens, sole traders (freelancers), and non-profit institutions serving to households were evaluated.

In accordance with other authors (Byrne and Davis 2003, Aron *et al.* 2012, Duca and Muellbauer 2013), we chose following the macroeconomic factors: gross disposable income, gross domestic product, unemployment rate, and inflation rate. The second part of the article evaluates the impact of these factors on the volume of savings. We investigated their effect using multivariate panel regression analysis of linear type, used also in the analyses of Hsiao *et al.* 2006, and Boubtane *et al.* 2013, where:

- response (dependent) variable represented: S - volume of gross savings in the EUR millions
- explanatory (independent) variables were: GD - GDP in EUR millions, at current prices, UR - unemployment rate in %, IR - inflation rate in %, DI - gross disposable income in EUR millions.

Thus we start from the fact that the changes of the variable S can be explained by changes in a number of variables, namely GDP, UR, IR, and DI. We assumed that the relationship between the dependent variable and independent variables is linear, and we enroll it as weighted panel econometric model of linear type in the form:

$$S_c = w_{c,0}*\beta_{c,0} + \beta_{c,1}* w_{c,1}*GDP_c + \beta_{c,2}* w_{c,2}*UR_c + \beta_{c,3}* w_{c,3}*IR_c + \beta_{c,4}* w_{c,4}*DI_c + + u_{c,t} \quad (1)$$

where: $\beta_{c,0}$, $\beta_{c,1}$, ... $\beta_{c,5}$ are estimates of regression coefficients for country C; $w_{c,0}$, $w_{c,1}$, ... $w_{c,5}$ are weights of explanatory variables for country C; $u_{c,t}$ is a random component for country C, which includes unmeasurable random factors.

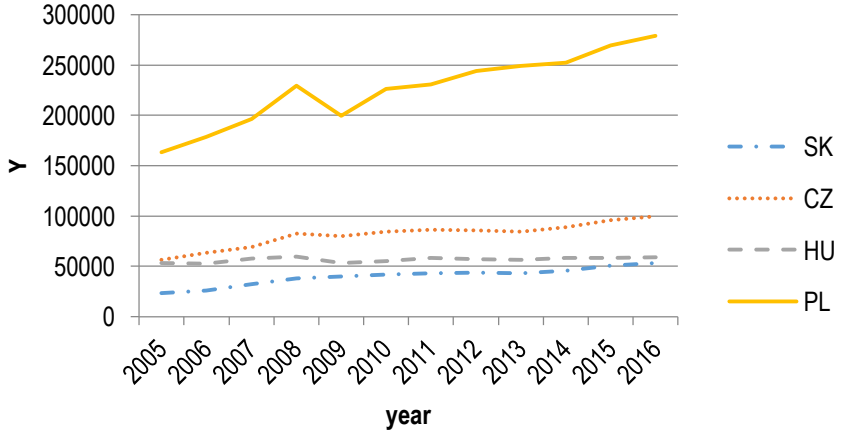
Weights of explanatory variables were chosen as follows: w_0=0.75, w_1=0.5, w_2=0.75, w_3=1, w_4=0.75. Weights have been divided into four zones divided by the value of 0.25. Specific multiplier, we assigned on the base of provided analysis of vector values of panel data explanatory variables. The data that served as input for modelling the volume of savings were tested for statistical disorders. We investigated the normality of residue values, the presence of heteroskedasticity, autocorrelation, and ultimately the correct specification of the overall model. For a decision on the test failures, we applied a standard 5% significance level. To determine whether residues derives from a normal probability distribution, the Jarque-Bera test (Jarque and Bera 1980) was used. For the presence of data heteroskedasticity the Breusch-Pagan test (Breusch and Pagan 1979), and the Goldfeld-Quandt test (Breusch 1978, and Godfrey 1978) were used. The presence of multicolinearity was determined by the Goldfeld-Quandt test (Goldfeld and Quandt 1965). We tested the autocorrelation by the Durbin-Watson test (Durbin and Watson 1950) and by the Breusch-Godfrey test (Breusch 1978, and Godfrey 1978). Finally, we verified the correct model specification by the Ramsey reset test (Ramsey 1969).

For all the Visegrad Four countries we have worked with several models. The model was ideal, if there was no heteroskedasticity, autocorrelation, and multicolinearity, and if the residues had normal distribution, and variables influenced the model with statistical significance. The values of the resulting models were presented only.

4. Development of disposable income, consumption and savings in the V4 countries in period 2005-2016

Household decisions about how much of their income they will use to present or future consumption has now become the subject of an increasing interest. Household consumption in most countries represents more than half of the GDP, affecting foreign trade and investments. An important factor influencing the volume of savings is amount of household disposable income, which constitutes internal funds for consumption or accumulation of savings, respectively. Its dynamics and volume during several observed countries reached significantly different values (Figure 1).

Figure 1. Gross disposable income development in the V4 countries (2005-2016) in millions of Euros



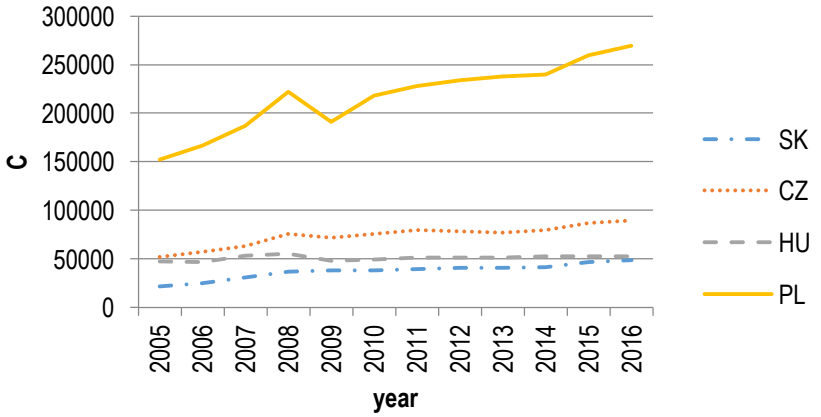
Source: Own processing of Eurostat data (2017)

In all the V4 countries there was an increase in disposable income until 2008, and in terms of the pre-crisis development reached the Slovak Republic (23.05%) the greatest improvement among the V4 countries, while the increase in disposable income in Czech Republic, Poland, and Hungary reached 10.90%, 9.96%, and 7.22% respectively. According to the Statistical Office of the Slovak Republic (SO SR) the fastest growth rate within the current income were recorded in case of property income (interests, dividends, land rental income, etc.) and other

disposable income (income from sole traders' business, revenue from sales of agricultural production, rental income, *etc.).* In the post-crisis period, the Czech Republic showed a decline in disposable income which had a negative impact to the level of sole traders' profits and hence there was an on-year decline in revenues. This negative fact was in the financial crisis period largely influenced by the impact of legislative changes, namely the introduction of a flat tax (21%), higher flat rates for a tax base deduction for sole traders, and setting of upper limit of insurance premiums for high-income workers. The situation was similar in Hungary, where disposable income fell the most significantly for the whole observed period to 10.56%, reaching the lowest income level (EUR 53,553). On the other hand, Poland was second fastest growing economy within the V4 countries until the crisis development. In 2008, Polish households have recorded positive disposable income development, which grew year on year by 16.81%, but in the next year of crisis (2009) it decreased similarly as in other V4 countries by 13.05%. Since 2013 in The Czech Republic positive disposable income development was evident, mainly due to continual year on year increase in the volume of wages and salaries, social benefits also had a positive contribution.

The growth of retirement was influenced significantly by the recovery in the labour market, the tax optimization effect at the turn of 2012 and 2013 had also a partial impact. In Poland during this period, household incomes grew by 5.91%, represented mainly by income increase of social character (assistance benefits in material need). In the Slovak Republic there was a negative impact of the year 2013, as the Slovak households' income declined by 0.43%. This decline was mainly due to the increasing unemployment rate, which in this period reached 14.2%, and was the highest among the V4 countries. Apart from the household incomes consumption expenditures are also important, as in case of income level increase the households are willing to spend more, thus increasing the consumption. Income growth in our analysis was accompanied by growth in consumption, while income grew faster than consumption (except for the period of crisis).

Figure 2. Household consumption development in the V4 countries (2005-2016) in millions of Euros



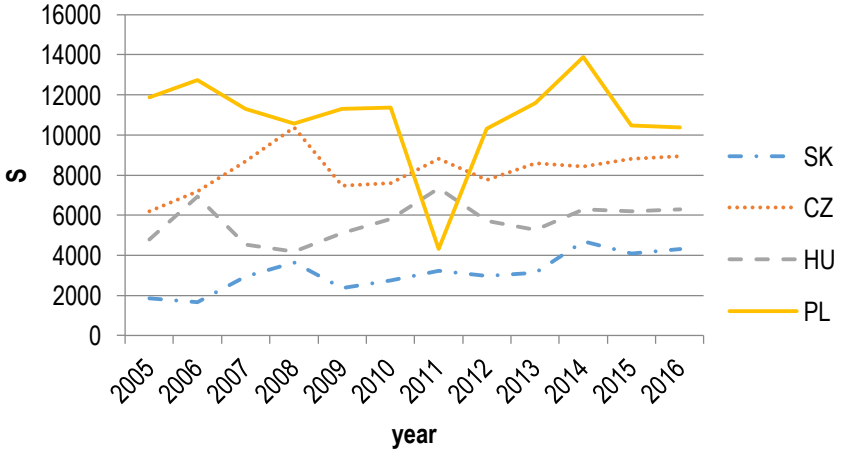
Source: Own processing of Eurostat data (2017).

One of the highest annual growth in household consumption (21.76%) (Figure 2) was achieved in the Slovak Republic in 2008, which was supported mainly by growth in gross disposable income (23.05%). The crisis influenced the prices of many goods and households took advantage of the better offers of the sellers. As for the other V4 countries the annual variation in the consumption of the population in 2009 decreased in all three countries (the Czech Republic by 5.44%; Hungary by 13.03% and Poland by 13.89%). During this period, households were more cautious and began to limit their consumption. In the Czech Republic and Hungary during observed period consumption decreased significantly (in the Czech Republic by 5.44%; and in Hungary by 13.03%). In Poland, consumption was increasing until 2008, then decreased (in 2009 by 13.03%), and since 2010 has grown slightly.

Household consumption development in individual countries was linked to wage growth, employment, as well as growth in other gross incomes (income from sole traders' business, revenue from the work performance agreements). The population tried to adapt their consumption to their income volume, as the consumption was

directly dependent on income and on funds available to the households. Decrease of individual consumption expenditures of households deepened, and together with high unemployment and lower wages caused lower domestic demand. Nevertheless, signals of households' improvement was the growth of their final consumption expenditures. It was particularly long-term consumption expenditures such as vehicles, household equipment, and others. Regarding the structure of consumer expenditures, expenditures on housing, water, electricity, gas and fuels rose (27.3%). The second largest item were expenditures on food and non-alcoholic beverages (15.7%). The smallest items were expenditures on clothing and footwear (3.0%), health (2.4%), post and telecommunications (2.9%), and education (0.6%). Growth of income and consumption results in growth of savings. Households saved more. It was caused by uncertainty and negative expectations about future income.

Figure 3. Household savings development in the V4 countries (2005-2016) in millions of Euros



Source: Own processing of Eurostat data (2017).

In the Slovak Republic household savings decreased by 35.01%, as the households used the total income for consumption, especially for goods of everyday use. In Hungary, household savings increased annually by 22.03% in 2009, as a result of households worries about the future, and following more intensive saving. Impact of the severe reduction in the number of jobs vacancies caused reduction in volume of wages, and this reflected in the payment of the unemployment allowance, and other social benefits respectively. People used more the early retirement institute, which further increased the income payments. This strengthening of the households' resources had a significant impact on the fact, that the households' disposable income did not fall, but despite the overall bad situation of the economy it was rising, thus increasing the volume of savings in 2011 (26.07%) (Figure 3).

In the Czech Republic the increase in savings until 2008 (19.60%) was replaced by a severe decrease (by 28.13%), and since 2010 again increase (1.90%), due to legislative changes. Negative savings were showed by none of the countries surveyed. The highest change in savings was recorded in Poland in 2012, when the savings increased by 139% over the previous year. During this period, the fraud of the century came to light, which get rid of the life savings of at least 2,990 Polish households (by almost 43 million of euros) by the investment into gold through the fund operated on the principle of a Ponzi scheme. It is expected that in bad times, when households have lower incomes, they use their savings or start to draw the loan. Over time, since 2010, the threat of lower revenues, or possible job loss respectively, has forced the households to save more. Households use various forms of saving, such as: direct investments into securities, mutual funds, life insurance, pension plans, building savings, foreign currency deposits, time deposits, demand deposits, and cash kept at home. Most popular alternative form of savings among the V4 countries is the building saving. In the Slovak households, moreover, there was quite a strong focus on cash, the amount of which was higher compared with the Czech Republic. This was also reflected before the Euro changeover, when households during the next few months put into domestic banks about SKK 120 billion (EUR 3.98 billions), the greater part of which was returned in form of new currency into household wallets during 2009.

Factors influencing the volume of savings: Macroeconomic factors affecting the volume of savings, which we have chosen for following analysis were: gross domestic product, unemployment rate, inflation rate and gross disposable income.

Gross Domestic Product: Development of GDP as an indicator of economic activity of each country represented a change in GDP comparing to the previous quarter in % for the period 2005-2016. GDP change, influenced mainly by consumption and investments reached in the Czech Republic increase by 9.10 % and in Poland by 19.32% in 2007. Investment activity grew in all areas. In case of consumption expenditures this growth was affected by the growth of real household income, which grew faster than productivity. In the Slovak Republic and Hungary, the pace of change in GDP fell, confirming the trend of economic slowdown from the previous year. In 2008 there was a decline in the rate of GDP change in all surveyed countries, caused by the financial crisis. The smallest decrease was recorded in Poland (1.34%). A year later there was a revival of the economy which affected the growth of gross disposable income. In late 2013, the rate of GDP change remains almost unchanged: in Poland annual increase reached 14.02%, in the Czech Republic by only 1.41%, and in Hungary by 5.99%. On the other side the Slovak Republic reached decrease by 3.31%. In 2014, however, the Czech GDP grew by 2.18%, while in the other V4 countries the decrease has occurred within the range 0.35 to 2.93%. Source of growth was the household consumption, as well as the improvement in the labour market, when the unemployment rate in the Czech Republic declined by 1.2%.

Unemployment Rate: The unemployment rate (UR) had a fluctuating trend during the surveyed period. Optimal results despite the recession were noticed in The Czech Republic, which maintained a single-digit unemployment rate ranged from 4.9% in 2007 to 7.4% in 2009. In the Slovak Republic the values were within the range 10.7% in 2007 to 14.3% in 2012. In the V4 countries, the Slovak Republic had the highest unemployment rate, which was mainly due to the financial crisis and poor conditions in the labour market, and later because of increased dismissals in the public administration, when the government applied the austerity measures. As a part of the shock wave all over collective dismissals occurred. The unemployment rate has therefore deteriorated regardless of whether the financial crisis hit the country. However, by the end of 2012 it began to gradually decrease and in 2013 and 2014 was the second lowest value of the UR indicator within the V4 countries (7.8%). The highest value over the past ten years was registered in Poland in 2005 (17.1%). Since then, the value of UR indicator was decreasing until 2008, when it reached the level of 6.9%. The unemployment rate began to decline in late 2012 and in 2014 has reached 8.2%. In the Czech Republic in 2009 the decrease in the number of employed people reflected in the increase in the number of jobseekers and the unemployment rate by 3%. Over the last ten years all the V4 countries managed to reduce the unemployment rate, and this trend still continues.

Inflation Rate: Inflation was increasing uncertainty, particularly in terms of disposable income, with following reduction of the savings rate. Monitoring of this indicator was provided by the Harmonized Index of Consumer Prices (HICP). During the reporting period, the inflation rate (IR) ranged from 0.1% in the Czech Republic in 2014 till 7.1% in Hungary in 2007. The acceleration of price level increase between 2006 and 2007 was caused mainly by services, food, and regulated prices adjustments. In all countries the price level growth accelerated in 2007, the highest increase was noticed in food and energy prices influenced by global factors. Significant growth of IR was reported in the Slovak Republic (when the value climbed by 4.7% till 2011), and in the Czech Republic (by 2.8%). On the other hand, in Hungary and Poland, this increase was not confirmed. While in 2009, commodity prices have inhibited the price increase, raising their prices together with the gradual economic recovery in 2010, reflected in the acceleration of price growth. In 2010, the Slovak and Czech Republic represented the countries with the lowest inflation growth, but in subsequent years, the price level increased together with an increase of inflation. Since late 2012, the inflation rate in all the V4 countries decreased gradually, while in 2014 the IR ranged from 0.1% in Slovakia to 1.0% in the Czech Republic.

Disposable Income: The last indicator, disposable income (DI), implies that wealthier households are saving more. A positive correlation between savings and disposable income was confirmed by Friedman's theory, according to which the households begin to draw from their savings if their income decline is temporary according to them. In case of a permanent change in income they adjust consumption. The development of household disposable income during the reporting period in all V4 countries showed a positive growth trend of DI indicator.

The Slovak Republic, which in its development overtook other V4 countries has successfully improved its position in the generation of income. In 2008 there was a decrease in disposable income in The Czech Republic by 2.37%, in Hungary by 10.56%, and in Poland by 13.05% due to the economic crisis. Furthermore, the Slovak Republic recorded 23.05% income increase, the fastest growth showed the property incomes (interests, dividends, incomes from land rentals), and gross mixed income (sole-traders' business, rental income, and the contribution of households to own housing construction). In 2012 and 2013 in the Slovak Republic, The Czech Republic and Hungary DI declined by 2.27%, which was associated with an increase in the unemployment rate. In 2014 an increase in revenue took place in all surveyed countries due to the stabilization of the economy.

Impact of selected macroeconomic factors on the volume of savings using regression analysis: In the following overview below the results of comparison of saving models in individual V4 countries based on panel data (Czech Republic: CZ, Hungary: HU, Poland: PL, Slovak Republic: SK) were processed. The models for each country have been compiled from the original panel data.

Table 1. Value of the resulting investment models in the individual V4 countries

Country	CZ	HU	PL	SK	Panel
Jarque-Bera test	0.2452	0.3213	0.6451	0.3291	0.4560
Breusch-Pagan test	0.1172	0.6341	0.4624	0.3467	0.3361
Goldfeld-Quandt test	0.1951	0.5549	0.3917	0.2656	0.4007
Durbin-Watson test	0.0745	0.2224	0.3214	0.1545	0.1781
Breusch-Godfrey test	0.3960	0.9574	0.7797	0.6382	0.8891
Ramsey reset test	0.0602	0.2311	0.4615	0.1240	0.1179

Source: Own processing.

Table 2. Shape of the investment models in the individual V4 countries.

Country	Panel
Model	S = 0.75*β0 + β1*0.5*GDP + β2*0.75*UR + β3*1*IR + β4*0.75*DI
Estimation of regression coefficients	β0 = 231.4645 *** β1 = -0.0859 ** β2 = -11.6743 *** β3 = -12.5727 ** β4 = 0.1924 *
Resulting model	S = 0.75*231.4645 - 0.0859*0.5*GDP - 11.6743*0.75*UR - 12.5727*1*IR + 0.1924*0.75*DI

Source: Own processing.
Legend: Statistical significance: *** (0, 0.001>); ** (0.001, 0.01>); * (0.01, 0.1>).

The resulting model of linear type of panel regression estimated the regression coefficients for calculation of savings' generation in the V4 countries. GDP variable had an impact on the amount of estimated regression coefficient β1 = -0.0859. Thus, the increase of GDP led to a reduction of savings.

Increase of GDP by 1 unit resulted in decrease of savings by 0.0859 units. The unemployment rate also had a negative effect on the final value of savings. Its increase by 1 percentage point decreased savings by 11.6743 units. Inflation rate was an explanatory variable with a negative impact on savings. Its 1 percentage point increase resulted into a decrease of savings by 12.5727 units. Disposable income as an explanatory variable had little numerical effect on the modelling of savings. Increase of disposable income by 1 unit caused the increase of savings by 0.1924 units. All explanatory variables were statistically significant at least at the 10% significance level. A constant value and inflation rate were statistically significant at 0.1% significance level, and the unemployment rate with disposable income were statistically significant at the 1% level of significance. Jarque-Bera test confirmed that the residuals come from a normal probability distribution and P-value of testing statistics reached the level 0.456. The data did not show signs of heterogeneity which was confirmed by Breusch-Pagan test and Goldfeld-Quandt test. P-values of the test statistics fluctuated around 0.3361, or 0.4007 respectively, not rejecting the presence of homoscedasticity. The autocorrelation testing was negative and did not show its presence in the model,

as the p-value of the test statistics reached values 0.1781, or 0.8891 respectively. Ramsey reset had to verify that the model obtained the accurate specifications. P-value of test statistic reached the value 0.1179, reflecting correct specification of the model.

5. Discussion

The question of the levels of income, savings, consumption and total household wealth is currently very actual and interesting topic of many research and scientific discussions (Byrne and Davis 2003, Aron *et al.* 2012, Duca and Muellbauer 2013). Understanding and monitoring of individual macroeconomic determinants that influence the volume of household savings is very important for processing and development of future projections of economic growth.

Similar issues were elaborated by Browning and Lusardi (1996), and Pécsyová *et al.* (2013). Their results confirmed that the savings rate were affected by income, interest rate, financial wealth, inflation, government savings, access to credit, and in short term period also an unemployment rate. They found that the savings rate has been above its estimated equilibrium level, thus households were saving more, than it was indicated by economic determinants. The reason was the uncertainty and negative expectations about future income. Sufficient amount of disposable income that households used at the current or future consumption is an issue discussed by many authorities.

The idea that changes in household wealth may affect its consumption is firmly rooted in the opinions of Milton Friedman, and also in the works of Modigliani and Brumberg (1954), and Ando and Modigliani (1963). These authors in their models has previously assessed that households consume less if their incomes are expected and regular. Permanent changes in household incomes (unexpected incomes) according to them results in higher consumption. In our analysis, we have concluded that consumption growth was faster than revenue growth. Brunková *et al.* (2010) noted, the higher household income, the greater was the households' propensity to save. Also in our survey we found that the increase in disposable income caused an increase in savings. In bad times, when households have lower income, they usually start to use their savings. Pécsyová *et al.* (2013) in this context have found that Slovak people were in long-term view saving considerably less than the EU average. The reason, according to them, were the differences in wealth, income, credit availability and others. Nevertheless, the indebtness is still lower.

Saving rate was significantly influenced by the GDP. The increase in GDP led to a reduction of savings. An assessment of impact of GDP on the amount of household savings were described in the works of Golhar and Deshpande (1997), Çiftçioğlu *et al.* (2007) and Barro (1996). They could not clearly verify this dependency, as the savings rate is affected by a range of regressors (investment rate, inflation rate, the level and degree of financial development).

The unemployment rate in our analysis had a negative effect on the final value of savings. The same conclusions were described in the work of Carbone and Hey (2004), in which they investigated the relationship of the household consumption, employment and volume of current income. Their results documented direct correlation of employment rate and the volume of consumption as well as the amount of savings. Similarly, Liptak *et al.* (2015) in their research have found, that unemployment rate and wages of employees in the V4 countries have a similar development. Inverse relationship of growth rates of real GDP, and change in the unemployment rate is consistent with the economic theory (Tvrdon 2014, Tvrdon *et al.* 2012).

Conclusion

Households have in the current difficult economic situation complicated role, reconsidering their priorities in consumption and savings based on disposable income. Since the households represent basic units of the national economy, our task was to assess the development and relationship of volume of savings and macroeconomic determinants that affect it in ten years period. After application of linear type of panel regression analysis we concluded that in all the V4 countries was confirmed a strong positive impact of disposable income on the volume of household savings, so that the growth of disposable income as the only factor caused the increase of savings.

All other determinants had a negative character. Gross domestic product and the unemployment rate were seen as important, but not a core determinant.

The inflation rate according to our results did not belong to important determinants in any observed country and it has showed a strongly negative character. There are several opportunities to expand performed analyses and thus to answer other important questions regarding the optimal volume of income, consumption and household savings. One of them is to extend the analysis by other methods of regression analysis (logarithmic-logit, probabilistic-probit) which would disclose any deviations of explanatory variables in individual observed time periods. The input factors, that affect the volume of savings and can affect the overall modelling structure of explaining variable-the savings, can be modified as well. It is questionable whether the expert discussions on future development trends and possible modifications of design of our determinants could reach consistency and general consensus.

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Peculiarities of Regional Development and Industrial Specialization of the Far East of Russia

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Abstract:

The article examines the specifics of the Russian Far East regional development for 2000-2015 periods, identifies the main sources of financing economic growth in its constituent territories, and estimates the production specialization of industries and its relationship with investments in fixed capital. The aim of the study is to identify the specifics of the regional development of the region and to assess its production specialization. Methods of system analysis, synthesis, structural analysis, dynamics and concretization methods are used. In general, the conclusion is made about the unbalanced development of the Russian Far East economy, as well as inefficient regional economic policy. Certain restrictions related to the lack of official information on the GRP structure by sources of income and final product and labor costs ratio in the regions for 2014-2015 are caused by calendar features of statistical data release by FSSS of Russia. Originality/scientific or practical values are in modified methodology for calculating localization indicator. Practical application of the obtained results is also possible in the formation of regional economic policy in the constituent territories of the Far East in terms of identifying the resources for financing investment in fixed capital, as well as in identifying long-range region specialization branches.

Keywords: regional development; industrial specialization; the Far East of Russia; gross regional product.

JEL Classification: O11; Q32; R11; R53

Introduction

The branch structure and dynamics of the Russian Far East development, was formed under the influence of state programs. Recently, this region is being paid with special attention to both from the state, which forms a new institutional environment for the balanced development of these territories, and from the large monopolies implementing their investment projects here. There is a change not only in the structure of the economy of the constituent territories of the Federation, but also changes in their production specialization, which is formed under the influence of large investment flows. As a result, the subject matter of the article is quite relevant and strategically important, and the results obtained can determine possible directions for the further development of the Russian Far East.

Hypothesis: the development of the Far East has occurred due to the increase in the predominantly state financing of investments since 2000, which in the course of 15 years allowed to achieve a two-fold increase of the Gross Regional Product (GRP) and to form a new production specialization of its constituent territories.

1. Literature review

Today, there are a number of publications on the development of the economy of post-Soviet states, for example Benešová and Smutka (2016), Krumins *et al.* (2015), but the change in the economy is seen in them from the perspective of the potential for future regional integration, including at the district level.

Disproportions of regional development are presented in articles Alcantar-Toledo *et al.* (2014), Okabeand Kam (2017), but the works presented are devoted to political economy and are purely theoretical in nature. Particular attention is paid to the modeling of regional economic growth in the study of Richard (2011) and the resulting models can find practical application in econometric approaches.

There are a number of papers in which the interrelationship between electricity consumption and GRP production is considered, and elasticity indicators are calculated. These are the papers of Burke, Csereklyei, Faisal *et al*. (2016). The latter paper considered the economy of Russia as an object.

The development of certain branches, as well as their specialization at the regional level, was considered by such authors as Jiang *et al.* (2017) in which attention is paid to transport, Qin and Zhang (2016) studying the specialization of agriculture. But these papers do not consider the Russian economy as an object of study.

Some studies are related to the role of investment in the formation of economic growth in individual territories, in particular Davletshin *et al.* (2015), Vertakova *et al.* (2015). They are of particular value, as they are considering certain regions of the Russian Federation.

In addition, the opportunities for the Russian Far East to enter the markets of the Asia-Pacific region are considered in the papers of Lee (2013) and Fortescue (2016), who identified possible directions in the development of economic production in the Far Eastern region.

2. Methods and materials

The paper uses the data of the Federal State Statistics Service of Russia for the period 2000-2015 in the quantity and structure sufficient to obtain and justify the conclusions and results, according to the subject matter of the article. The study consists of the following steps and methods used:

- determination of the role of the Far East in the Russian economy using the method of structural analysis and based on Federal State Statistics Service of Russia's data on the gross regional product;
- measurement of economic growth in the constituent territories of the Far Eastern Federal District by the dynamic method and the method of comparative analysis, as well as the identification of factors for the formation of the final product (GRP) using the structural method of statistics;
- the study of the main sources of financing investment in fixed capital in the regions by the structural method, as well as the concretization of state regional policy in the Far East using methods of system analysis and synthesis;
- evaluation of the production specialization of the Far Eastern Federal District's constituent territories with the use of a statistical method for assessing the differentiation of regions, the cluster approach and location quotients;
- identification the relationship between investment in fixed capital and product specialization using the method of comparing data on the structure of investment and location quotients in the context of the economic activity types.

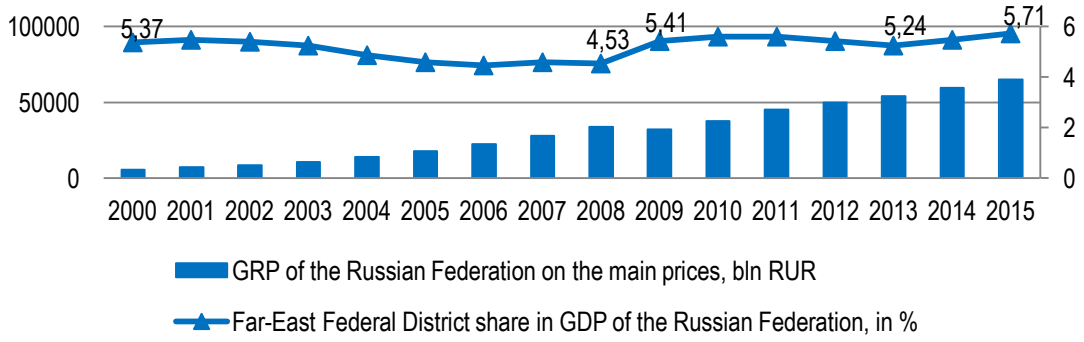
3. Result

3.1. The contribution of the Far Eastern region to the Russian economy. Estimation of gross regional product (GRP) dynamics.

Particular attention in the regional economic policy of the Russian Federation for the last five years has been given to the development of the Far Eastern region. The creation of a Ministry for the Development of the Far East in the structure of the Government of the country, the formation of separate funds and institutions that implement regional programs, the preparation of regulations and the allocation of certain areas of advanced social and economic development are all accompanied by investment projects of large Russian corporations and foreign investors in the region. These processes are caused by geopolitical changes, which are also supported by the large explored reserves of minerals of the Far East, its geographical proximity to the largest markets in the Asia-Pacific region (R. Lee 2013), the availability of the available infrastructure.

Despite this, the contribution of the Far Eastern Federal District to the development of the Russian economy with its enormous but not realized potential remains still not significant enough. Figure 1 presents data on the Gross Regional Product (hereafter GRP) of the Russian Federation at basic prices and the share of the Far Eastern Federal District in this indicator for the period 2000-2015.

Figure 1. GRP of the Far East in the structure of GRP by constituent territories of the Russian Federation



Sorce: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data.

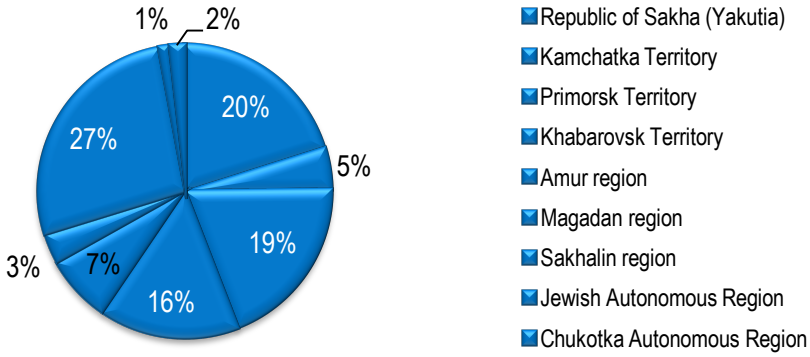
Favorable conjuncture of world hydrocarbon markets, observed in 2000-2008, allowed the Russian Federation's economy, against the backdrop of macroeconomic stability, to have quite high growth rates of the economy. At the same time, for this period the share of the Far East in the structure of the GRP of the Russian Federation has been constantly decreasing from 5.37% in 2000 to 4.53% in 2008 as shown in Figure 1, which is quite significant on the scale of the country's economy.

Under the influence of the global financial and economic crisis, there was a decrease in the GRP of the Russian Federation in 2009, but this process had a smaller impact on the economy of the Far Eastern region, whose share increased to 5.41% of the GRP of the Russian Federation this year. The further increase in the share of the Far Eastern Federal District in the Russian economy began to be observed from 2013 to 2015 - this is the time for the start of major projects implemented in the region that coincided with the deterioration of the macroeconomic situation in the country's economy as a whole - the devaluation of the ruble, a decrease in the volume of foreign trade, sanctions and retaliatory sanctions (Gurvich and Prilepskiy 2015). At the same time, the growth in the GRP of the country for the given period in basic prices is, in our opinion, primarily inflationary and is not connected with an increase in economic activity in the country.

3.2. The Gross Regional Product structure of the Far East for the constituent territories of the Federation and an assessment of its dynamics.

In order to find out exactly which exactly constituent territories of the Far Eastern Federal District make the largest contribution to the GRP of the Russian Federation, we will consider the structure of the GRP produced for 2015.

Figure 2. GRP structure in basic prices for the constituent territories of the Far Eastern Federal District in 2015



Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

About 82% of the GRP created on the constituent territories of the Far Eastern Federal District fell on four constituent territories in 2015: Sakhalin Region - 27%, the Republic of Sakha (Yakutia) - 20%, Primorsk Territory -

19%, Khabarovsk Territory - 16%. This is primarily due to the uneven distribution of production capacities, as well as resources and factors of production (Khomich and Boriskina 2014).

In order to examine in more detail which of the constituent territories of the Far Eastern Federal District had a significant regional dynamics of economic development during the period 2000-2015, we will analyze the GRP growth indices, the data are presented in Table 1.

Table 1. GRP growth indexes in some constituent territories of the Far Eastern Federal District and on average in Russia

Constituent Territory of the Russian Federation	2007 by 2000	Average annual rate in 2001-2007, %	2015 by 2007	Average annual rate in 2008-2015, %	2015 by 2000	Average annual rate in 2001-2015, %
The Russian Federation	1.69	7.8	1.12	1.4	1.88	4.3
Far Eastern Federal District	1.43	5.2	1.40	4.3	2.0	4.7
Republic of Sakha (Yakutia)	1.03	0.4	1.48	5.0	1.52	2.8
Primorsk Territory	1.45	5.5	1.33	3.6	1.92	4.4
Khabarovsk Territory	1.24	3.1	1.18	2.1	1.47	2.6
Amur Region	1.47	5.7	1.19	2.2	1.75	3.8
Sakhalin Region	2.85	16.1	1.67	6.6	4.78	11.0

Sorce: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

The table shows two main periods, differing in different macroeconomic conditions: 2000-2007 is the period of favorable conditions and world conjuncture; 2008-2015 is the period of economic crises and stagnation of the country's economy.

The total growth in all regions of Russia over the entire period increased by 1.88 times as a whole (Table 1), while GRP of the Far Eastern Federal District for the same period increased by 2 times. At the same time, the total GRP growth rates during the period under study were registered in the Sakhalin Region, here for 2000-2015 GRP in real terms increased 4.78 times. It was in exactly this constituent territory that new capacities of the oil and gas industry were put into operation.

The lowest growth rates of the economy for the period 2000 - 2007 are marked in the Republic of Sakha (Yakutia). The economy of Yakutia has lost its leading position in the district and has shifted to second place since 2005.

The GRP indicators in the Khabarovsk Territory are below the average regional dynamics. At an average annual growth rate of 2.6%, the real GRP of the region for 2000-2015 grew by only 47%.

The development of Primorsk Territory economy was largely determined by the high volumes of state funding to its infrastructure at the end of the period under consideration (the Vladivostok development subprogram in preparation for the Asia-Pacific Economic Cooperation summit).

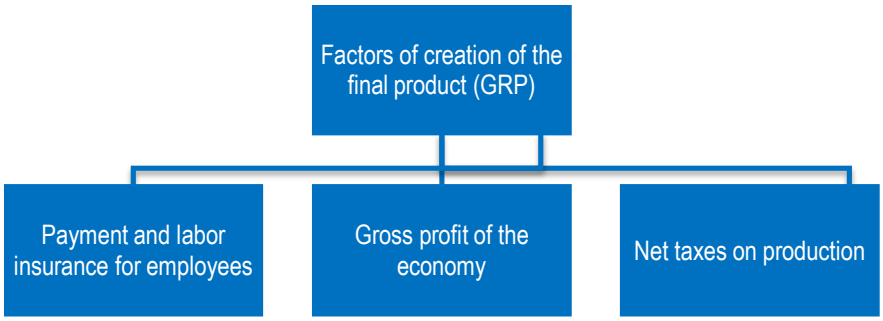
Indicators of GRP in the Amur Region in 2000-2007 exceeded the average growth rates of the Far Eastern Federal District during the same period. The average GRP growth rate has decreased from 5.7% to 2.2% since 2008. The decline in GRP is associated with large-scale flooding, which caused significant damage to the regional economy, especially its agriculture, in 2013, but on the whole GRP of the region for the period under review increased by 75%.

In general, for the Far Eastern region, economic growth for the period 2000-2015 was more stable than the average Russian, and was less affected by market changes.

3.3. Classification of the final product creation factors (Gross Regional Product) in the Far Eastern region

Further it is necessary to understand the question of what exactly determined the constituent territory of GRP in the subjects of the Far East of Russia. For this, the following factors can be identified for creating a final product (GRP) in the region at the primary income stage, as shown in Figure 3.

Figure 3. Factors of the final product creation in the region (GRP)



It should be noted that the gross profit margin of the economy includes profits of enterprises, incomes of entrepreneurs, depreciation. Net taxes on production, herewith, exclude the government subsidies to producers. These factors are the main reproductive resources of the region's economy in the Russian Federation.

Let us also estimate the ratio between the cost of labor as a production factor, on the one hand, and the magnitude of the final product (created from gross profit margin and net taxes), on the other. The results for 2013 are presented in the table. This period is taken in view of the fact that official data for subsequent periods, at the time of the study, have not yet been published by Federal State Statistics Service of Russia.

Table 2. The structure of GRP by sources of income and the ratio of the final product and labor costs in the regions following the results of 2013.

Territories	Share of factor in GRP structure, %			Profit and net taxes per unit of labor, rubles / rubles
	Costs of labor	Gross Profit Margin and Mixed Income	Net taxes on production	
Russian Federation's Regions				
Russian Federation's Regions on average	41.6	56.8	1.6	1.40
Far Eastern Federal District	47.2	51.3	1.5	1.12
Constituent Territories of the Russian Federation				
Republic of Sakha (Yakutia)	47.7	50.7	1.7	1.10
Kamchatka Territory	72.9	25.7	1.4	0.37
Primorsk Territory	48.9	49.2	1.9	1.04
Khabarovsk Territory	61.8	36.0	2.2	0.62
Amur Region	54.9	42.9	2.2	0.82
Magadan Region	70.9	27.9	1.2	0.41
Sakhalin Region	23.0	76.6	0.4	3.35
Jewish Autonomous Region	53.6	44.8	1.6	0.87
Chukotka Autonomous District	66.2	31.9	1.9	0.51

Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

As presented in Table 2, on average in the Russian regions, 41.6% of GRP was formed from paid labor, 56.8% - gross profit margin and mixed income, 1.6% - due to net taxes on production. It follows that in the Russian economy for 1 ruble of paid labor account for 1.40 rubles of added value.

In the Far Eastern Federal District economy per unit of paid labor, this indicator is lower by 20% and amounts to 1.12 units of gross profit margin and net taxes. Among the constituent territories of the Far Eastern Federal District, a special place occupied by the Sakhalin Region should be noted. The considered quotient in this constituent territory was 3.35, which is more than twice the average for the Russian Federation. At the same time, the share of the economy gross profit margin in the GRP structure of this constituent territory for the considered period was 76.6%. This is explained by the export supplies of oil and gas raw materials, on the one hand, and the maximum prices for hydrocarbon raw materials that were fixed on world markets - on the other (Gupta 2016).

Primorsk Territory and the Republic of Sakha (Yakutia) also have a high potential for expanded reproduction.

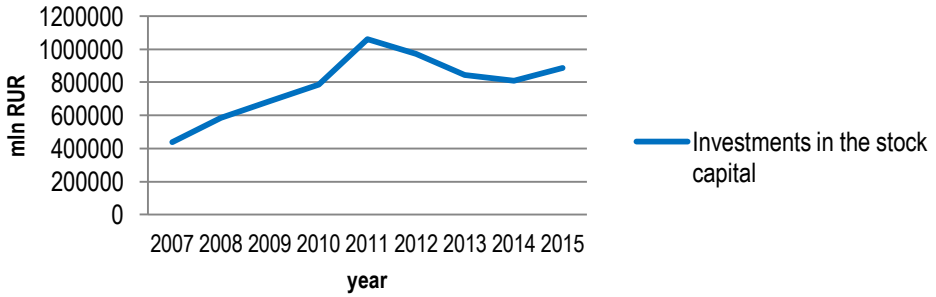
Here, most of the cost of GRP is also formed due to gross profit margin and mixed income.

However, most regions of the Far Eastern Federal District, in particular, the Kamchatka Territory, the Khabarovsk Territory, the Magadan Region, the Chukotka Autonomous District, are characterized by the fact that most of the product created in the territory of these regions is allocated for costs of and insurance labor. These regions form insufficient resources for intensive development of their economy.

3.4. Dynamics and structure of investments in fixed capital and their meaning by types of economic activity

Until 2011 the Far East was one of the leading regions in terms of the growth rate of investments in fixed capital. Cash was extensively invested mainly in capital-intensive infrastructure and resource projects, unevenly distributed across the territory (Figure 4).

Figure 4. Dynamics of investment in fixed capital in the Far Eastern Federal District



Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

Up to 80% of capital investments fell on the Republic of Sakha (Yakutia), Primorsk Territory, Khabarovsk Territory and Sakhalin Region. The visibility of the investment boom was created by the funds invested in infrastructure construction in the framework of investment programs of the monopolies, as well as direct budget injections into the construction of the Asia-Pacific Economic Cooperation summit facilities (about 679 billion rubles), the Eastern Siberia – Pacific Ocean pipeline (about 656 billion rubles).

However, after the completion of mega-construction projects, investments in the fixed capital of the Far Eastern Federal District began to decline. And only in 2015 the growth resumed, which is connected with the beginning of the implementation of projects within the framework of the formation of social and economic development areas, as well as investment projects in the fuel and energy sector directed to China (Skalamera 2016), and the associated production infrastructure (construction of export the "Siberia Power" gas pipeline, the Amur Gas Processing Plant's project, *etc.*), the coal industry, and the mining of minerals.

Despite the dynamics described above, there is a weak dependence in the economy of the Far East between the rates of investment growth and GRP growth. So the economy of the Far Eastern Federal District is characterized by a high investment rate, the value of which over the period under review was higher than the average Russian indicator, as shown in Table 3.

Table 3. Equity contribution in fixed capital in gross regional product, %

Indicator	2000	2002	2004	2006	2008	2010	2012	2014	2015
Russian Federation's Gross Domestic Product	15.9	16.3	16.8	17.6	21.3	19.8	18.8	17.8	22.34
Gross Regional Product of the Far Eastern Federal District	17.4	24.2	31.9	33.1	38.1	37.3	35.9	25.5	23.8

Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

The imbalance in gross regional product growth rates and investment in fixed capital is explained by the structure of investments with the predominance of capital-intensive long-term projects in the infrastructure and raw materials branches. Therefore, the search and attraction of investments in the regional economy, including foreign

direct investment, (Davletshin *et al.* 2015), which would have a greater impact on economic production - is a key issue determining the development of the economy of the Far Eastern region.

3.5. The main sources of financing for investments and their structure in the regions of the Far East of Russia

The main sources of financing investments in fixed capital for the region are:

- retained income and amortization (own funds of enterprises);
- funds received from budgets of various levels and extra budgetary funds;
- open market resources: loans of organizations, banks' lending resource, mobilized with the help of securities (shares, bonds) and other forms of capital mobilization.

The existing structure of the given sources of investment capital mobilization is presented in Table 4.

Table 4. Structure of investments financing source in fixed capital of the Far Eastern Federal District in 2005 - 2015, in %

The source of financing	Years	Average in the RF	Far Eastern Federal District	Republic of Sakha (Yakutia)	Khabarovsk Territory	Primorsk Territory	Sakhalin Region
Own means of the organizations (retained income and amortization)	2005	44.5	24.3	55.3	45.7	50.2	4.6
	2010	41.0	28.1	46.3	26.9	14.1	44.0
	2015	50.2	43.6	56.3	50.2	30.3	51.1
Budgetary and Extra budgetary Funds	2005	20.4	14.7	28.1	21.2	25.2	1.7
	2010	19.5	23.0	23.4	12.5	44.5	6.9
	2015	18.3	21.0	13.7	18.2	30.3	14.2
External Funds and Others	2005	35.1	61.0	16.6	33.1	24.6	93.7
	2010	39.5	48.9	30.3	61.3	41.4	49.1
	2015	31.5	35.4	30.0	31.6	39.4	34.7

Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data

There was a clear trend in increasing the share of own funds of the organizations of the Far East, which amounted to 43.6% in 2015 of the total amount of financing investments in fixed capital. At the same time, the share of borrowed and other raised funds in the region's economy is declining: in 2015, it decreased to 35.4%, which is confirmed by earlier studies (Sitnikova *et al.* 2015). The share of budget financing for the last 5 years remained at the level of slightly more than 20%.

Thus, the regional investment policy pursued by the state in the Far Eastern Federal District is characterized by the increasing role of self-financing of investments in fixed capital, with a gradual decrease in the share of attracted main sources of financing and a slight increase in the share of budget funds.

3.6. Production specialization of constituent territories of the Far East. Relationship of investment in fixed capital and production specialization

To obtain information about what or which activities determine the production specialization of the constituent territory, we calculated the location quotients K_L. A more detailed presentation of the localization indicators for the formation of a global index is presented, for example, in paper of Olivier *et al.* (2017).

This indicator shows how many times the concentration of this branch in the region is more or less than in other regions and in the whole country. The calculation was carried out according to the following modified formula:

$$K_L = \frac{FEA_p}{O_p} \quad (1)$$

where: FEA_p is the region type of economic activity, billion rubles; O_p - turn-round of regional organizations, billion rubles.

As an indicator of the type of economic activity in the region (country), authors suggest using the turn-round

indicator of organizations of a specific type of activity. As a turn-round of organizations in the region (country) in the calculations it is expedient to use the turn-round indicator of organizations of all types of activities. The results of calculations using the modified formula are presented in Table 5.

Table 5. Distribution of location quotients by types of economic activity of the Far Eastern Federal Districts

Type of economic activity	Far Eastern Federal District	Republic of Sakha (Yakutia)	Khabarovsk Territory	Primorsk Territory	Sakhalin Region	Amur Region	Kamchatka Territory	Magadan Region	Jewish Autonomous Region	Chukotka Autonomous District
Agriculture, hunting and forestry	1.07/1.3	0.2/0.3	2.2/2.7	1.4/1.9	0.2/0.3	4.0/2.3	0.4/0.6	-/0.4	-/0.8	-/0.3
Fishery	19.1/18.2	-/-	9.9/6.5	30/37.3	17.3/12.0	-/-	140/138	22.6/35.9	-/-	-/3.4
Mining	3.8/2.6	6.6/5.4	0.9/0.5	0.2/0.3	7.4/5.9	3.0/0.7	0.8/0.6	5.2/3.3	1.1/0.1	7.2/2.1
Manufacturing Activity	0.3/0.3	0.1/0.2	0.5/0.6	0.6/0.5	0.1/0.1	0.4/0.2	0.5/0.3	0.1/0.1	0.8/0.4	-/0.1
Production and distribution of electricity, gas and water	1.3/1.5	1.4/0.9	1.6/1.7	1.5/2.0	0.2/0.4	2.8/2.1	1.5/3.3	1.4/2.8	1.5/1.2	0.8/2.9
Construction	1.5/2.2	1.2/1.4	2.1/1.8	0.5/0.8	1.7/3.9	3.2/3.3	1.4/1.6	0.7/1.1	-/7.1	1.3/3.0
Distributive industries; repair of motor vehicles, motorcycles, household goods and personal private use	0.7/0.6	0.2/0.5	1.1/0.9	1.3/0.8	0.1/0.1	0.5/0.5	0.7/0.5	0.7/0.4	1.3/0.5	0.4/0.8
Transport and communication	0.9/0.6	0.7/1.0	1.4/1.8	1.5/2.6	0.5/0.7	0.2/3.4	0.4/1.0	0.3/1.1	-/2.8	0.3/1.1

Source: Compiled by the authors on the basis of Federal State Statistics Service of Russia's data
*Note**: the numerator contains data for 2015, in the denominator - for 2007.

It is possible to highlight three traditional specialization branches in the Far East - fishing, mining and construction - they remain highly concentrated in terms of locating within the national economy. Frankly speaking, if mining of mineral resources in 2015 increased its position as a specialization branch in comparison with 2007, then fishing and construction - reduced the level of spatial concentration.

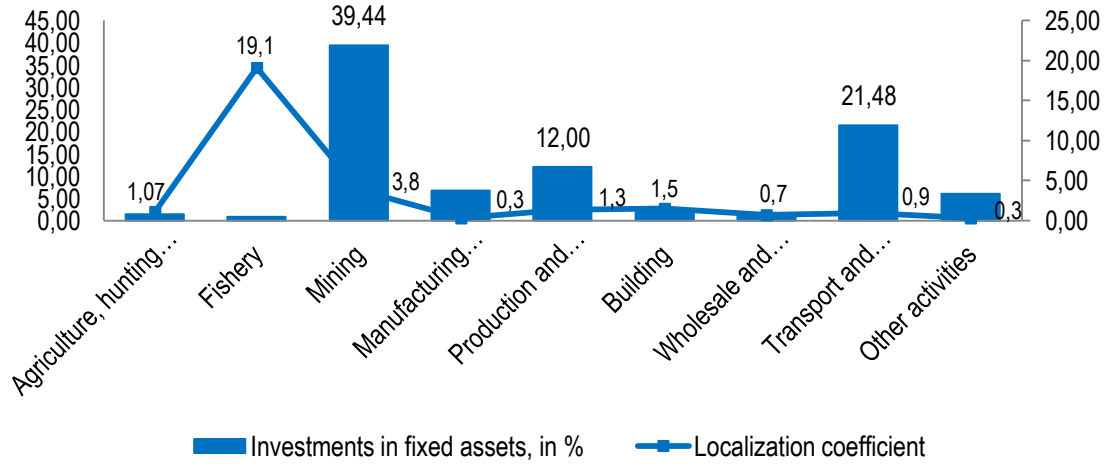
The largest specialization in the fishing industry was shown by the Kamchatka and Primorsk Territories, Magadan and Sakhalin Regions, as well as by the Khabarovsk Territory, which is related to the geographical position and the outlet to the Pacific seas. A high concentration of mineral extraction was noted in the Sakhalin Region, the Chukotka Autonomous District, the Republic of Sakha (Yakutia), the Magadan and Amur Regions, which is explained by the presence of high-grade deposits.

Construction is also a specialization of the period under consideration in the Khabarovsk Territory and especially in the Amur Region, where large federal projects for the construction of the spaceport "Vostochny" were carried out, as well as the construction of the Nizhne-Bureyskaya hydro-electric power station. Only in the Amur Region, the electric power industry can be considered as regional specialization branch due to the concentration of highly efficient and powerful hydroelectric power stations here (Kalashnikov *et al.* 2011). Agriculture, thanks to favorable conditions and the presence of large areas of arable land, is also specialization branch of this region. At the same time, the role of this branch can be underestimated and its development is (Qin and Zhang 2016).

Analyzing the obtained indicators for the specialization of individual regions, it can be assumed that the concentration of production was formed under influence of investment in fixed capital in various types of economic

activity, which are a resource for balanced, sustainable economic development in the regions of Far East.

Figure 5. Comparison of the volume of investment in fixed capital and the location quotient by types of economic activity of the Far Eastern Federal District in 2015



Source: Calculated by the authors on the basis of Federal State Statistics Service of Russia's data

As already noted above and shown in Figure 5, the main specialization branches of the Russian Far East, with the largest location quotient, are fisheries (19.1), mining (3.8) and construction (1.5).

However, the largest amount of investment directed to the economy of the regions was concentrated in the extraction of minerals (39.44%), transport and communications (21.48%), and production and distribution of electricity, gas and water (12.01%). Consequently, it can be concluded that the economy development of the region in question is unbalanced, in which investments in fixed capital do not form the specialization branches of the Far Eastern Federal District.

Thus, when achieving the aims set in this study, the authors revealed the following features of the regional development of the Russian Far East:

- Despite the richness of natural resources with great export potential (Gubaidullina and Yakupov 2015), the contribution of the Far Eastern region to the development of the Russian Federation's economy remains still not significant enough. An analysis of the dynamics of the GRP indicator showed that under favorable circumstances and the growth of the Russian Federation's economy as a whole, the share of the Far East is declining, and if the macroeconomic conditions worsen or the total Russian Federation's GRP decline is reduced, its share in the country's economy is growing.
- The heterogeneity of the economic space within the Far Eastern Federal District is revealed, which is noted in separate studies on global economic growth (Dinopoulos and Unel 2011). Among the constituent territories of the Far Eastern Federal District, the dynamics of the development of the economy is multidirectional, and in different periods different GRP incremental steps are noted.
- There is a weak correlation between the growth rates of investment in fixed capital and the growth of GRP in the economy of the Far East. At the same time gross profit margin and net taxes on production are the main reproductive resources of the regional economy. There is also a high share of costs of labor in combination with low reproductive potential, which does not ensure a balanced economic growth in full volume.
- In the period under review, the largest role in investments in fixed capital was in self-financing, with an insignificant increase in the share of budget funds and a simultaneous gradual decrease in the share of attracted sources of financing, which coincides with Sitnikova's separate conclusions of Sitnikova *et al*. (2015).

In addition, in accordance with the aim of the study, an assessment of the production specialization of the Russian Far East was made. The production localization indicators calculated which made it possible to distinguish three traditional specialization branches in the Far East - fishing, mining and construction. Of course, these

branches do not allow obtaining products with high added value. Comparison of the specialization of constituent territories of the Far Eastern Federal District with investments in fixed capital in terms of types of economic activity did not show the relationship of these indicators, *i.e*. directed investments do not form specializing branches in the economy of the Russian Far East.

4. Discussion

In the opinion of the authors of the article, as the discussion points that remain in the consideration of this subject, the interrelationships of the economic development of territories, investments and the features of the formation of the Gross Regional Product in the Far East of Russia are not fully revealed. A more detailed study of these dependencies can be a separate area of scientific study, requiring additional collection of necessary information, application of statistical methods, and modeling methods.

The structure and dynamics of sources of financing investments in fixed capital enable the authors to assume that for the period 2000-2015, there was a change in the regional investment policy pursued by the state in the Far Eastern Federal District in the direction of reducing the role of budgetary, borrowed funds and increasing self-financing.

In addition, the debating point remains connected with the fact that it acts as the main reproduction resources of the economy of the Russian Far East? There is a high share of costs of labor, combined with low reproductive potential. And recently gross profit margin and net taxes on production are the main engines for expanded reproduction in the region.

There are certain limitations in the study period regarding the results obtained in the Far East of Russia: there are branches in which large investments in the period under review have not led to the formation of specialization, while types of economic activity that do not have significant investment flows are the specialization branches of the regions. Perhaps, the period 2000-2015 does not allow to reveal systemic changes, and the construction of a longer series of data can reveal long-term structural investment processes and change in the specialization of regions.

Conclusion

Summing up, it should be noted that among the regional features of the development of the economy of the Russian Far East, one can name a large resource potential and heterogeneity of economic growth for individual constituent territories. At the same time, the first part of the hypothesis of this study, which explains the development of the Russian Far East since 2000 "due to the increase in predominantly state financing of investments," was not fully confirmed. It was determined that the ongoing investment policy for the period under report 2000-2015, is associated with the increased role of self-financing of investments at the expense of enterprise funds, with a small increase in the share of budget financing and a decrease in the role of borrowed funds.

The estimation of production specialization with the help of localization coefficients confirmed the traditional for the Far Eastern Federal District types of economic activity - fishing, mining, and construction. At the same time, the second part of the proposed study hypothesis, in which investments allowed "to form a new production specialization of its constituent territories" was not confirmed: directed investments did not form the specialization of the economy of the Far East of Russia for the considered period, and the weak dependence between the increase in investments in fixed capital and GRP confirms the inefficiency of the regional economic policy pursued in the investment sphere of the region.

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The Influence of Decentralization with Autonomy Power, Decentralization with Authority Power, Factor Mobility, the Construction Cost Index, and Inflation Rate Toward Labor Absorption Rate. Implications toward Regional Inequity in Indonesia

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Abstract:

This study to examine the influence of decentralization with autonomy power, decentralization with authority power, factor mobility, the construction cost index, and inflation rate toward labor absorption rate and its implication toward regional inequity in Indonesia. The research method used in this research is the library research, as a form of research that utilizes the tools available literature in the form of books, journals, data and other empirical studies. Cluster analysis in this study is used to classify regencies'regional inequity into two levels, namely low, and high regional inequity, also in economic growth in two levess, low, and high growth. Also the factor affecting such as decentralization with autonomy power, decentralization with authority power, mobility factor, construction cost index, and inflation rate in two levels (low, and high level). Based on the analysis, the result shows that decentralization with autonomy and authority power significantly effect to labor absorption. The highes value of decentralization, will decreasing the labor absorption rate. Vice versa, the lowest value of decentraliation, will increasing the labor absorption rate. Labor absorption rate as mediation variable in relationship between decentralization with autonomy and authority power significantly to regional inequity. This means that the higher the Decentralization with Authonomy and authority Power, with Labor Absorption Rate which the higher, the level of Regional Inequality will decrease.

Keywords: economic growth; regional inequity; autonomy power; authority power; cluster analysis

JEL Classification: C4; H1; O1; O4

Introduction

The decentralized system, generally, assures every possible autonomy for local governments in exploring sources of income and its allocation to the good of the people. The notion of decentralization itself should be interpreted and brought into practice carefully so then maintaining the harmony of politic, economy, and fiscal decentralization. Political decentralization essentially grants authority to the local government to carry out a policy, while the administrative decentralization or decentralized managerial provide clues to how the implementation of the transfer of authority of these functions. Fiscal decentralization then provide financing for the transfer of authority. Thus, fiscal decentralization is part of a larger design that consists of political decentralization, administrative decentralization, and fiscal decentralization which leads to the welfare of the people (economic decentralization).

Several studies suggest that the central government was failed in realizing the expected level of economic growth, poverty reduction, income distribution, and preparation of appropriate public services (Oates 1972). Although district are main providers of public services of the region, very few studies had been done on district's growing burden in decentralization era. The main reason of the lack of study in district level is due to the lack of data on district government which eventually encourages the writers to conduct the study of the relationship newly decentralized administration in regional level and how these changes affect the economic growth, and the imbalance among regions which is also a very important issue.

1. Research background

Fiscal decentralization as something that requires a shift of responsibility with regard to accountability at lower levels governments (Thiessen 2001). It can be defined that the lower government should be able to increase tax

revenue and allocate it into policies with given criterions. Moreover, Bird and Wallich (1993) state that fiscal decentralization is frequently interpreted as a package of changes aimed in improving efficiency in public sector in order to create a competitive atmosphere among regional governments in term of public service and to stimulate economic growth.

Fiscal decentralization, positively, encourages larger regional revenue by the transference of fund from the central government to regional government, *i.e*. the General Allocation Fund (DAU), Special Allocation Fund (DAK) and DBH (natural resources and taxes), and ultimately increase the economic growth of the region and, eventually, provide flexibility for local governments to forge policies purposed to stimulate the economic growth. Yet, negatively, fiscal decentralization may also increase the impact on the fiscal imbalances between regions, because of differences in potential and capacity.

The budget allocation for investment region will increase the capital stock of the region and opportunities for employment, thereby increasing the capacity of regional economies which eventually boosts economic growth. Moreover, increased economic growth impacts consumption and savings (investment) of the community and leads to the increased local tax base. Subsequently, the increased tax revenue and levies result in higher regional revenue. Therefore, it is assumed confidently that fiscal decentralization can encourage economic growth in spite of the consequences of redistribution of resources (Martinez-Vazquez and McNab 2001).

Regional districts and cities are today's main focus in term of increasing and encouraging their economic growth. Regions have resources that should be developed in a sustainable manner in which various possibilities can be done to encourage regional economic growth and equity by the local community. Local governments pursue high economic growth by opening and providing opportunities for development by opening various businesses or developing existing businesses. To do so, local government can initiate more development to industrial areas, hire professionals, or seek investors from other regions. Moreover, various incentive policies may be practiced to attract investment. Thus, generally, the local government aims to provide an enticing region for investors and a comforting region for staying.

Fiscal decentralization is a process by which local governments are given the region's economical authority. It covers fiscal responsibility at various levels of administrations. It also relates to fiscal instruments and procedures in order to assist the implementation of public services (Bird *et al*. 1995). Fiscal decentralization allows regional governments to provide varieties of different combinations of goods and public services sinceregional governments have more understanding toward the needs of its people compared to the central government. Proponents of decentralization believe that economic efficiency can be achieved in a decentralized government because they can provide multiple outputs (goods and services) at its best and reflects the priority needs of the regional people (Oates 1972).

A centralized government tend to provide a homogenous goods and public services for regions with different needs in the country. Assume that people from different regions needs different goods and public servies, different needs, then a centralized government that offer homogenous goods and services is not efficient. Moreover, Oates (1999) states that a form of decentralized state offer an increased efficiency of the economy by providing various outputs of public goods which is relevant with the needs of the differences between communities. The provision of public goods and services can also be associated with a lower administrative costs because the cost of implementation and supervision will be cheaper. Further, Oates (1999) also states that the benefits of economic efficiency, fiscal decentralization is the increasing accountability of local officials, especially when they have been elected. Moreover, government officials who are closer to their voters are more likely to allocate resources efficiently, and they do their best to optimize the level of economic development and public services as the only way to re-elected. In addition, each region is obliged to pay what they provide, so then they will attempt to achieve the efficient cost in which the marginal benefit grows simultaneously with merginal cost, compared to those services conducted by the central government (Tanzi 1996).

Community in a region of fiscal decentralization acts as a "research laboratory" for the entire population of the country (Osborne 1988). Decentralization allows experimentation and innovation in the production process of public goods (Tanzi 1996) and for the next, the experiment may lead to a more developed technology and producing better public goods and services and public policy (Oates 1999). When local communities grow and develop models

of economic development in a decentralized system, the first program implemented is that a relatively small scale. If the program is successful, it will developed in all parts of the country. Yet, even if the trial program is failed, only a small proportion of the people who suffered losses. Therefore, the transference of responsibilities to those represent the country illustrates the failure of the existing program and efforts of making the country as an experiment to find the program that suits all.

Economic growth is no longer a major concern in the theory of fiscal decentralization in generals since the principal concern is now on economic efficiency. Actually, growth theory does not provide a specific framework to explain or analyze the relationship between fiscal decentralization and economic growth (Martinez-Vazquez and McNab 2001). However, in the last two decades, fiscal decentralization policy has been massively applied in industrial countries as well as in developing countries, in which the goals or objectives of the fiscal decentralization policy making is to encourage better economic growth. Akai and Sakata (2002 and 2005) have examined the relationship of fiscal decentralization and economic growth and regional imbalances in states of the United States during the period 1992 to 1999. They found that the positive effect of fiscal decentralization on economic growth even tough fiscal decentralization did not have a significant effect on regional imbalances if fiscal decentralization measured by revenue contribution or contribution in the area of local government expenditure. While the attainment of autonomy by fiscal decentralization has a negative influence on regional inequality.

Zhang (2006) examines the impact of fiscal decentralization and political decentralization on economic growth and inequality in China and it was found that due to the large differences in economic structure beginning with a basic revenue of each region, so that the tax rate and the fiscal burden to support the role and functions of local government are significantly varies across the regions, where the regions are already from the beginning to have a basic a large tax is not sourced from the farm need not rely on the companies existing or new companies to finance public goods or services, and eventually create a healthy investment environment for non-agricultural sector to grow. In contrast, regions with agriculture as the main economic activity have resources left relatively small for public investment since all expenditures incurred to finance the bureaucracy. As a result, differences in economic structure and the fiscal burden could lead to regional deepened disparities.

Cheng and Li (2006) examines the inequality of revenue and efficiency by using a decomposition approach and its application in China. This study suggests a new interpretation on the decomposition of the Theil inequality index if the income can be described as a multiplicative component. By applying these methods in China, they found that the impact of technical inefficiency in inequality between regions shows a trend of diminishing. Yoshihiko, Mho and Tadashi (2007) introduces some relevant policy-oriented approach, which measures the economic impact of the development of social inequality. Gini inequality is frequently used because it is highly flexible and both individuals and groups of data are taken into account to describe a clear influence on the change of the Gini inequality. First, the estimation of the Lorenz curve is described as a concept that is very closely related to the Gini inequality. Next, using individual data from the 5938 household consumption expenditure in Vietnam, Kikuchi draw the conclusions of the factors that influence the inequality. By using multivariate statistical analysis, the study analyzes the calculation system of public expenditure, compared to public expenditure priorities before and after the execution of the development program of Western China (Western China Development Programme). There are two ways of analysis of the main component, the first one is based on a calculation system of the ordinary and the another one is based on the system of the new calculation, in which it is established through the analysis of the grouping variable, and considering the wholefully of Western China, the research study the changes of spending priorities. The main conclusion of the study is, after the execution of the development program of Western China (Western China Development Programme), there is a significant change in public expenditure priorities. The government has made change to prioritize the infrastructure provision and administrative maintenance, and transform community's stabilization policies.

Thornton (2007) examines the relationship between fiscal decentralization and economic growth using cross-section data from 19 OECD member countries. He reveals that limiting the size of fiscal decentralization to the revenue side of the regions that obtain full autonomy, then the impact of fiscal decentralization on economic growth is not statistically significant. Thus, the significance of fiscal decentralization and economic growth relationship cannot be explained due to independent tax power among the regions which in turn represents the

effectiveness of decentralization. Based on the background of the problems stated above, this research is aimed at studying the Factor in Economic Growth and Regional Inequity in Indonesia. Factor affecting in this study are decentralization of autonomy power, decentralization of authority power, mobility factor, construction cost index, and inflation rate.

2. Methodology

This study employs survey method. According to Mc Millan and Schumacher (2006), survey is used to study about attitude, belief, values, demography, behavior, opinion, habit, willingness, ideas, and other types of information. This study is located in Indonesia, distributed in 26 Provinces in Indonesia starting from Aceh to Papua. Population in this study is region/ Regency development area in Indonesia. Total population is 127 regions/regencies. This study takes all regions which are 127 regencies. Primary data is needed as supporting data to help further enrich the discussion of this research. This data is sourced from direct interviews or questionnaires several local governments with regard to the fiscal management of the area. Particularly with regard to financial management and a number of indicators that have been achieved.

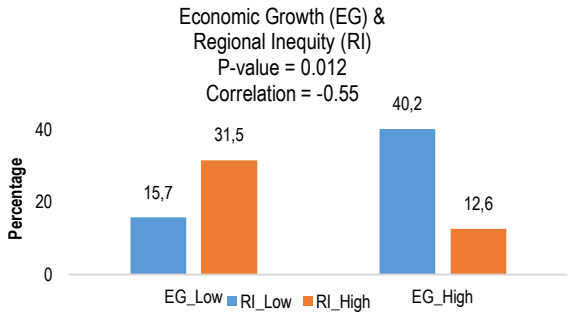
Secondary data is key data used in the model analysis of this study and sourced from multiple data sources, such as the Central Bureau of Statistics (BPS), the Ministry of Finance, Bank Indonesia reports and other sources. All data used in this study is a cross section data for all districts and cities in Indonesia area for each variable of research in 2008. Cluster analysis in this study is used to classify regencies'regional inequity into two levels, namely low, and high regional inequity, also in economic growth in two levess, low, and high growth. Also the factor affecting such as decentralization with autonomy power, decentralization with authority power, mobility factor, construction cost index, and inflation rate in two levels (low, and high level).

3. Case studies

3.1. Analysis result

The result of cluster analysis by Non-Hierarchical Cluster with Euclidean Distance showing 68 regencies classified in low regional inquity, and 59 regencies classified in high regional inquity. In other hands, the result of cluster analysis by Non-Hierarchical Cluster with Euclidean Distance showing 58 regencies classified in low economic growth, 38 regencies classified in moderate economic growth, and 31 regencies classified in high economic growth.

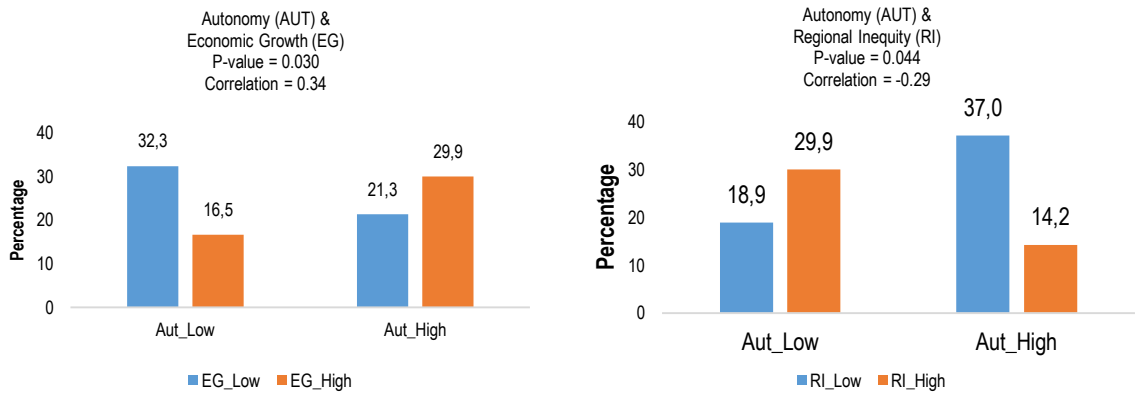
Figure 1. Economic Growth and Regional Inequity



The results of the analysis of cross-tabulation in Figure 1 shows that of the 127 regencies, 15.7% to the level of economicgrowth is low, have regional inequity is low; while 31.5% more to the level of regional inequity is high (more dominant regions with levels of economic growth is low, then it will lead the regional inequity that is high). On the other hand, at a high growth level of economic, are more likely to have a 40.2% regional inequity regions is low, although there are regenciess that have a 12.6% regional inequity is high. From the test results showed that the economicgrowth has a significant and negative relationship to the regional inequity (P-value of

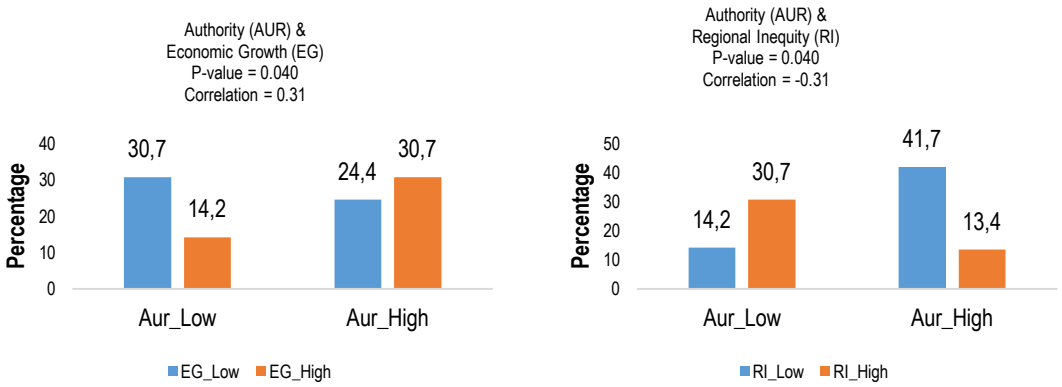
<0.05, and the value of negative correlation). It can be concluded that the higher the economicgrowth in the region, the lower the regional inequity of the regencies.

Figure 2. Autonomy power and economic growth-regional inequity



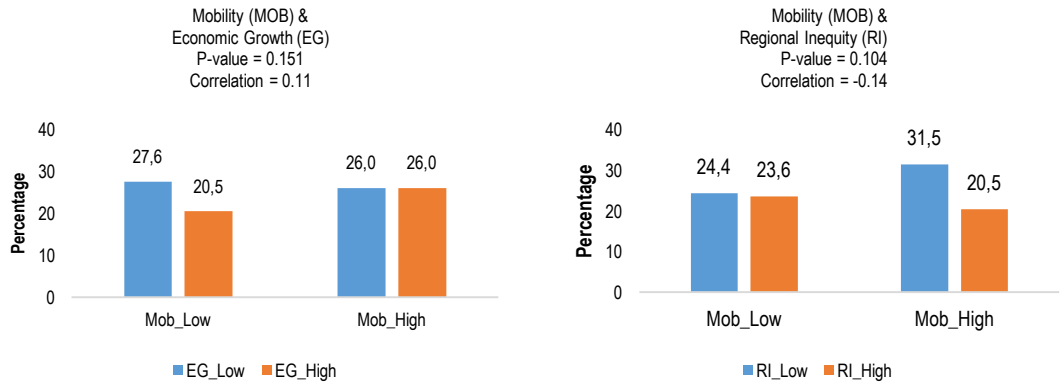
The results of the analysis of cross-tabulation in Figure 2 shows that of the 127 regencies, 32.3% to the level of autonomypower is low, have economic growth is low; while 16.5% more to the level of economic growth is high (more dominant regions with levels of autonomy power is low, then it will lead the economic growth that is also low). On the other hand, at a high power level of autonomy, are more likely to also have a 29.9% economic growth regions is also high, although there are regenciess that have a 21.3% economic growth is low. From the test results showed that the autonomy power has a significant and positive relationship to the economic growth (P-value of <0.05, and the value of positive correlation). It can be concluded that the higher the autonomy power in the region, the higher the economic growth of the regencies. Based on the right figure (relationship between autonomy power and regional inequity), 18.9% to the level of autonomypower is low, have regional inequity is low; while 29.9% more to the level of regional inequity is high (more dominant regions with levels of autonomy power is low, then it will lead the regional inequity that is high). On the other hand, at a high power level of autonomy, are more likely to have a 37.0% regional inequity regions is low, although there are regenciess that have a 14.2% regional inequity is high. From the test results showed that the autonomy power has a significant and negative relationship to the regional inequity (P-value of <0.05, and the value of negative correlation). It can be concluded that the higher the autonomy power in the region, the lower the regional inequity of the regencies. The result on Figure 1 and Figure 2 conclude that Economic Growth as mediation effect in relationship between Autonomy Power toward Regional Inequity, with negative correlation. It means that, the higher the autonomy power in the region, the higher the economic growth of the regencies, and will affect the lower the regional inequity of the regencies. In other hand, the lower the autonomy power in the region, the lower the economic growth of the regencies, and will affect the higher the regional inequity of the regencies.

Figure 3. Authority Power and economic growth-regional inequity



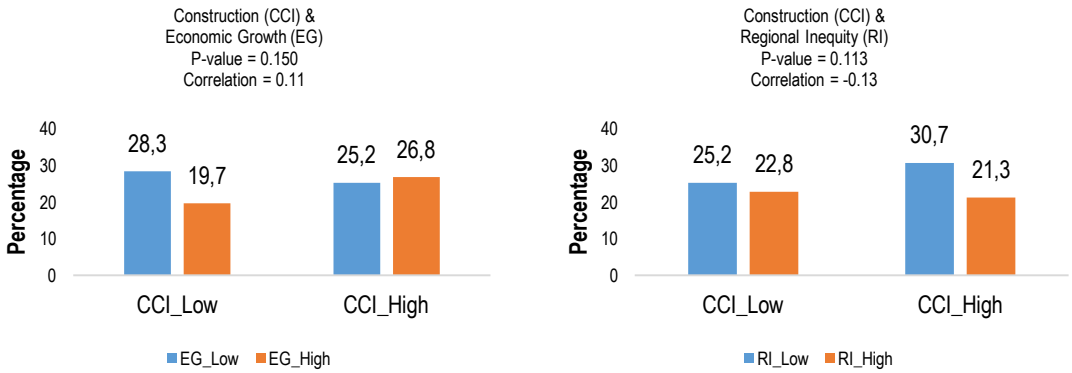
The results of the analysis of cross-tabulation in Figure 3 shows that of the 127 regencies, 30.7% to the level of authoritypower is low, have economic growth is low; while 14.2% more to the level of economic growth is high (more dominant regions with levels of authority power is low, then it will lead the economic growth that is also low). On the other hand, at a high power level of authority, are more likely to also have a 30.7% economic growth regions is also high, although there are regenciess that have a 24.4% economic growth is low. From the test results showed that the authoritypower has a significant and positive relationship to the economic growth (P-value of <0.05, and the value of positive correlation). It can be concluded that the higher the authoritypower in the region, the higher the economic growth of the regencies. Based on the right figure (relationship between authority power and regional inequity), 14.2% to the level of authoritypower is low, have regional inequity is low; while 30.7% more to the level of regional inequity is high (more dominant regions with levels of authority power is low, then it will lead the regional inequity that is high). On the other hand, at a high power level of authority, are more likely to have a 41.7% regional inequity regions is low, although there are regenciess that have a 13.4% regional inequity is high. From the test results showed that the authoritypower has a significant and negative relationship to the regional inequity (P-value of <0.05, and the value of negative correlation). It can be concluded that the higher the authoritypower in the region, the lower the regional inequity of the regencies. The result on Figure 1 and Figure 3 conclude that Economic Growth as mediation effect in relationship between Authority Power toward Regional Inequity, with negative correlation. It means that, the higher the authoritypower in the region, the higher the economic growth of the regencies, and will affect the lower the regional inequity of the regencies. In other hand, the lower the authoritypower in the region, the lower the economic growth of the regencies, and will affect the higher the regional inequity of the regencies.

Figure 4. Mobility factor and economic growth-regional inequity



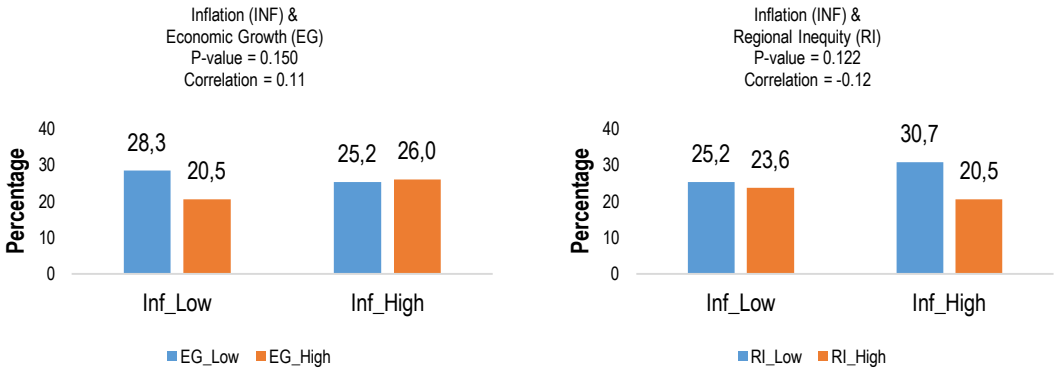
The results of the analysis of cross-tabulation in Figure 4 shows that of the 127 regencies, 27.6% to the level of mobility factor is low, have economic growth is low; while 20.5% more to the level of economic growth is high (two level approximately equal). On the other hand, at a high factor level of mobility, have equal response in level of low economic growth and high economic growth. From the test results showed that the mobility factor has a insignificant relationship to the economic growth (P-value of >0.05). It can be concluded that economic growth does not depend on mobility factor. Based on the right figure (relationship between mobility factor and regional inequity), 31.5% to the level of mobility factor is high, have regional inequity is low; while 20.5% more to the level of regional inequity is high (two level approximately equal). On the other hand, at a high factor level of mobility, have equal response in level of low regional inequity and high regional inequity. From the test results showed that the mobility factor has a insignificant relationship to the regional inequity (P-value of >0.05). It can be concluded that regional inequity does not depend on mobility factor.The result on Figure 1 and Figure 4 conclude that Economic Growth is not mediation in relationship between Mobility factor toward Regional Inequity, because the relationship is insignificant.

Figure 5. Construction Cost Index and Economic Growth-Regional Inequity



The results of the analysis of cross-tabulation in Figure 5 shows that of the 127 regencies, 28.3% to the level of construction cost index is low, have economic growth is low; while 19.7% more to the level of economic growth is high (two level approximately equal). On the other hand, at a high index level of cost, have equal response in level of low economic growth and high economic growth. From the test results showed that the construction cost index has a insignificant relationship to the economic growth (P-value of >0.05). It can be concluded that economic growth does not depend on construction cost index.Based on the right figure (relationship between construction cost index and regional inequity), 30.7% to the level of construction cost index is high, have regional inequity is low; while 21.3% more to the level of regional inequity is high (two level approximately equal). On the other hand, at a high index level of cost, have equal response in level of low regional inequity and high regional inequity. From the test results showed that the construction cost index has a insignificant relationship to the regional inequity (P-value of >0.05). It can be concluded that regional inequity does not depend on construction cost index. The result on Figure 1 and Figure 5 conclude that Economic Growth is not mediation in relationship between Construction cost index toward Regional Inequity, because the relationship is insignificant.

Figure 6. Inflation Rate and Economic Growth-Regional Inequity



The results of the analysis of cross-tabulation in Figure 6 shows that of the 127 regencies, 28.3% to the level of inflation rate is low, have economic growth is low; while 20.5% more to the level of economic growth is high (two level approximately equal). On the other hand, at a high rate level of inflation, have equal response in level of low economic growth and high economic growth. From the test results showed that the inflation rate has a insignificant relationship to the economic growth (P-value of >0.05). It can be concluded that economic growth does not depend on inflation rate.Based on the right figure (relationship between inflation rate and regional inequity), 30.7% to the level of inflation rate is high, have regional inequity is low; while 20.5% more to the level of regional inequity is high (two level approximately equal). On the other hand, at a high rate level of inflation, have equal response in level of low regional inequity and high regional inequity. From the test results showed that the inflation rate has a insignificant relationship to the regional inequity (P-value of >0.05). It can be concluded that regional inequity does not depend on inflation rate. The result on Figure 1 and Figure 6 conclude that Economic Growth is not mediation in relationship between Inflation rate toward Regional Inequity, because the relationship is insignificant.

3.2. Discussion

The study concludes that,after observations and the results of the quantitative analysis that has been done, and examines the fiscal decentralization model that is likely more appropriate and more effective in developing countries like Indonesia. If the economic and political pressures on fiscal decentralization is getting stronger and at the same time the encouragement of democratic development continues to grow, many countries, including Indonesia,the demand for fiscal decentralization is increasing. However, despite the increased support and desire, fiscal reform for regional governments is likely to remain slow and the process is also depressing due to the serious constraints on the decentralization still unresolved, such as overlapping authority, excessive burdens of the officials, and insufficient regional infrastructure.

Based on the analysis of the effects of decentralization with autonomy power, the correlation to economic growth rate is not significant. It gives an indication that the fiscal decentralization run at the provincial level conducted by strengthening revenue through increased taxes and levies, do not grant any significant effect toward the rate of economic growth in the provinces. Overall, it can be concluded that the fiscal decentralization does not provides optimum benefits to Indonesia, both on the level of employment, economic growth rate and the rate of regional inequality. It is caused by the difference reaction in each region to the implementation of fiscal decentralization as a result of different resource reserves in each region. In addition,large apparatus expenditure paid by the APBD results in highly limited fiscal space.

The analysis of long road reveals no significant effect on the rate of economic growth, and regional disparity levels directly or indirectly. The analysis of the effect of construction cost index reveals no significant effect on the rate of economic growth, directly or indirectly, but there is a direct positive influence on the level of regional

inequality. The analysis of the effect of inflation reveals no significant effect on the rate of economic growth rates, and regional disparity levels directly or indirectly.

The analysis of the effect of fiscal decentralization with the power authority (power authority) reveals no significant effect on the rate of economic growth which indicates that the remaining regional expenditures is too small to support the rate of regional economical growth. Fiscal decentralization has not provided optimum benefit to the regions of Indonesia, both on the level of economic growth and the level of regional inequality. It is caused by various obstacles such as the lack of resource, or limited regional expenditures.

Thus, it can be argued that the variable of economic growth has not proved as bridging variable (mediate) the effect between decentralization with autonomy power, decentralization with authority power, mobility factors, construction cost index and inflation rate toward regional inequality. Thereby, it shows that the variable of economic growth is not serving as a mediate variable in the effect of decentralization with autonomy power, decentralization with authority power, mobility factors, construction cost index, inflation rate toward the rate of regional inequality.

Conclusion

Based on the result and discussion, the conclusion of this research are follow. Decentralization with autonomy and authority power has positive and significant effect to economic growth, the higher value of decentralization with autonomy and authority power, will be lead the higher value of of economic growth. Economic growth has positive and significant effect to regional inequity, the higher value of economic growth, will be lead the lower value of regional inequity. Economic growth as mediation effect in relationship between decentralization of autonomy power and authority power toward regional inequity. It means that the lower the autonomy and authoritypower in the region, the lower the economic growth of the regencies, and will affect the higher the regional inequity of the regencies. In other hand, mobility factors, construction cost index, and inflation rate does not effect to economic growth and regional inequity.

Based on the conclusions of the research, then put forward some suggestions into the implications of the results of this study include (1). The results of this dissertation study reveals that there exists any space that enables fiscal decentralization to improve economic growth and repair regional inequality. Yet, local governments should be steadily alerted to the positive/negative effect for it only occurs in some cases. Thus, to achieve the optimum level, the appropriate economic environment is highly needed, which gives the researcher to suggest the revitalization of monetary competence of the region (2). Fiscal decentralization, despite giving impetus to economic growth area, but still has the potential to create imbalances between regions if the funds transfer policy experiencing distortion. It is advisable to use a standard formula without being distracted by the basic allocation and policy adjustments.

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Competitiveness of the Tourism Cluster of Kazakhstan: Comparative Analysis of Key Indicators

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Abstract:

In the context of modernization of the Kazakhstan economy, tourism clusters have an objective opportunity to become not only a new driver of the growth, but also to provide a control on preservation and rational use of cultural and natural heritage. The main purpose of this article is a comparative analysis of key indicators of the tourism cluster development in Kazakhstan from 2007 to 2015 on the basis of secondary data of Travel & Tourism Competitiveness Report. The study is based on a combination of statistical data from international organizations and the results of company executives' survey in the tourism industry. Competitive advantages and negative factors affecting the development of the tourism cluster were revealed based on this analysis. Necessary measures were proposed in the context of legal, institutional and financial mechanisms for ensuring sustainable and effective development of the Kazakhstan tourism cluster.

Keywords: tourism cluster; Kazakhstan's competitiveness; tourism infrastructure; human resources; tourism policy

JEL Classification: E2; L83; Z32

Introduction

Today clusters are dominated in the world economic map, *i.e.* a critical mass of unusual competitive success in a certain area, concentrated in one place (Kryvenko 2015). Cluster development of the regions and the various sectors of the economy provides a modern mechanism to improve the efficiency of economic activities. And in this regard, considering the continuous growth of the importance of tourism and its positive impact on world economy, the inclusion of domestic tourism clusters in global chains of cost will allow to significantly raise the level of economic growth of Kazakhstan due to increase in the international competitiveness of the enterprises which are a part of a cluster.

For the first time the need of cluster approach for development of the competitive Kazakhstan economy was discussed in 2004, when the Government of the Republic of Kazakhstan initiated the project "Kazakhstan's Competitiveness: Roadmap Towards a Diversified Economy" (Porter 2005). According to this project, a tourism cluster is one of seven priority clusters in traditional economy sectors. As a result of this, a number of legislative acts and program documents was adopted for regulating the tourism activity, and it had a positive impact not only on development of the branch, but also favorably influenced the international image of the country.

In this regard, the analysis of the tourism cluster competitiveness in Kazakhstan at the level of a single tourist destination and at the level of business structures becomes very relevant and timely. Therefore, we offer to use data of the report on the tourism and travel competitiveness developed by the World Economic Forum for more exact idea of development of the cluster tourism industry in the Republic, and for the detailed review of the strengths

and weaknesses of the tourism cluster for defining the priority directions and formation of tourism economic development policy.

1. Brief literature review

Many distinguished scholars were engaged in scientific researches in the field of clusters. As warranted by the context, research authors interpret the cluster definition in different ways. Porter (1998), the founder of the cluster approach in the economy, defines a cluster as "a geographically neighboring group of interconnected companies and associated organizations functioning in a certain area, characterized by common activities and complementary to each other".

A significant contribution to the study of tourism cluster development was made by such scholars as Jackson and Murphy (2002), Svensson *et al.* (2005), Jackson (2006), Novelli *et al.* (2006), Ewen (2007), Lade (2010), Weidenfeld *et al.* (2011), De Ribeiro and Andrade (2015).

Works of Crouch and Ritchie (1999), Kozak and Rimmington (1999), Vanhove (2002), Dwyer and Kim (2003), Mangion (2005), Koc (2009), Hong (2009), Leung and Baloglu (2013), Hanafiah *et al.* (2016) are devoted to researches of tourism industry competitiveness.

However, the analysis of scientific publications shows that questions of the tourism cluster development and its competitiveness did not find comprehensive disclosure since researches are mainly devoted to the processes of clustering and competitiveness of the Kazakhstan economy as a whole, what has predetermined the goals and objectives of this research.

2. Research purpose. Data and methods

Research purpose is a comparative analysis of key indicators of the tourism cluster development in Kazakhstan on the basis of secondary data of Travel & Tourism Competitiveness Report, for all the years of research from 2007 to 2015.

The index of tourism industry competitiveness was calculated on the basis of 3 main subindexes grouped into 14 criteria which were divided into 79 indicators until 2015:

- *subindex* A: T&T regulatory framework: policy rules and regulations (9 indicators); environmental sustainability (7 indicators); safety and security (4 indicators); health and hygiene (4 indicators); prioritization of Travel &Tourism (5 indicators);
- *subindex* B: T&T business environment and infrastructure: air transport infrastructure (7 indicators); ground transport infrastructure (5 indicators); tourism infrastructure (3 indicators); ICT infrastructure (7 indicators); price competitiveness in the T&T industry (5 indicators);
- *subindex* C: T&T human, cultural, and natural resources: human resources (10 indicators); affinity for Travel & Tourism, natural resources (4 indicators); natural resources (5 indicators); cultural resources (4 indicators) (Blanke and Chiesa 2007, 2009, 2011, 2013).

In 2015 the index has been developed. Still based on 14 pillars, the new methodology relies on a larger set of indicators (90 instead of 79).

The above indices are based on the combination of public statistics and the results of the survey of business executives in the tourism sector, where we estimated the quality indicators using a uniform scale from 1 (the lowest quality) to 7 (the highest quality), and normalized the quantitative indicators in order to unify the comparison according to the following formulas:

$$I_C = 6\times\left(\frac{country\ score-sample\ minimum}{sample\ maximum-sample\ minimum}\right)+1 \quad (1)$$

$$I_C = -6\times\left(\frac{country\ score-sample\ minimum}{sample\ maximum-sample\ minimum}\right)+7 \quad (2)$$

Further, by means of arithmetic averaging of the normalized quantitative indices and quality indicators ordered according to a uniform scale, we define the average rating for each of the fourteen criteria making a competitiveness index and receive average values for three complex subindexes.

3. Results

In 2015, Kazakhstan was rated at 3.48 points out of seven possible in the rating and occupies only the 85th position out of 141 countries, having only slightly improved its positions compared to the previous index in 2013, which was the 88th position (see Table 1). It is quite natural and reasonable, considering that the greatest share of indicators as a part of the index is below the 60th position, and by 18 of them Kazakhstan is listed among backward countries, staying behind the 100th position.

Table 1. The Travel & Tourism Competitiveness Index of Kazakhstan, Subindex A: 2007-2015

Indicators	2007		2009		2011		2013		2015		Changes 2015/2007
	Rank (out of 124)	Score (1-7)	Rank (out of 133)	Score (1-7)	Rank (out of 139)	Score (1-7)	Rank (out of 140)	Score (1-7)	Rank (out of 141)	Score (1-7)	
Travel & Tourism Competitiveness Index	82	3,8	92	3,7	93	3,6	88	3,8	85	3,48	-3
T&T regulatory framework	81	4,0	60	4,7	65	4,6	62	4,7	71	5,31	+10
Policy rules and regulations	106	3,5	86	4,1	95	4,0	99	4,2	106	3,77	-
Environmental sustainability	80	3,7	117	3,9	129	3,9	124	3,9	91	3,84	-11
Safety and security	76	4,1	76	5,0	108	4,1	99	4,2	72	5,32	+4
Health and hygiene	45	5,3	8	6,8	9	6,7	3	6,8	7	6,68	+38
Prioritization of Travel & Tourism	97	3,2	101	3,7	93	4,2	90	4,2	84	4,38	+13

Source: Compiled by the authors based on The Travel&Tourism Competitiveness Report (Blanke and Chiesa 2007, 2009, 2011, 2013, Crotti, Misrahi 2015)

So, political rules and standards were estimated in 2015 at 3.77 points having been at the 106th place in the context of the first subindex of standard and legal base. In comparison with 2013, this indicator fell 7 positions down (the 99th position) and returned to an identical indicator of 2007 (the 106th position). It is explained by rather low positions of such indicators as property rights protection (the 75th position), legislative regulation of investment activity (78), visa formalities (128), openness of bilateral air agreements (123).

Under the ecological stability criteria, Kazakhstan positions were improved from the 124th place in 2013 to the 91st place in 2015 (+23). Today the government pays special attention to increasing of forest area (the 17th position), wastewater treatment (the 51st position) and particulate control (the 27th position) as environment protection is an important element of potential success of the tourism industry. Besides, the tourism based on proximity to the nature becomes increasingly noticeable tendency in the world travel market. In this context, assessing the prospects of tourism cluster development in Kazakhstan, which has no great potential of beach tourism and tours by world-famous attractions, the priority is naturally shifted to the sphere of natural resources use for development of active leisure and ecological tours. For safety criteria, Kazakhstan also shows higher positions in 2015, having taken the 72nd place (the 99th in 2013 and the 108th in 2011). This positive dynamic pleases as today safety is a primary factor in the choice of a tourist destination, in connection with the arisen sharp conflicts, political disorders and terrorist attacks exerting very ambiguous impact on development of the industry of tourism in recent years thereby significantly reducing a tourist flow.

The health care and hygiene are among the main indicators of competitiveness in tourism. The protection of tourists' health is also important in provision of medical services, equipment and access to hospitals. According to this indicator, Kazakhstan shows the highest position since 2009 (the 8th position). Kazakhstan achieved the best result in 2015, having taken the high 7th place among 141 countries which participated in a research.

The last indicator within "T&T regulatory framework" represents priority of the tourism sphere. It is a very important indicator as estimates priority of tourism in the government policy, financing of branch, efficiency of marketing and strategy of country branding. Unfortunately, the presence of the Tourism Development Concept, systematic work on realization of the Perspective National Clusters Formation Concept, as well as the implementation of regional programs of tourism development in the country do not convince the international

experts that tourism is related to the priority development sphere. In this regard, Kazakhstan has a lower position and a slight increase. So, we have achieved the highest results and occupied the 84th position in 2015, raising on the 6th line in comparison with 2013 (the 90th position).

Assessing the second component subindex of the business environment and infrastructure, it should be noted that Kazakhstan has shown a negative trend (see Table 2). So, we lost 10 positions and fell to the 89th position in 2015 in comparison with 2013 (the 79th position). Land transport infrastructure has the lowest position and occupies the 102nd position in 2015, which is 30 places lower than in 2007. Problem areas are the quality and density of roads (the 113th and the 135th position respectively), as well as the quality of port infrastructure (the 122nd position). Nevertheless, there are two competitive advantages in the form of rail infrastructure quality (the 27th position) and ground transport network (50).

Table 2. The Travel&Tourism Competitiveness Index of Kazakhstan, Subindex B: 2007-2015

Indicators	2007		2009		2011		2013		2015		Changes 2015/2007
	Rank (out of 124)	Score (1-7)	Rank (out of 133)	Score (1-7)	Rank (out of 139)	Score (1-7)	Rank (out of 140)	Score (1-7)	Rank (out of 141)	Score (1-7)	
T&T Business environment and infrastructure	81	3,0	96	2,9	88	3,3	79	3,5	89	3,06	-7
Air transport infrastructure	75	2,8	89	2,6	86	2,7	82	2,7	76	2,54	-1
Ground transport infrastructure	72	3,2	87	3,0	96	3,1	80	3,3	102	2,85	-30
Tourism infrastructure	100	2,1	91	2,1	81	3,1	87	3,1	81	3,81	+19
ICT infrastructure	78	2,3	72	2,7	61	3,4	48	3,7	48	4,74	+30
Price competitiveness in the T&T industry	51	4,7	93	4,2	92	4,3	73	4,5	49	4,92	+2

Source: Compiled by the authors based on The Travel & Tourism Competitiveness Report (Blanke and Chiesa 2007, 2009, 2011, 2013, Crotti, Misrahi 2015)

The infrastructure of air transport increased by 6 positions in 2015 (the 76th position) in comparison with 2013 (the 82nd position). The positive growth dynamics have been noted in number of internal flights (the 32nd position) and density of the airports (the 35th position). However, other indicators remain problematic and are connected with such factors as weak technological infrastructure and wear of land infrastructure of the airports (50%), the outdated park of aircrafts, the small number of active airfields of local airlines, etc.

The tourist service infrastructure, assessing the number of hotel rooms and automatic teller machines, as well as availability of car rental companies, shows a gradual growth dynamic, increasing by 16 positions since 2007 (the 81st position). Information and communication technologies infrastructure (the 48th position) and price competitiveness in tourism (the 49th position) have rather steady positions. So, good results are provided by the number of subscribers of mobile telephone communication (the 5th position), mobile broadband communication (the 34th position) and the level of prices for fuel (the 29th position). Main indicators of price competitiveness, such as taxes on air tickets and airport taxes, the price of accommodation in hotels occupy lower positions, indicating their high price policy, which greatly increases the cost of the tour in Kazakhstan and, accordingly, reduce its competitiveness on the international market price. The last subindex is human, cultural, and natural resources, which are based on six indicators (see Table 3). Human resources have the highest position and raised to the 37th place that is almost twice higher in comparison with 2013 (the 71st position). This indicator is additionally measured by such indicators as education and training (the 80th position), as well as the availability of skilled labor (the 17th position). Another indicator of a composite index is the tourism industry attractiveness, which is understood as openness of the country and its economy to foreign tourists. According to this indicator, Kazakhstan is on the 122nd position in 2015.

Table 3. The Travel & Tourism Competitiveness Index of Kazakhstan, Subindex C: 2007-2015

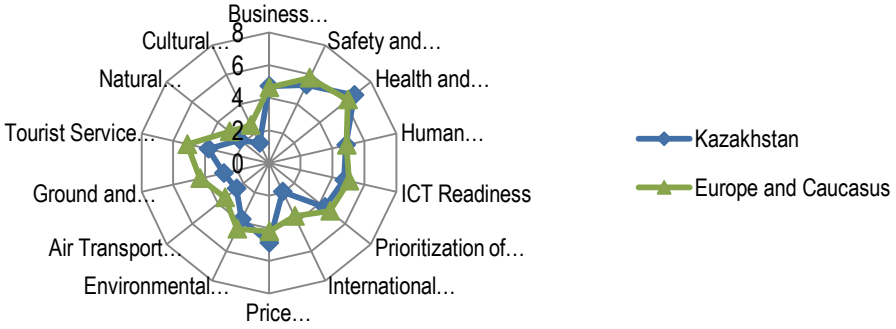
Indicators	2007		2009		2011		2013		2015		Changes 2015/2007
	Rank (out of 124)	Score (1-7)	Rank (out of 133)	Score (1-7)	Rank (out of 139)	Score (1-7)	Rank (out of 140)	Score (1-7)	Rank (out of 141)	Score (1-7)	
T&T human, cultural, and natural resources	90	4,4	121	3,3	123	3,2	119	3,3	75	1,81	+15
Human resources	60	5,2	74	5,0	80	4,8	71	4,9	37	4,8	+23
Education and training	49	4,9	68	4,7	65	4,7	66	4,7	80	5,1	-31
Availability of qualified labor	30	4,7	84	5,3	95	4,8	73	5,0	17	4,6	+13
Affinity for Travel & Tourism	-	-	112	4,3	126	4,0	121	4,1	122	4,3	-10
Natural resources			106	2,5			120	2,7	111	2,27	+6
Cultural resources	117	3,2	116	1,4	107	2,5	117	1,5	101	1,35	+16

Source: Compiled by the authors based on The Travel & Tourism Competitiveness Report (Blanke & Chiesa 2007, 2009, 2011, 2013, Crotti, Misrahi 2015)

The remained two indicators assess cultural and natural resources of a tourism cluster of Kazakhstan which unfortunately are on rather low positions for all years of this research. And the reason for this is not because we have few natural or cultural sights, we have it above the average. So, Kazakhstan is on the 43rd position in the world in amount of Natural World Heritage Sites of Kazakhstan, and on the 58th position for its cultural sites, and on the 41st position for oral and immaterial form of cultural self-expression. The tourism cluster is decreased by the efficiency of the use of this wealth, which is measured by the quality of the environment content (the 91st position), the number of protected areas (the 126th position), the availability of online organization of nature tourism (the 118th position), and cultural and entertainment tourism (the 104th position).

Figure 1 shows the comparison of the Kazakhstan tourism indicators competitiveness with Europe and Caucasus countries in 2015. Comparing indicators rating, you can clearly see visually that the countries of Europe and the Caucasus advance Kazakhstan by many parameters.

Figure 1. T&T Competitiveness Index 2015 pillar rankings: Kazakhstan and Europe and Caucasus



Source: The Travel & Tourism Competitiveness Report (Crotti, Misrahi 2015)

We have identified quite large differences in international openness, infrastructure, tourism services, air and ground transportation, natural and cultural resources, and environmental protection. Nevertheless, Kazakhstan has also competitive positions concerning such indicators as safety (5.32), health and hygiene (6.68). Positions on indicators of the business environment (4.71) are increased and that fact demonstrates that development of business became a real practical priority in activity of the Government of Kazakhstan. Very large system changes were conducted, which have found their practical application.

Conclusion

On the basis of the foregoing analysis, we can draw a conclusion that tourism cluster competitiveness of Kazakhstan, despite negative results, increases gradually and there has been some progress. So, in 2015, Kazakhstan took the 85th position among 141 countries, having risen by three lines in comparison with 2013. Since 2007, we have improved its position in the two main subindices out of the three ones – in the context of the regulatory framework (10) and in the context of human, cultural and natural resources (15). Only 28 indicators out of 90 are allocated as competitive advantages of Kazakhstan.

However, today the available potential and opportunities are not used fully, and the influence of tourism on the economic growth of Kazakhstan is insignificant and made 1.6% of Kazakhstan GDP in 2015 (WTTC Economic Impact Report, 2016) that is a rather low indicator. However, tourism can give 3% of GDP by 2020 and create up to 300 thousand new jobs with a full government support (Concept of development of the tourism industry of the Republic of Kazakhstan till 2020, 2014). It is obvious that taking into account today's structural challenges, tourism can become a strategically important branch for Kazakhstan. In this regard, we believe it is appropriate to consider the following measures:

- to create special tourist zones with special legal and policy benefits in forest lands and protected natural areas (based on the successful example of Korea and India);
- to develop a complex of systematic measures to simplify existing procedures and rules for short-term entry into Kazakhstan with tourist purposes;
- to develop the tourism infrastructure through joint efforts of the government and private sector with diversification of main tourist natural and resort zones, to develop new destinations;
- to develop obligatory qualification requirements to the workers of the tourism industry who are directly rendering tourist services in the sphere of entrance and internal tourism;
- to form a positive attitude of local people towards tourists by means of distribution of information brochures, holding of special seminars and actions showing positive results from tourism development;
- to develop the especially protected natural territories and the state forest fund, taking into account the maximum preservation of natural and reserved fund, the protection of natural and cultural resources in partnership with local population.

Thus, today the tourism cluster of Kazakhstan is faced with a task not only to save the achieved results, but also to increase competitive advantages, improving legal, institutional and financial mechanisms promoting Kazakhstan to become a global tourist destination.

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Typology of Coastal Zones in the European Part of Russia: Modern Particularities within the Trend of Cross-Border Clustering

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Abstract:

Coastal areas worldwide have the tendency to attract human activity, showing outstripping performance on a number of indicators. The transcendence of coastal regions is generally observed in relation to the average values of national performance. These include the indication of competitive clusters located at the coastal zone. The current study addresses the issue of cross-border clustering in coastal areas of the European part of Russia. Article presents the results of an inventory of the existing and potential cross-border clusters in the coastal zones under study, providing typology criteria to their delimitation. It is established that cross-border clusters are mainly formed in export-oriented primary industries – fishing and primary processing of marine biological resources; extraction and transportation of oil, natural gas, wood and timber; manufacture and export of metals, mineral fertilizers, grain. The cross-border relations also take place in shipbuilding, pharmaceutical and chemical industry (*e.g.* Leningrad region), recreation and tourism (*e.g.* Kaliningrad region). Based on complex assessment of the natural, geographical, economic and demographic factors, the study resulted in the identification of the main types of coastal zones. It is shown that the intensity of clustering, its forms and mechanisms vary significantly both at macro- and meso-scale.

Keywords: coastal zone; coastal area; coastal region; cross-border cluster; European Russia.

JEL Classification: L14; L16; L26; O11; O18; P25

Introduction

Coastal zones are important areas of economic and social activity. Studies on socio-economic development of coastal regions indicate a concentration of a large part of the global population in such areas: as much as 37% of all the population of the Earth is localized in the 100-km coastal zone, and up to 50% of the world population are situated in the 200-kilometer coastal zone (Cohen *et al*. 1997, Pak and Majd 2011). Vallega (1998) evaluates the localization of the coastal population up to 60% in the band of about 60 km. Gorkina (2015) notes that 2/3 of the world's cities with a population of over 1.5 million people (*e.g.* Buenos Aires, Mumbai, Istanbul, Shanghai, and others) are located in the coastal zone. The entire coastal regions have formed, the largest of which are the Gulf region, Californian, Atlantic and Tokaido (Druzhinin and Lachininskii 2015). Up to 40% of the EU territory can be classified as coastal that is home to 50% of the population (Collet and Engelbert 2013, Makhnovsky 2014). Similarly, the coastal zone in some regions of Russia accounts for over 60% of employment, 70% of enterprises, 60% of investment and 66% of industrial production (Druzhinin *et al.* 2015). The significance of coastal regions is often caused not only by the presence of enterprises of a maritime complex, but also by the border position, the localization of the largest cities – metropolitan centers. The generation of economic activity in such areas is also determined by the multiplier effect, *e.g.* Ivchenko (2008) found that one job in the maritime sector and ports creates up to 10 jobs in coastal infrastructure.

Being outlined by a coastline, coastal area as a spatial object has movable boundaries from the side of land, which varies depending on the research approach and objectives (Bezrukov 2008, Dergachev 1980, Druzhinin 2004, Gogoberidze 2008, Pokshishevsky 1979, Salnikov 1984, Slevich 1988). In Europe the width of the coastal zone often takes the value of 50 km (Valev 2009). Vallega (1998) outlines the distance of 60 km, and Salnikov (1984) considers the width of a coastal zone to be 80 km. Other versions propose the consideration of coastal regions within 100 km (Makhnovsky 2014), 200 km (Pak and Majd 2011) and even 500 km (Arakelov 2011). Bezrukov (2008) suggests that the regions considered to be directly located within 50 km from the sea are the coastal areas, while those separated from the coast by 50-200 km are to be considered as indirectly related to the sea. Thus, the heterogeneity of coastal zones, their typological differences that emerge under the influence of natural and socio-economic factors, often remains out of the analysis. The purpose of this article is to provide the typology of coastal zones (CZ) in the European part of Russia based on the analysis of potential for cross-border clustering.

1. Methodological framework

Apart from ambiguity in defining the remoteness of the CZ from sea and ocean shores, the study on the structure of CZ requires utilization of a significant number of various analytical tasks. These include the problem of the detailed structuring of the CZ on the basis of its multi-vector development. Being projected onto the structure of

coastal areas, this fact determines their polycomponental status in both the 'longitudinal' – along the coast, and 'transverse' – inland territory context (Druzhinin 2017). The complexity of the processes of morphogenesis in CZs is determined by a set of highly ambiguous processes which varies from the realities of political-territorial and administrative-territorial division (Fedorov and Korneevets 2015, Green 2009) to natural, environmental and landscape differentiation (Humphrey and Burbridge 1999).

According to the levels of longitudinal structuring, the CZ of the European part of Russia can be differentiated into: *macro-zones* – Baltic-Barents-Arctic, Black Sea and Caspian Sea, and *meso-zones* – Baltic, Arctic, Barents-White Sea, Azov-Black Sea, Caspian (Druzhinin 2016c). Along with such division it is suggested to apply the categorization of the CZ sectors, which are the parts of the CZ in the particular marine basin. These sectors can be identified according to their political-territorial and other characteristics. Furthermore, the category of the CZ segments can be applied, identified according to administrative-territorial and other characteristics as parts of the CZ sector.

The special aspect in the CZ design is a specific economic structure, including multi-scaly representation in its 'marine component' of the economy (Druzhinin 2016a, Gogoberidze 2008), as well as the economic effects followed (*e.g.*, the phenomenon of coastal rent; Druzhinin 2004) and the overall increased institutional economic density of territories. The economic dynamics often corresponds with the demographic and ekistic features of CZ, characterized by the concept of coastalization of population (Druzhinin 2016b).

Russia displays the full manifestation of these trends. The urbanization in the Russian Arctic has a non-continuous, discontinuous, 'insular' character (Pilyasov 2016), as a result of the selectively-continuous development of the North (Slavin 1961). Due to these factors, the CZ of Russia resembles an intermittent narrow band. Almost 36.8 of the 41 thousand km sea borders of the Russian Federation are Arctic and Pacific coasts, poorly developed and generally unfavorable for human habitation. Against this background, there can be highlighted areas of socio-economic influence – the St. Petersburg, Rostov-on-Don, Vladivostok, Kaliningrad and other coastal agglomerations.

The complexity of CZ structure causes the need in its differentiation. The key typological features for the differentiation of coastal territories of the European part of Russia are:

- basin principle, differentiating CZ into ones having direct access to the World ocean and those with the access through the inner seas (the special situation is for the Caspian Sea and its CZ, where there is no natural link with the World ocean);
- climatic specificity, which determines the possibility of navigation, as well as the potential for placement of related production and terminals;
- coastal bottom topography as the condition for shipping and possible tonnage of the fleet;
- markets-recipients factor, *e.g.* the ports of the Baltic and Barents-White Sea macro-zones historically have been playing the dominant role in foreign trade with the countries of Western Europe and in the whole North Atlantic, the Azov-Black Sea – with the Middle East, North Africa and Southern Europe, as well as the ports of the Caspian Sea – with Iran;
- geo-strategic factor, that determines the multi-vector strategy of Russia for the interests in marine basins. Coastal zones contain the fleet-basing points (*e.g.* Novorossiysk, Sevastopol, Baltiysk, St. Petersburg, Murmansk, Severodvinsk, Astrakhan), in the combination with a powerful shipbuilding clusters in St. Petersburg, Kaliningrad, Arkhangelsk and Severodvinsk.

Based on the approaches outlined above, the research focus is made on, firstly, the instrumental and methodological aspects (developing approaches to monitoring, modeling and forecasting cross-border clustering and its projection on the socio-economic and ekistic development of maritime territories), secondly, the conceptual framework (development of the theory of cross-border clustering and conceptualization of maritime zones), and, thirdly, the analytical issues (the formation of a detailed database on cross-border clusters in coastal areas in the European part of Russia, on the economic dynamics and the evolution of settlement systems in coastal municipalities and regions of the Russian Federation.

2. Research results

In the late 1990s – early 2000-ies it was recognized that "while some of the clusters are local to the region, others may cross regional boundaries" (Hofe vom and Bhatta 2007, 6). Currently, the description of the phenomenon of international cluster is accompanied by the considerable terminological diversity, including such terms as transboundary, cross-border, transnational, international, interstate, over-the-border, transborder, and a number of other (Mikhaylov 2015). In the process of cross-border cluster development, the formation of a system of close ties between takes place, with the exchange of information, knowledge, competences, organizational procedures, technology, other codified and tacit knowledge between its members. The sustainability of the interactions' system is determined by the interdependence and complementarity of its members, the need for frequent formal and informal contacts to maintain domestic competitiveness. The nature of the relationships between actors in cross-border cluster varies and can take many forms: vertical contractual dyadic relationships between manufacturers and suppliers, including in the framework of the supply of specialized equipment, components, services, etc.; strong and weak horizontal linkages between economic entities, research organizations, public authorities and administration within the implementation of joint cross-border projects and participation in cross-border initiatives; personal informal contacts between the representatives of the organizations – members of the cluster.

In the European part of Russia, the most comprehensive and dynamic cross-border clustering processes occur on the territory of St. Petersburg coastal region, which unites the city of St. Petersburg and 37 administrative units of the Leningrad, Novgorod, Pskov regions and the Karelia Republic (Lachininskii *et al*. 2016). The most significant are:

- shipbuilding cluster – the cross-border cooperation relations in the poly-nuclear framework between Vyborg and Helsinki with Russia being the sales market. Foundation of the cluster is the JSC "Vyborg Shipyard" (Leningrad region) and "ArctechHelsinkiShipyard", including the shipyard "Hietalahti" in Helsinki (Finland), JSC "United Shipbuilding Corporation" (Russian Federation);
- pulp and paper cluster – the cluster is under formation with the stakeholders being located in Svetogorsk (Russia) and Imatra (Finland);
- cluster of medical and pharmaceutical industry – located in St. Petersburg with 137 cluster members. In Arkhangelsk region three potential cross-border clusters are distinguished:
- tourism cluster – its distinctive feature is coastal location and the presence of unique sites, including the Solovki archipelago and the state nature reserve "Franz Josef";
- shipbuilding and ship-repairing cluster based in Severodvinsk and Arkhangelsk. The key companies are: JSC "PO "Sevmash", JSC "Center of Ship Repair "Zvezdochka", JSC "Northern Production Association "Arctic", JSC "Northern Raid", CJSC "Bius", CJSC "Industrial Technologies";
- timber cluster "Pomorinnovales", accounting about a third of the Russian production of pulp and paperboard, up to 8% of sawn timber and up to 10% of paper. The cluster is presented by 32 participants, including the regional loggers, Arkhangelsk PPM, JSC "Arkhbum", and "Titan" group of companies.

Murmansk region has six clusters with various levels of cross-border orientation. They are:

- tourism cluster that is oriented to use the potential of Arctic coasts;
- transport and logistics cluster, its core is presented by ports of Murmansk, Kandalaksha and Vitino;
- metallurgical cluster, developing on the basis of reserves of apatite and nepheline (Khibiny deposits), and iron ores in Olenegorsky and Kovdorsky fields (about 10% of Russian production);
- fishery cluster, providing 16% of the national fishing;
- mining and chemical cluster – the large mining and chemical companies "Apatit" JSC, "KovdorskyMining Plant", as well as new mining and chemical complex of the holding "Akron" are its core;
- oil and gas cluster that includes non-commercial "Association of suppliers for oil and gas industry "Murmanshelf", uniting enterprises of the industry, construction, transport, service, logistic, financial and educational organizations, as well as the Norwegian Association "PetraArktik".

Over the past decades large-scale economic clustering has gained a considerable impetus for growth in the Rostov region. Being based on cross-border, transnational relations and using the coastal geo-economic situation in the region, the following clusters are developed:

- sunflower-grain cluster provides about 22% of the Russian production of sunflower. The core companies are: “Aston”, “YugRusi”, “Agrokom”, “RZ Agro”;
- machine-building cluster that includes the industries based on maritime supply of finished products and components;
- cluster of marine engineering “Marine Systems” focused on the products that are specifically designed for the needs of sea and river fleet;
- cluster of shipbuilding, ship repair and port industry – a combined initiative of “Don Shipyard” and “Taganrog Shipyard”.

This list can be extended as new generation of clusters rise over the last three years. The availability of sufficient investment capacity of own capital, stabilizing the production and contraction risks, as well as the business environment seems to be the main feature of the region. The emerging trends of diversification and interpenetration of clusters (including the orientation to the needs of maritime industries as a stable domestic demand) help to catalyze clustering processes and reach the multiplier effect.

The priority of cross-border clustering in the Russian part of the Caspian Sea is the port economy (just in Astrakhan there are 19 stevedoring companies), shipbuilding and ship repair (*e.g.* shipbuilding plant “KrasnyeBarrikady”, Shipbuilding and shiprepair plant named after Lenin, Astrakhan shipbuilding shipyard, Shipbuilding and shiprepairing plant named after A.P. Guzhvin), a cluster for the extraction and transportation of hydrocarbons (Russian-Kazakh joint projects on the Caspian shelf); the food and raw materials cluster, including such aspects as the extraction and processing of marine bioresources, as well as the cultivation of vegetables and fruits, sheep breeding (55% of the Russian sheep population is concentrated in the Caspian and bordering regions of the Russian Federation), and a tourist and recreational cluster.

Prospects of cross-border clustering in the Republic of Crimea and Sevastopol are related to such areas as tourism and recreation, as well as shipbuilding, and are significantly related to the normalization of the geopolitical situation and the removal of economic sanctions.

There is a wide range of cross-border clusters in the coastal zones of the European part of Russia, both established, effectively functioning, and latent. They are significant for the economy of these territories, are essential for solving typology problems. Research results suggest the following typological variations of the CZ of the European part of Russia at the macro level at the macro level (Table 1):

- the Barents-White Sea macro-zone: sector 1. the oceanic coast of the Murmansk region; Sector 2.b.1. coastal areas of Murmansk, Arkhangelsk regions and the Republic of Karelia, with restrictions on depths and restricted navigation during the winter;
- the Baltic macro-zone: sector 2.b.1. the Leningrad region and St. Petersburg with open deep-water access to the World Ocean via inland seas (with the depths in the case of St. Petersburg being less favorable) and restricted navigation in winter; sector 2.b.2. the Kaliningrad region with more favorable natural and climatic conditions, whose port complexes also need dredging;
- the Azov-Black Sea macro-zone: sector 2.b.3. the Azov-Nizhnedon basin with limited depth and freeze-up; sector 2.a. the remaining Black Sea ports;
- the Caspian macro-zone: sector 3 characterized both by the absence of direct access to the World Ocean and by the small depths of the port water areas.

Table 1. Typological variations of the coastal zones of the European part of Russia at the macro level

Macro-level Sector of the coastal zone	Access to the World ocean	Restrictions on navigation based on depths and climate
1	Direct access to the World ocean	Favorable conditions of depths and restrictions on natural and climatic conditions
2.a	Access to the World Ocean through inland seas	Favorable conditions of depth and climate
2.b	Access to the World Ocean through inland seas	Restrictions on the depth and / or climate
3	No direct access to the World ocean	Restrictions on the depth and / or climate

Typologization at the meso-level shows more fractional segments of the CZ, which are identified by taking into account the economic and residential features of specific coastal regions. The economic position of the 'enclosing' regions is significant for the formation of both a general 'background' of economic activity on the coast, and foreign trade exchanges with reliance on the port infrastructure. The key ekistic-demographic (and economic) indicators directly characterize the CZ at the meso-level – the presence of foci of socio-economic development in the form of large urban centers, urban agglomerations and bands of continuous resettlement and economic development. At the meso-level coastal zones, one can single out the poles of the all-Russian (St. Petersburg) and macro-regional (Rostov-on-Don) scale, as well as the meso-level poles – most regions of the European part of Russia have a coastal focus of economic activity in the form of a city or an agglomeration center. Lack of development poles is identified in Karelia and Kalmykia.

From the residential, infrastructural and economic points of view, the meso-level CZ are differentiated into deeply echeloned (by the criterion of the depth of the densely developed zone) and the zone of predominantly focal development. The factor of geographical zoning is important: the zone of continuous settlement (or the settlement of a nodal character, as in the Krasnodar Krai) can be observed in case of the Baltic Sea Region, the Azov-Black Sea basin and Dagestan. In extreme natural conditions (the Arctic zone, as well as the arid regions of Kalmykia and the Astrakhan region), it is a question of predominantly focal development of the territory.

The positioning of the enclosing coastal regions in the economic centro-peripheral structure is illustrated by the GRP volume. Two key poles stand out here: St. Petersburg and the Krasnodar Krai (in 2013 their GRP was, respectively, 2496.5 and 1617.0 billion rubles). Regions of the 'second row' are the Arkhangelsk, Leningrad and Rostov regions with GRP in the range of 500-1000 billion rubles. The rest of the regions occupy relatively less prominent positions in the generation of the gross product (mainly in the range of 150 – 450 billion rubles).

The clarifying criterion of economic development is the GRP structure. In general, the basic industries account for from 63-64% (St. Petersburg, Kaliningrad region, Karelia) to 80% (Leningrad region) of GRP. At the same time, all coastal regions can be divided into mono- and poly-specialized. Mono-specialization is when the industry share in the structure of GRP is at 30% or higher (Karelia, Arkhangelsk, Kaliningrad, Leningrad, Murmansk, Astrakhan regions, in the latter case, industry share is 28.8%). Kalmykia is specialized in agriculture (32.3% of GRP). Regions where there are two dominant industries or the GRP structure is diversified are: St. Petersburg (share in industry and trade is 20-25% each), Krasnodar Krai, Rostov region, Dagestan (no industry has a share of more than 25% in GRP).

The volume of foreign economic activity characterizes the significance of CZ as a transit foreign trade gateway of Russia and reflects the status of localized ports: for St. Petersburg the total turnover of foreign trade exceeded 63.2 billion USD in 2014. In the Kaliningrad and Leningrad regions and Krasnodar Krai it amounted to 15-20 billion USD. In the remaining coastal regions of the European part of Russia it stayed at the level of 3 billion USD (intermediate position of the Rostov region with a turnover of 8.1 billion USD and a significant fall by 2013), reducing to a minimum in Kalmykia (22 million USD).

The complementary characteristic of the meso-level CZ is the potential for cross-border clustering as an indication of economic development of the meso-level CZ and its cross-border interactions. Three types of situations are identified: first, partially implemented cross-border clustering reflected in tight integration of production with foreign counterparties in several industries – St. Petersburg, as well as the Leningrad and Kaliningrad regions; second, availability of a favorable prospect for cross-border clustering defined by sufficient

economic activity in the region in conjunction with potentially clusterogenic external economic interaction – Arkhangelsk, Murmansk, Rostov regions, and the Krasnodar Krai; third, absence of significant prerequisites for clustering in the medium term, including for geopolitical reasons, – other coastal regions of the European part of Russia.

The overlap between the parametric properties of macro-zones and the spatial hierarchy of economic and ekistics characteristics inherent at the meso-level reflects a consolidated typology (Table 2).

Table 2. Classification of macro- and meso-level coastal zones of the European part of Russia

Macro-level coastal zone	Meso-level coastal zone	Sector 1	Sector 2					Sector 3
			Sector 2.a		Sector 2.b			
			22.a.1	22.a.2	22.b.1	22.b.2	22.b.3	
Barents-White Sea	Barents Sea	*						
	White Sea					**		
	Karelian-White Sea						**	
Baltic Sea	St. Petersburg				**			
	Kaliningrad					**		
Azov-Black Sea	Kuban-Black Sea		**					
	Don-Azov Sea					**		
	Crimea-Sevastopol			**				
Caspian Sea	Lower Volga-Caspian Sea							*

Note: *Sector 1* – zone of 'semi-periphery' with dispersed development and prospective clustering; *Sector 2.a.1* – the economic core, an area of continuous settlement and prospective clustering; *Sector 2.a.2* – peripheral zone with the predominance of continuous settlement and perspective clustering; *Sector 2.b.1* – the economic core, an area of continuous settlement and implemented clustering; *Sector 2.b.2* – zone of 'semi-periphery' with continuous / dispersed development and realized / perspective clustering; *Sector 2.b.3* – peripheral zone with a predominance of dispersal settlement and lack of prospects for clustering; *Sector 3* – peripheral zone with predominance of dispersed / continuous settlement and perspective clustering.

Taking into account the economic and ekistic characteristics of the meso-level coastal zones, one can in particular distinguish three of their integrated variations:

- the economic core – the zone of continuous settlement and realized / perspective clustering;
- 'semi-periphery' zone with continuous / dispersed development and realized / perspective clustering;
- zone of periphery with a predominance of disperse settlement and a lack of prospects for clustering. The combination of macro- and meso-level parameters makes it possible to separate seven typological variations within the European part of Russia. Fist type includes zones with direct access to the World Ocean (terms of access to the World Ocean / integrated economic and ekistic assessment of the centro-peripheral status) – zone of open access to the World Ocean in key geo-economic directions with the status of 'semi-periphery', dispersed development and prospective cross-border clustering. Second type are zones with indirect access to the World Ocean via the inland seas: subtype 2.a.1 – zones of a closed (via inland seas) access to the World Ocean in key geo-economic directions with good shipping conditions in the status of the economic core, continuous development and realized / prospective cross-border clustering; subtype 2.a.2 – zones of closed (via inland seas) access to the World Ocean in key geo-economic directions with good shipping conditions with peripheral status, predominance of continuous development and the prospect of cross-border clustering; subtype 2.b.1 – zones of closed (via the internal seas), restricted (by climatic and / or aquatorial parameters) access to the World Ocean in major geo-economic directions in the status of the economic core, continuous development and realized / prospective cross-border clustering; type sub 2.b.2 – zone of the closed (via the internal seas), restricted (by climatic and / or aquatorial parameters) access to the World Ocean on significant geo-economic directions in the status of 'semiperiphery' with continuous / dispersed development and realized / prospective cross-border clustering; subtype 2.b.3 – zones of the closed (through the internal seas), restricted (by climatic and / or aquatorial parameters) access into the World Ocean on significant geo-economic directions in the status

of the periphery, with the predominance of disperse population and the absence of prospects for cross-border clustering. Third type of zones – with missing sea access to the World Ocean: type 3 – zones of a closed (via internal seas) access into the World Ocean (or without access to it) restricted (by climatic and/or aquatorial parameters) on limited geo-economic directions in the status of the periphery, with the predominance of disperse population and the lack of prospects for cross-border clustering. The types and subtypes identified vary according to the main economic and ekistic characteristics, as shown in Table 3.

Table 3. Some basic economic and ekistic parameters for identified sectors of coastal zones of the European part of Russia

Coastal zone sector	Total cargo turnover of seaports, 2015, million tons*	Total population of coastal cities, 2015, thousand people	Retail turnover, 2014, billion rubles**
Sector 1	28.6	395.8	77,610.0
Sector 2.a.1	204.7	1,854.0	398,271.0
Sector 2.a.2	3.8	692.0	210,300.0
Sector 2.b.1	216.1	5,361.3	1,041,484.0
Sector 2.b.2	12.7	548.4	74,705.0
Sector 2.b.3	28.0	1,650.2	347310.0
Sector 3	6.7	1,528.2	236,390.0

Note: *data based on Association of cargo seaports of Russia,** indicative indicator, including urban population share

The marked differences between the established types are traced along the 'North-South' lines. In particular, the northern sectors of the coastal zone in most have the status of an 'economic core' or 'semi-periphery'; the peripheral type accounts for only one of the six meso-scale zones defined in the North. At the same time, in the South, two out of four zones have peripheral status. Differences are also observed along the axis of the zone with direct access to the World Ocean – zones of mediated / absent access to the World Ocean. As the conditions for access to the main world maritime routes worsen, peripheral status increases. At the same time, opportunities for cross-border clustering also shrink.

Conclusion

Coastalization effect is said to affect the regional development across the globe, with the coastal regions and coastal zones in particular, resembling the status of growth poles at national level. Natural-geographical, infrastructural, institutional, geo-economic, geopolitical and a range of other factors influence this development, causing differences in-between the coastal areas. An influential factor to the welfare of the coastal frontier areas is the sustainability of its economic systems, interlinked internationally via interstate trade and production, cross-border clusters in particular. The research conducted covered the entire European part of Russia placing emphasis on the analysis and typologization of coastal zones with respect to cross-border clustering. All of the coastal zones were differentiated by scale – macro- and meso- level, and by sector types and subtypes. Research results display the prevalence of the St. Petersburg coastal agglomeration over the rest of territories under study. Coastal zones of Kaliningrad and Rostov regions are the territories that resemble high potential of cross-border clustering, while the northern territories of the European part of Russia are highly vulnerable to natural inhibitors – harsh climate, rough terrain, *etc*.

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Catching-Up Process and Gross Domestic Product Synchronisation in the European Union: Bayesian Shrinkage Estimation and Distance-Based Approach

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Abstract:

The convergence and the business cycle synchronisation in the European Union (EU-28) remains a topical issue as recent economic crisis has affected GDP growth of each member country. The aim of the paper is to test a real convergence between the European countries and to analyse the synchronisation of their GDP per capita. Firstly, the speed of β-convergence is tested using Bayesian Shrinkage Estimators allowing for heterogeneity in panel data model. Secondly, we estimate the cluster dendrogram, which offers the categorisation of countries into clusters according to the similarities of their GDP growth rates. Thirdly, a distance-based method is applied in order to analyse a temporal dynamics of GDP per capita synchronisation in the whole EU-28. Bayesian Shrinkage Estimators reveal rather the heterogeneity of the speed of convergence. The distance-based approach concludes that the overall convergence in the EU-28 prevailed up to 2007, but the crisis caused a divergence of their GDP per capita. Despite a recent temporal convergence, average distances between GDP per capita of all EU-28 countries remain important and are still higher compared to the pre-crisis period.

Keywords: speed of convergence; dynamic panel model; bayesian shrinkage estimator; distance-based method.

JEL Classification: O52; O40; N14; C23; C52; C11

Introduction

Despite the general idea of business cycle synchronisation in Europe, we can still observe certain differences in the evolution of GDP per capita in the EU-28 countries. Moreover, these differences seem to be increased during the economic and debt crisis in Europe. Therefore, the ambition of the paper is to answer tree main questions.

Firstly, we aim to calculate the speed of real convergence of each EU-28 member and to compare the speed of convergence of Central and Eastern European (CEE) countries with core EU countries.

Secondly, we aim to look at the GDP synchronisation and the categorisation of countries according to the similarities in the evolution of their GDP per capita growth rates.

Thirdly, we aim to answer whether we can conclude to overall convergence or divergence of GDP per capita of the whole EU-28 and also whether the economic crisis affected the overall similarities in GDP evolution. Our paper is organised as follows: Section 1 presents an overview of the empirical studies on real convergence and GDP synchronisation; Section 2 describes data and methods. Bayesian dynamic panel estimation is used to test a speed of real convergence in the EU-28 and allows taking into account individual heterogeneity between countries. Cluster analysis is used to categorise the EU-28 members according to the similarities in their GDP growth rates. The distance-based method allows for temporal dynamics and permits to see the overall convergence tendencies in the whole EU-28 in several sub-periods.

Our empirical results are given in Section 3.

1. Convergence and gross domestic product synchronisation: Literature review

The idea of β-convergence (Barro and Sala-I-Martin 1992), initially developed from neo-classical growth models (Solow 1956), suggests that less advanced economies having higher GDP per capita growth rates than the advanced ones will converge to the advanced ones in future.

The empirical studies tested initially the assumption of β-convergence using cross-section data (Barro and Sala-I-Martin 1992):

$$\log\left(y_{iT}/y_{i0}\right) = a - \left(1-e^{-\beta T}\right)\log\left(y_{i0}\right) + u_t \quad (1)$$

where: $\log\left(y_{iT}/y_{i0}\right)$ is GDP per capita growth rate on the time period (0,T); $\log\left(y_{i0}\right)$ is an initial level of GDP per capita; β is a speed of the convergence and i corresponds to the individual country. According to Barro and Sala-I-Martin (1992), we accept the hypothesis of β-convergence if the estimated coefficient of initial level of GDP per capita $\log\left(y_{i0}\right)$ is negative.

The cross-section models have been used by several authors (such as Barro 1991, Levine and Renelt 1992, Barro and Sala-I-Martin 1992). Barro (1991) estimated a cross-section model and concluded β-convergence for 98 countries over the period 1960-1985. Caselli *et al*. (1996) estimated cross-country growth models using "generalized method of moments" estimator.

However, it should be pointed out that β-convergence models in cross-section have two limits:

- the data used for estimation cover only the initial period and the final period;
- countries' heterogeneity is not considered as the cross-section results offers only the average value of β-convergence for the whole sample of countries (Tykhonenko 2013).

Maddala and Hu (1996) also consider that the empirical results of this approach are fragile as they depend on the choice of countries included in the sample.

As limits of cross-section models are obvious, more recent studies (Evans 1998, Gaulier *et al.* 1999, Tykhonenko 2005, Bonetto *et al*. 2009) estimate panel data models, which allows for heterogeneity. Some authors estimated models with heterogeneous auto-regressive structure, *i.e.* analysed time-series data (Oxley and Greasley 1995, Bernard and Jones 1996, Evans and Karras 1996, Gaulier *et al*. 1999), for which the estimated β-convergence rates are different for each individual country. Oxley and Greasley (1995) used time-series data and concluded catching-up in case of pairs of countries United Kingdom - United States as well as Australia - United States over the period 1870–1992. Gaulier *et al.* (1999) followed the approach of Evans and Karras (1996) and revealed a common convergence process in the European Union over the time 1960-1990.

Crespo Cuaresma *et al.* (2008) tested the convergence in the EU-15 applying means of panel data and concluded that the EU membership has an asymmetric impact in favour of the convergence. Vojinović and Oplotnik (2008) applied cross-section as well as panel data models of convergence and revealed the existence of β- and σ-convergence among 10 new EU members (which joined the EU in 2004) during the 2000s. Ranjpour and Zahra (2008) also tested a real convergence in 10 new EU members over the time period 1995 - 2005 by applying different unit root tests for panel data and concluded their convergence towards the EU average. On the other hand, Alexe (2012) applied Euclidian distance analysis in order to test the impact of economic crisis on convergence of new EU members towards the euro area average and concluded an increase of distances for majority of countries.

As far as recent empirical studies on real convergence, Próchniak and Witkowski (2013) applied Bayesian model averaging, included time dummies and used GMM system estimator in order to test the time stability of β-convergence in the EU-27 and the EU-15; and revealed the existence of gently faster and slower convergence periods. Crespo-Cuaresma and Fernández-Amador (2013) analysed business cycle convergence in the euro area using a method based on the cross-country dispersion of business cycles and also revealed the existence of divergence as well as convergence sub-periods over the time 1960-2008. Monfort *et al.* (2013) applied cluster analysis to test real convergence in GDP per capita in Europe and concluded the existence of club convergence, whereby the results show that two convergence clubs exist within the EU-14 and two convergence clubs exist within

the Eastern European countries. Borsi and Metiu (2015) also tested a real convergence in the European Union over the time period 1970 - 2010 using a non-linear latent factor framework; they applied an iterative convergence test and identified several clubs of convergence: CEE countries vs. core EU countries as well as South-East vs. North-West categorisation of the EU countries. A different approach to the GDP evolution investigation in the EU countries is presented in Horváth *et al.* (2013a), where the probability transition matrix model serves to interlink the GDP, GNP and tax burden under the conditions of the countries' closeness.

Furthermore, many authors (for instance Artis and Zhang 1997, Camacho *et al.* 2006, Darvas and Szapáry 2008, Aguiar-Conraria and Soares 2011, Weyerstrass *et al.* 2011, Degiannakis *et al.* 2014, Antonakakis and Tondl 2014, Asteriou and Moudatsou 2015, Di Giorgio 2016, Matesanz *et al.* 2017) focused on the question of business cycle synchronisation in Europe.

Darvas and Szapáry (2008) concluded an increase in GDP synchronisation within the euro area, in case of Hungary, Poland and Slovakia but the analysis showed that other CEE countries are not synchronised towards the core EU countries. Aguiar-Conraria and Soares (2011) applied a wavelet analysis to test business cycle synchronisation within the EU-15 and the euro area and concluded that Germany and France are the most synchronised whereas some countries (*e.g.* Spain) are more synchronised with France and others (*e.g.* Austria) are more synchronised with Germany. Degiannakis *et al.* (2014) applied time-varying correlation to analyse business cycle synchronisation in the EU over the time period 1980 - 2012 and concluded an increase in synchronisation until 2007 and after that an appearance of business cycle desynchronisation. Matesanz *et al.* (2017) applied a correlation matrix and minimum spanning tree methodology and concluded an increase in business cycle synchronisation in the euro area after the economic crisis and identified clusters of countries according to the degree of their synchronisation. Di Giorgio (2016) analysed business cycle synchronisation between CEE countries and the euro area over the time period 1993 - 2014, estimated Markov switching autoregressive models and revealed that the synchronisation is higher in times of recession and lower in times of expansion.

2. Methodology

Our analysis comprehends the sample of 28 EU member countries. The annual data of GDP per capita based on purchasing-power-parity (PPP) (in Current international dollar) cover the period from 1995 to 2014 (*source*: WEO Database, IMF, April 2016).

In order to test a real convergence and GDP synchronisation in the European Union EU-28, we use three methods:

- panel data model: Bayesian Shrinkage estimators to test the speed of real convergence;
- cluster dendrogram to show similarities in GDP evolution;
- distance-Based approach (developed by Horváth *et al.* 2013b, 2014) to reveal temporal dynamics of the overall convergence tendencies.

2.1 Dynamic panel data model: Bayesian Shrinkage estimators

In general, to test a real convergence, we need to specify the correlation between the GDP per capita growth rate and the initial GDP per capita (see Barro and Sala-I-Martin 1995). Here, we follow the model of real convergence proposed by Islam (1995, 2001), who developed the original cross-section model of absolute β-convergence in dynamic panel data model:

$$\log\left(y_{it}/y_{it-1}\right) = a-\left(1-e^{-\beta}\right)\log\left(y_{it-1}\right)+\varepsilon_{it} \quad (2)$$

where: $\log\left(y_{it}/y_{it-1}\right)$ - is annual GDP per capita growth rate; $\log\left(y_{it-1}\right)$ - is logarithm of GDP per capita in previous period (t-1); a - is an intercept; $-\left(1-e^{-\beta}\right)$ - a slope coefficient; ε_{it} - is an error term.

If β is positive, the annual GDP per capita growth rate $\log\left(y_{it}/y_{it-1}\right)$ is negatively correlated with $\log\left(y_{it-1}\right)$ and so we accept the hypothesis of absolute β-convergence (*see* Barro and Sala-I-Martin 1995). It means that initially less developed economies (*i.e.* new EU member states in our case) tend to reach higher GDP per capita

growth rates than the developed ones *(i.e*. core EU countries in our case) and consequently we conclude an absolute β-convergence.

In order to estimate the speed of convergence (*i.e.* the coefficient β) for each individual country, we use Bayesian Shrinkage estimator. The Bayesian Shrinkage estimator has been developed by Hsiao *et al.* (1999) and is strongly recommended by Maddala *et al.* (1997) if the model contains lagged endogenous variables, which is the case of our dynamic panel data convergence model. Consequently, using the Iterative Bayesian procedure, we identify the distribution of the speed of real convergence through EU countries.

2.2. Cluster dendrogram

Cluster dendrograms are used to identify the similarities in the evolution of GDP per capita growth rates in the EU-28 over the whole period 1995 - 2014.

According to Mantegna (1999), similarities in the evolution of chosen indicator can be identified by calculation of distances between the time series. This calculation of distances comes from the calculation of correlation coefficients (Mantegna 1999). The idea is that smaller distance between time series means higher similarity.

As it is proposed by Mantegna (1999), the classical correlation coefficient ρ_{xy} between GDP per capita growth rate of country *x* and GDP per capita growth rate of country y can be transformed to the Euclidean distance d_{xy} between GDP per capita growth rate of country *x* and GDP per capita growth rate of country *y*:

$$d_{xy}=\left(2\left(1-\rho_{xy}\right)\right)^{1/2} \quad (3)$$

It follows that higher correlation coefficient ρ_{xy} between two GDP per capita growth rates corresponds to smaller distance d_{xy} between them. The distances between each pair of GDP per capita growth rate of country x and GDP per capita growth rate of country *y* (*i.e.* for each pair of the EU-28 countries) generate distance matrix D, which consists of individual pair distances d_{xy} and is used to estimate cluster dendrograms. In our analysis, we apply Ward method of clustering. Cluster dendrograms offer the decomposition of countries into several clusters ("clubs of convergence" in our case), at which one cluster contains the most similar objects (Focardi 2001), *i.e*. the countries having the smallest distance d_{xy} of their GDP per capita growth rates.

2.3. Distance-based approach

Distance-based methodology allows the calculation of distances between time series of chosen indicators. This method, we use here, is called distance-based approach (in analogy with Zhang *et al.* 2009) and was developed by Horváth *et al.* (2013b, 2014).

Horváth *et al*. (2013b) consider a time-dependent data matrix X(t), which contains n×m items $X_{it}(t)$ combining the information from chosen factor k∈{1,2,…m} corresponding to the country i∈{1,2,…n}. Horváth *et al*. (2013b) propose to calculate an average of the Minkowski-type distance in each time *t* between each pair of time series.

We calculate firstly the inter-country pair mean distance $D_{ij}^{cc}(t)$ (according to Horváth *et al.* 2013b):

$$D_{ij}^{cc}(t)=\left[\frac{1}{T}\sum_{\tau\in W(t,T)}\left|\hat{X}_{ik}(\tau;t,T)-\hat{X}_{jk}(\tau;t,T)\right|^{p}\right]^{1/p} \quad (4)$$

where: i, j represent two analysed countries (all together we have 28 countries: i∈{1,2,…n=28} and j∈{1,2,…n=28}); k represents the analysed indicator – the only one indicator in our case: GDP per capita; T is the extent of the running time window, for which we calculate the distance and p is an index describing the type of the distance, which is calculated between time series (here, we calculate the Euclidean metric distance, so that p=2); $D_{ij}^{cc}(t)$ is the inter-country pair mean distance (Horváth *et al.* 2013b) between the time series of GDP per capita of country i and the time series of GDP per capita of country *j.*

We calculate the inter-country pair mean distance for each pair of 28 analysed countries of the EU-28.

Thereafter, we calculate arithmetic inter-country mean distance $D_i^c(t)$, which describes the mean distance of the country *i* in relation to all rest analysed *n-1* countries (according to Horváth *et al*. 2013b):

$$D_i^c(t) = \frac{1}{n-1} \sum_{j=1, j \neq i}^{n} D_{ij}^{cc}(t) \quad (5)$$

Our objective is to reveal prevailing convergence or divergence tendencies of GDP per capita in the whole EU-28. We calculate an average of the particular inter-country mean distances $D_i^c(t)$ (as it is proposed by Horváth *et al.* 2013b) and we obtain the evolution of mean distance of GDP per capita in the whole EU-28:

$$\overline{D}^c(t) = \frac{1}{n} \sum_{i=1}^{n} D_i^c(t) \quad (6)$$

To compare the Distance-based approach and the Bayesian Dynamic Panel estimation when researching the real convergence in the EU-28, we can state the following: the Bayesian approach takes into account the individual heterogeneity between countries, nevertheless it gives the estimation for the whole analysed period and does not allow to research temporal changes. However, this restriction is overcome by above given Distance-based approach, which allows for temporal dynamics as mean distances are calculated for chosen running time window (*e.g*. running time window containing 3 years or 5 years), which decomposes the evolution in several sub-periods.

3. Results

3.1. Bayesian Shrinkage estimators for the rates of convergence

Table 1 presents the results of Bayesian shrinkage estimators for rates of convergence (β) and the estimated "half-life", *i.e.* the number of years needed so that the GDP per capita gap is halved. Table 1 reveals that new EU members, which are generally less advanced countries, such as Croatia, Romania, and Bulgaria have higher convergence rates (β) than core EU countries. This result supports the theory of real convergence (Barro and Sala-I-Martin 1995): if the GDP per capita increases, the rate of convergence (β) decreases. Bayesian shrinkage estimates in Table 1 show that Croatia has the highest rate of convergence (β) in our sample (5.8% per year) and Luxembourg has the smallest one (5% per year).

Moreover, "half-life" is higher for core EU members than for new EU members, *i.e*. CEECs. The estimates reveal that Luxembourg would need 6 years to catch-up half of GDP per capita gap whereas new EU members or CEE countries (such as Croatia, Bulgaria and Romania) would need only 5.2 years. When we look at V4 countries, the Czech Republic would need 5.4 years, Hungary 5.3 years, Poland 5.6 years and Slovakia 5.5 years. In case of Baltic countries, "half-life" estimate for Estonia and Lithuania is 5.5 years and for Latvia 5.4 years (see Table 1).

Table 1. The rates of convergence (β_i): Bayesian Shrinkage Estimators

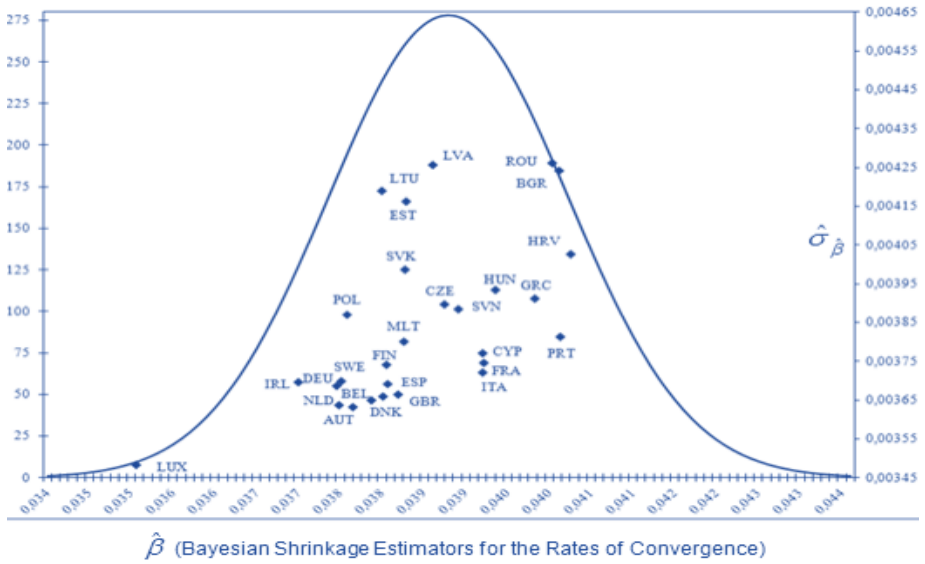
Shrinkage Estimators state by state : 5 iterations					
Country	Country abbreviation	Half-life	Beta - β	Std. Errors	T-Stat
Austria	AUT	5.6	0.0540377	0.0036375	14.855703
Belgium	BEL	5.5	0.0545992	0.0036505	14.956755
Bulgaria	BGR	5.2	0.0578087	0.0042437	13.622213
Cyprus	CYP	5.3	0.0565015	0.0037730	14.975273
The Czech Republic	CZE	5.4	0.0558517	0.0038974	14.330454
Germany	DEU	5.6	0.0540829	0.0037002	14.616317
Denmark	DNK	5.5	0.0547900	0.0036599	14.970273
Spain	ESP	5.3	0.0565173	0.0037463	15.086215
Estonia	EST	5.5	0.0552032	0.0041648	13.254580
Finland	FIN	5.5	0.0548633	0.0037423	14.660498
France	FRA	5.5	0.0550524	0.0036649	15.021681
Great Britain	GBR	5.5	0.0548681	0.0036933	14.856183
Greece	GRC	5.2	0.0573905	0.0039123	14.669369

Shrinkage Estimators state by state : 5 iterations					
Country	Country abbreviation	Half-life	Beta - β	Std. Errors	T-Stat
Croatia	HRV	5.2	0.0580091	0.0040271	14.404633
Hungary	HUN	5.3	0.0567215	0.0039361	14.410598
Ireland	IRL	5.6	0.0533518	0.0036966	14.432581
Italy	ITA	5.3	0.0565080	0.0037238	15.174711
Lithuania	LTU	5.5	0.0547769	0.0041923	13.066139
Luxembourg	LUX	6.0	0.0505674	0.0034841	14.513879
Latvia	LVA	5.4	0.0556585	0.0042579	13.071904
Malta	MLT	5.5	0.0551513	0.0038031	14.501704
Netherlands	NLD	5.5	0.0542870	0.0036343	14.937366
Poland	POL	5.6	0.0541829	0.0038721	13.993261
Portugal	PRT	5.2	0.0578446	0.0038148	15.163159
Romania	ROU	5.2	0.0577054	0.0042631	13.536009
Slovakia	SVK	5.5	0.0551771	0.0039881	13.835413
Slovenia	SVN	5.4	0.0560970	0.0038874	14.430493
Sweden	SWE	5.6	0.0540030	0.0036875	14.644793

Source: Authors' calculations

Notes: tested hypothesis: absolute β-convergence, analysed period: 1995-2014; the catching-up period half-life: $t = \log(2)/\beta$.

Figure 1. Distribution of estimated β-convergence rates for EU-28 countries over the period 1995 - 2014



Source: Authors' calculations

Notes: Tested Hypothesis: Absolute Real Convergence.

Figure 1 reveals the distribution of the estimated β-convergence rate for each individual country in the EU-28. The results lead to several conclusions:

- Luxembourg is in the first section (from left to the right): note that Luxembourg has the lowest β-convergence rate (only 5% per year, see Table 1). The result can be explained by the fact that Luxembourg has been already taking off economically since 1980'.
- Core EU countries are situated in the second section of the distribution: the estimated β-convergence rate is 5.5% per year on average (Germany 5.4%, Belgium 5.45%, Netherlands 5.43%, Sweden 5.4%, Denmark 5.47% and Great Britain 5.48%).

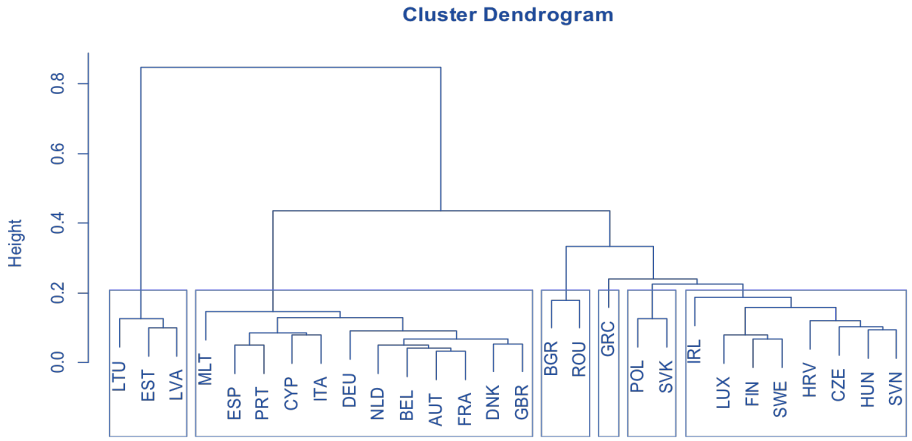
- The CEE countries that joined the European Union in 2004 (V4 countries - the Czech Republic, Poland, Hungary, Slovakia as well as three Baltic countries - Estonia, Latvia and Lithuania) are situated in the third section of the distribution.
- The newest EU member candidates (such as Bulgaria, Romania and Croatia) are situated in the last section.

Consequently, we can conclude that the distribution of estimated β-convergence is in conformity with countries' economic performance measured by GDP per capita. The results support an idea that β-convergence rates of new EU members (*i.e*. CEE countries) are systematically higher than convergence rates of rich core EU countries.

3.2. Results from cluster analysis

Cluster dendrogram (see Figure 2) offers the overall view on similarity and synchronisation in evolution of GDP per capita growth rates in the EU-28. Cluster dendrogram presents the categorization of all 28 analysed countries into several clusters, at which the countries with the smallest pair distance between time series of their GDP per capita growth rates are situated in one cluster.

Figure 2. Clustering of the growth rates of GDP per capita based on purchasing-power-parity (PPP)



Source: Authors' calculations, output from R.

Notes: Ward method of clustering; Euclidean metric distance was used to calculate distances. The growth rate of GDP per capita is calculated as $\ln(y_{it} / y_{i,t-1})$; time period 1995 - 2014.

Figure 2 reveals the similarity in evolution of GDP per capita growth rate in core European Union countries (such as Germany, Netherlands, Belgium, France, Denmark, Italy, Austria, Great Britain, Portugal and Spain) as these countries are found in one and the biggest cluster. The result is in accordance with the estimated rates of convergence as these countries have hereby almost the same speed of convergence (see Table 1 and Figure 1).

According to the Cluster dendrogram on Figure 2, three Baltic countries (Estonia, Latvia and Lithuania) have markedly small distances between their GDP per capita growth rates and create one cluster, which is apparently separated from other groups of countries. Note that these countries have very similar speed of convergence according to the Bayesian shrinkage estimators (see Table 1).

Thereafter, a separate cluster is created by two countries of the latest cycle of EU enlargement to the East, *i.e*. Bulgaria and Romania (see Figure 2), having the same position according to the speed of convergence (Figure 1). Moreover, the evolution of GDP per capita growth rate in Slovakia and Poland, *i.e.* the countries of the first cycle of EU enlargement to the East (which joined the EU in 2004), is very similar according to the cluster dendrogram on Figure 2. These countries are also situated in the same third section of graph describing the distribution of countries according to their speed of convergence (see Figure 1). Finally, the Cluster dendrogram reveals GDP per

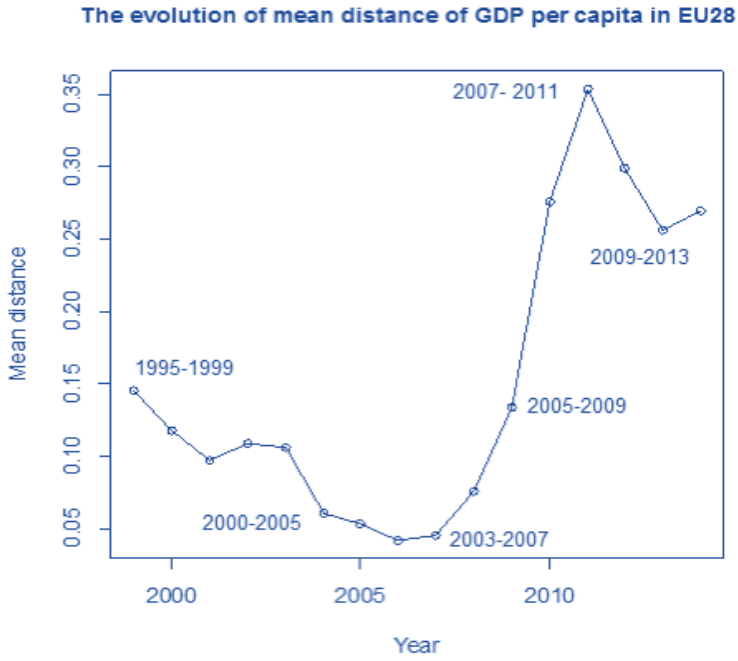
capita growth rate similarity in the Czech Republic, Hungary, Slovenia and Croatia, *i.e.* countries of the first and the second cycle of EU enlargement to the East.

3.3. Results from Distance-based approach

The Bayesian panel data estimation of the rate of convergence (see Figure 1, Table 1) enables to reveal inter-country disparities during the whole analysed period 1995 - 2014, while the evolution of mean distance (see Figure 3 and 4) allows revealing a temporal dynamics of the GDP per capita convergence of the whole EU-28.

The Distance-based approach, *i.e.* the calculation of mean distance, allows for temporal dynamics as a running time window decomposes the evolution of mean distance in several sub-periods. Here, we present results for running time window T=5 years (the mean distance is calculated in more aggregated five year sub-periods *i.e.* 1995 - 1999, 1996 - 2000, …, and 2010 - 2014; see Figure 3) and T=3 years (the mean distance is calculated in sub-periods, which consist of three years*, i.e.* 1995 - 1997, 1996 - 1998, …, and 2012 - 2014; see Figure 4).

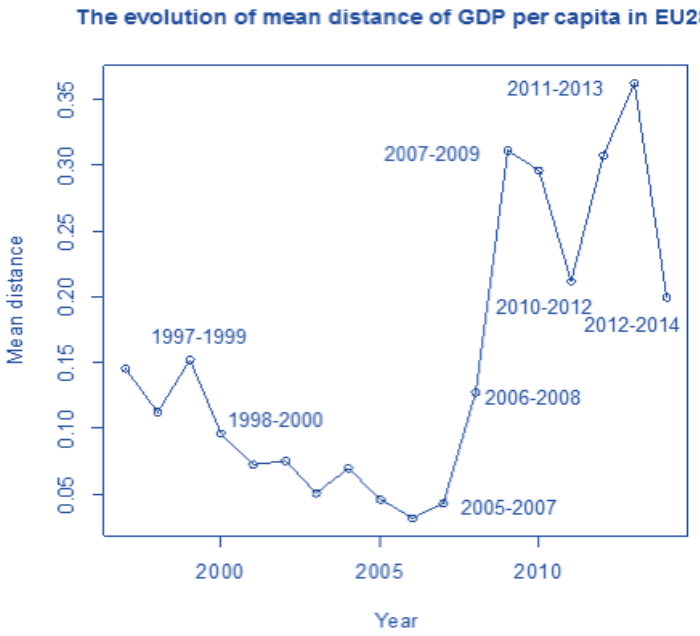
Figure 3. The evolution of the mean distance of GDP per capita in the EU-28 with running time window T=5



Source: Authors' calculations, output from R.

Notes: The evolution of mean distance $D^c(t)$ is calculated from inter-country mean distances (see eq. (6)); index p = 2 (Euclidean metric distance); Distances are calculated over the running time window T=5 (year 1999 = 1995-1999, 2000 = 1996-2000, 2014 = 2010-2014); time period 1995 - 2014.

Figure 4. The evolution of the mean distance of GDP per capita in the EU-28 with running time window T=3



Source: Authors' calculations, output from R.

Notes: The evolution of mean distance $D^c(t)$ is calculated from inter-country mean distances (see eq. (6)); index p = 2 (Euclidean metric distance); Distances are calculated over the running time window T=3 (year 1997 = 1995-1997, 1998 = 1996-1998, 2014 = 2012-2014); time period 1995 - 2014.

As far as the evolution of the mean distance $\overline{D}^c(t)$ of GDP per capita between all EU-28 countries (Figure 3 and Figure 4), converging trends prevailed up to 2007. However, the strongest convergence, *i.e.* the smallest mean distance of the GDP per capita, is observed over the time period 2002-2006 (see Figure 3) and 2004 - 2006 (see Figure 4). This result is expected as 10 countries (Slovakia, the Czech Republic, Poland, Hungary, Latvia, Lithuania, Estonia, Malta, Cyprus and Slovenia) joined the European Union in 2004; they had to meet Maastricht criteria and started to approach the core European Union countries.

Although a crisis year caused a divergence of GDP per capita in the EU-28. Diverging tendencies started over the time period 2004 - 2008 (Figure 3) or 2006 - 2008 (Figure 4) and an increase in mean distance of GDP per capita prevailed up to 2011. Then, we observe again a convergence tendency (Figure 3), which was induced by a decrease in mean distance over the time periods 2010 - 2012 and 2012 - 2014 (see Figure 4). However, a mean distance of GDP per capita is still important compared to the pre-crisis period. Finally, it should be pointed out that we observe even an increase of mean distance over the time period 2011 - 2013 (Figure 4).

Conclusion

The objective of the paper was to estimate the speed of real convergence among EU-28 by Bayesian Shrinkage Estimators, to reveal similarities, *i.e.* synchronisation in evolution of GDP per capita by cluster analysis and to research the overall convergence or divergence tendencies by application of the so-called distance-based approach.

Nowadays, when countries are marked by economic and debt crisis, we cannot conclude the acceleration of convergence of the CEE countries towards core EU countries. According to our results, the evolution of GDP per capita growth divides EU-28 countries in several clusters and the overall average distance in GDP per capita evolution is increasing. Even Greece is still characterised by imbalances, having relatively high distance of its GDP per capita compared to the core EU countries. This fact is confirmed by our cluster analysis of GDP per capita

growth, where Greece does not belong to main cluster consisting of the core EU countries and seems to be rather independent.

To estimate the catching-up process within the EU-28 and to take into account countries heterogeneity, we used Iterative Bayesian procedure. Bayesian Shrinkage estimation of dynamic panel data model of convergence calculated the rates of β-convergence for each individual EU-28 member. Our results support the idea that the countries converge at different β-convergence rates. Moreover, the results support the theory of convergence as the estimation shows that β-convergence rates of new EU members (CEE countries) are systematically higher than convergence rates of core EU countries.

The estimation of the rates of convergence was complemented by cluster analysis. Cluster dendrogram offers the categorization of 28 EU countries into several clusters and revealed (i) similarity of the GDP per capita growth in core EU countries (such as Germany, Netherlands, Belgium, France, Denmark, Italy); (ii) positioning of Latvia, Lithuania and Estonia in one separated cluster; (iii) similarity of GDP per capita of Bulgaria and Romania; and Slovakia and Poland (iv) GDP per capita growth rate similarity in the Czech Republic, Hungary, Slovenia and Croatia. In general, our results concluded that countries situated in the same cluster have very similar rate of convergence according to the Bayesian shrinkage estimators.

As Bayesian panel data estimation reveals individual heterogeneity between countries for the whole analysed time period and does not allow to research temporal changes, this restriction has been overcoming by application of the distance-based approach, which allows for temporal dynamics and decomposes the evolution in several sub-periods. The evolution of calculated mean distance of GDP per capita between all EU-28 countries permitted to conclude that convergence tendencies prevailed up to 2007, while the strongest convergence was observed over the time period 2004 - 2006. However, recent crisis in Europe caused a divergence of GDP per capita and an increase of mean distance of GDP per capita prevailed up to 2011. Although we observe convergence tendencies over the time periods 2010 - 2012 and 2012 - 2014, an increased distance of GDP per capita remains important. Moreover, it should be pointed out that a mean distance between GDP per capita of all EU-28 countries is importantly higher compared to the pre-crisis period.

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Transfer of Technology in Asian-Pacific Economic Cooperation States. Regional Development Models

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Abstract:

The article deals with regional features of technology transfer within APEC (Asian-Pacific Economic Cooperation) member economies taking into consideration different institutional structures (government, regional authorities, scientific, educational, and industrial institutions.) The authors have performed analysis of opportunities for significant economic and technological development based on implementation of regional programs of technical and technological integration of Asian and Pacific region countries, showing quick economic growth due to increase of productive capacity, qualification level of personnel, accompanied with substantial amounts of investments into real sectors of economy, and large-scale implementation of state-of-the-art technologies. Details of forming of different integration models within the region under question: Japan, China, South Korea, Singapore, Taiwan, are studied. Key elements of creation and development of the technology transfer systems from Asian and Pacific leaders in field of technology are provided. The authors use system approach, comparative and statistical analysis in their work. The study describes opportunities for significant economic and technological development based on implementation of regional programs of technical and technological integration of Asian and Pacific region countries. The article contains also a conclusion concerning perspectives of development of global economy on the basis of efficient unlocking of the potential of major regional economic zones, including the ones of the Asian and Pacific region.

Keywords: technology transfer; Asian-Pacific Economic Cooperation; innovations; technologies; development.

JEL Classification: O30; O31; O32; O33

Introduction

Development and economic growth of almost any country depends on a number of factors, ensuring both increase of real production volumes, and improvement of growth quality, as well as effectiveness level. In course of development of economies this range of factors and estimated cost of the factors value change. But development of innovative industry, high-tech, and knowledge economy shift to the first place for most of leading countries of the world.

The USA and Japan are the globally recognized technology field leaders in the world and, particularly, in Asian and Pacific region. However, a number of countries, which mostly imported technologies before, have recently entered the global high technology market. Among the first of these were newly industrialized countries

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(NIC) of the "first wave" (Republic of Korea, Singapore, Taiwan, Hong Kong) - they have increased investments and governmental expenses for research and development (R&D) works (Table 1).

Table 1. Gross domestic expenditure on R&D (GERD) at current prices and PPPs, Million USD

Country	2010	2011	2012	2013	2014
Australia	20,572,2	20,955.6	...	23,084.0	...
Canada	25,048.2	25,674.6	26,279.0	26,303.8	25,813.6
Chile					
China	213,460.1	247,808.3	292,062.9	333,521.6	368,731.6
Japan	140,607.4	148,389.2	152,325.6	162,347.2	166,861.3
Korea, Rep.	52,172.8	58,379.7	64,862.5	68,051.5	72,266.8
New Zealand	...	1,766.6	...	1,902.8	...
Russian Federation	33,093.5	35,192.1	37,911.5	36,614.1	39,863.0
Singapore	7,218.1	8,359.7	8,176.9	8,686.4	...
United States of America	410,093.0	428,745.0	436,078.0	456,977.0	...

Source: Compiled by the authors based on data provided by OECD, Main Science and Technology Indicators Database, January 2016.

1. Methods

As basic research methods we used system approach, comparative and statistical analysis of indicative values of innovation and technological development of the Asian and Pacific region.

In order to assess scientific and innovation potential since 2007 the Intelligence Unit of the Economist magazine calculates The Global Innovation Index annually (see Table 2). Thus, in 2016 the research included 128 countries, which constitute 99.4% of the global GDP. Russia, occupying the 62nd place in 2013, reached the 43rd place in 2016 (The Global Innovation Index 2013, The Global Innovation Index 2016).

Table 2. The Global Innovation Index (APEC States) 2016

Country / Economy	Score (0-100)	Rank	Income	Rank	Region	Rank	Efficiency Ratio	Rank
United States of America	61,40	4	HI	4	NAC	1	0,79	25
Singapore	59,16	6	HI	6	SEAO	1	0,62	78
Hong Kong (China)	55,69	14	HI	14	SEAO	3	0,61	83
Korea, Rep.	57,15	11	HI	11	SEAO	2	0,80	24
Canada	54,71	15	HI	15	NAC	2	0,67	57
Japan	54,52	16	HI	16	SEAO	4	0,65	65
New Zealand	54,23	17	HI	17	SEAO	5	0,73	40
Australia	53,07	19	HI	19	SEAO	6	0,64	73
China	50,57	25	UM	1	SEAO	7	0,90	7
Malaysia	43,36	35	UM	2	SEAO	8	0,67	59
Russian Federation	38,50	43	HI	39	EUR	29	0,65	69
Chile	38,41	44	HI	40	LCN	1	0,59	91
Thailand	36,51	52	UM	8	SEAO	9	0,70	53
Viet Nam	35,37	59	LM	3	SEAO	11	0,84	11
Peru	32,51	71	UM	19	LCN	8	0,51	109
Philippines	31,83	74	LM	8	SEAO	12	0,71	49
Indonesia	29,07	88	LM	11	SEAO	13	0,71	52

Source: Compiled by the authors based on data provided by The Global Innovation Index 2016

Note: World Bank Income Group Classification: LI - low income; LM - lower-middle income; UM - upper-middle income; HI - high income. Regions are based on the United Nations Classification: EUR - Europe; NAC - Northern America; LCN - Latin America and Caribbean; CSA - Central and Southern Asia; SEAO - South East Asia, East Asia and Oceania.

Economic and technological development of the Asian and Pacific Region countries, rising of the "first wave" NIC in 1960s, followed by second to fourth ones, evolvement of China in the global market means forming a regional

model of development, which includes intraregional distribution of labor in accordance with geographic location, natural resources, level of economic and technological development.

2. Findings

Economic and technological development of the Asian and Pacific Region countries, rising of the "first wave" NIC in 1960s, followed by second to fourth ones, evolvement of China in the global market means forming a regional model of development, which includes intraregional distribution of labor in accordance with geographic location, natural resources, level of economic and technological development.

Technology transfer process has its own regional features. Thus, in the USA, as a result of sustainable national policy the distributed institutional network was created, each participant of which has its own needs and opportunities. Forming of such network aims in further achieving of efficient interaction between the state, scientific institutions, and business in course of creation and application of knowledge and technologies ensuring common economic growth. Forming of a technology transfer system in Singapore aims creation and development of state-of-the-art technology in the field of agricultural production, including (in the long view) export supply of the agricultural products of scientific and production parks and innovative technology into Asian and Pacific Region countries. National innovative system of Hong Kong was formed based on historical features, as economic integration of the country's economy with southern provinces of China (after transition of the country under the jurisdiction of China in 1997), had in such circumstances a great influence, causing migration of some production facilities to the territory of Hong Kong. Activities carried out by the Scientific and technological park of Hong Kong, having a range of research centers and incubators, with governmental support for scientific business has shown its effectiveness. In Japan its national technopolises creation strategy, aimed at development of the country's economy and based on the idea of interaction of business structures (production facilities) with universities and institutes (education and science), and with government and local authorities (governing level) became a cornerstone of formation of the technology transfer system. In such circumstances both government of Japan and its business structures pay much attention to creation of technopolises, reasonably considering them to be the key source of technologies, defining both economic growth of the country and its future.

National policy of China aims at global support of innovative and high-tech enterprises, technological park structures, efficient development of the country's economy, basing on its own scientific potential. Thus, in accordance with China's national program adopted in 2006, governmental authorities are obliged to allocate a part of its funds for purchasing products of innovative Chinese companies exclusively (without regard to economic feasibility of such purchases). According to the new rules the governmental authorities may purchase foreign products only in case its substitutes are not produced in China. The basis of the Southern Korean national innovative system lies in creation of technological parks as a result of cooperation of a state with scientific and production facilities, aimed at implementation of promising production technologies and inventions. In such circumstances technological park structures, supported by government, supply experts, carry out researches and development in conjunction with local enterprises (both private and governmental ones). Taiwanese government has built its national innovative system on the basis of both Japanese and US experience in creation of technological park structures, and has chosen the following priority goals from the very beginning: development of new high-tech production facilities, including development and putting into production computers, semiconductor-based devices, and inventions in fields of biotechnology and fine chemistry, optic electronics. In Russia, in the existing technology transfer system, created due to transformation of the country's economy, there arises a need in formation of special practices for innovative processes organization, ensuring efficient interaction among all its participants - government, industrial enterprises, scientific and educational institutions, financial institutions. The existing Russian technology transfer system needs special practices of innovative processes organization, providing efficient interaction among all its participants - government, industrial enterprises, scientific and educational institutions, financial institutions. The first-order condition of its efficient implementation is formation of the appropriate innovative infrastructure: legislative base, aimed at energizing innovative enterprises and warranting protection of intellectual property rights; specialized scientific and educational centers, scientific (innovative, technological) parks, technology transfer and commercialization centers, business-incubators,

innovative firms, ensuring transformation of promising scientific ideas and knowledge in productive, informational, and technological innovations; financing research and development activities from enterprises sector by creation of legal and financial guarantees, concessional loans, various out-of-budget and joint funds, governmental awards; telecommunication infrastructure for information supply of Russian science, connection of local informational networks to the global ones, increase of number of electronic libraries and distribution of the Internet, expanding of access of Russian scientists to international data banks, development of venture firms and funds, small-scale inculcation companies, and other components of innovation infrastructure.

3. Consideration: Regional development models of the Asian-Pacific Economic Cooperation states

Let's consider the most characteristic features of technology transfer systems forming in a number of countries - technology leaders of Asian and Pacific Region.

3.1. United State of America

Recognition of technology transfer system as the economy factor of the greatest importance is enshrined in the US legislation, determining administrative, financial, and other obligations of actors in field of innovative business in course of creation and implementation of innovations and technology. Thus, the first Federal law, governing the technology transfer process (Bayh-Dole Act 1980), entitled universities and non-profitable small-scale enterprises to supply industrial companies with licenses for commercial application of research and development results, obtained under financial support of the government. The same year one more law (Stevenson-Wydler Act) was adopted, aimed at improvement of interaction between federal laboratories and industrial companies of the state and private sectors (Jolly 1980).

In 1986 the technology transfer act was adopted, entitling various institutions to enter into agreements concerning carrying out joint research and development activities. The law defined limitations related to commercial and state secret and national security information. Creation of industrial technology transfer centers in order to ensure closer cooperation between state and private sectors of economy was vested by a Global Trade and Competition Law in 1988. Provisions of these laws were complemented by the Competitiveness Technology Transfer Act (1989), entitling federal laboratories bound by contractual obligations with federal agencies, enter into agreements with third parties — both state and private. After implementation of sustainable national policy efficiency of technology transfer was recognized, as a process, bringing benefits to both state and private sector. The transfer gave an opportunity to increase profits of companies and corporations, to improve their competitiveness level at global high technology markets.

Drawing on the obtained results the US government at the beginning of the 1990s has formed the National Technology Transfer Network, comprising a central National Technology Transfer Center and six regional Technology Transfer Centers, based in different regions of the country. A certain number of technology transfer programs implemented by ministries and departments of the country (these are programs of the National Scientific Fund, National Airspace Agency, programs by Department of Defense, Department of Energy, Department of Agriculture and other departments) are implemented in the USA.

Thus, The US has built a distributed institutional network, each participant of which has its own needs and opportunities. Forming of such network aims in further achieving of efficient interaction between the state, scientific institutions, and business in course of creation and application of knowledge and technologies ensuring common economic growth.

3.2. Singapore's model

At the end of 1970s government of Singapore has chosen development of knowledge-intensive industries as a priority task for national policy. Declaration on necessity to create informational and knowledge-intensive industries was adopted. Thus, in 1981 the first scientific and production park of Singapore was created based on Singapore University; it became the most powerful innovation center of the country and the major industrial research and development center.

After that the government of Singapore has chosen biotechnology, healthcare, biochemistry, microbiology, genetics, and zoology as priority fields of research and development activity. Up to mid-1990s 10 agricultural technological parks had been created; leading experts of the aforementioned fields of science worked there.

These scientific and production parks has contributed a lot into implementation of national development programs of Singapore. Thus, Singapore Science Park, established in 1980 became the basis for forming of high-technology companies of the country and the center for a range of national programs and R&D campaigns, aimed at development of such fields of science, as biological medicine, informational technologies, software development, telecommunication, electronics, food technologies, chemistry, and material science (Singapore Science Park 2016). In 2000 the government of Singapore has initiated new technological park project One-North Science Habitat, which includes creation of multi-purpose research and development community, and two technological park structures have been created within the existing complex: Biopolis — orientated to biological technologies, and Fusionopolis — orientated to informational and fundamental sciences (Analysis and assessment of state and development trends of innovation and science legislation abroad 2012).

Companies, taking part in development of such parks, are provided with a wide range of benefits. Among these there are the following: decreasing of profit tax twice in case it is invested into research and development activities; tax credit for construction and operation of industrial structures at the territory of the Production Park, etc. The government of Singapore is going to increase number of technological parks operating in field of creation and development of state-of-the-art agricultural production technologies. In the long view exporting supply of agricultural products of the scientific and production parks, as well as new inventions and technologies into Asian and Pacific Region countries are foreseen (Report of the Economic Strategies Committee: Ministry of Trade and Industry Singapore 2010).

3.3. Hong Kong

National innovative system of Hong Kong was formed based on both historical features (separation in XIX century from China and transformation into a British colony) and geographic ones, formed based on interest of some countries (China, Eastern and South-Eastern Asia, Europe, and the USA).

Economic integration of the country's economy with southern provinces of China (after transition of the country under the jurisdiction of China in 1997), had in such circumstances a great influence, causing migration of some production facilities to the territory of Hong Kong. Activities carried out by the Scientific and technological park of Hong Kong, having a range of research centers and incubators, with governmental support for scientific business has shown its effectiveness. Thus, in 1999 government of Hong Kong has formed a dedicated fund of 5 billion of Hong Kong dollars ($645 mln.) for supporting of application research and development projects (Interview with the Chief Executive Officer of the Scientific and technological park of Hong Kong Anthony Tan 2012). And in 2001 the Corporation of Scientific and Technology parks of Hong Kong was established, which became the basic institution of the national innovative system.

As Chief Executive Officer of the Scientific and technological park of Hong Kong Anthony Tan says, the principle "designed in Hong Kong — made in China" was successfully implemented by a lot of resident companies of the Park. Particularly, this principle was used as a basis of business activity of Sensixa Company, which is a derivative of the London King's College. Sensixa develops and produces contact sensors, able to monitor degree of physical loads and state of a patient's organism. R&D-center in Hong Kong allows the company to market its product to market of the South-Eastern Asia due to low production costs of continental Chinese manufacturing facilities. In 2010 an ear clip sensor, designed by Bluetooth Company was awarded as the best invention globally by the Bluetooth Special Interest Group (Interview with the Chief Executive Officer of the Scientific and technological park of Hong Kong Anthony Tan 2012).

3.4. Japanese model

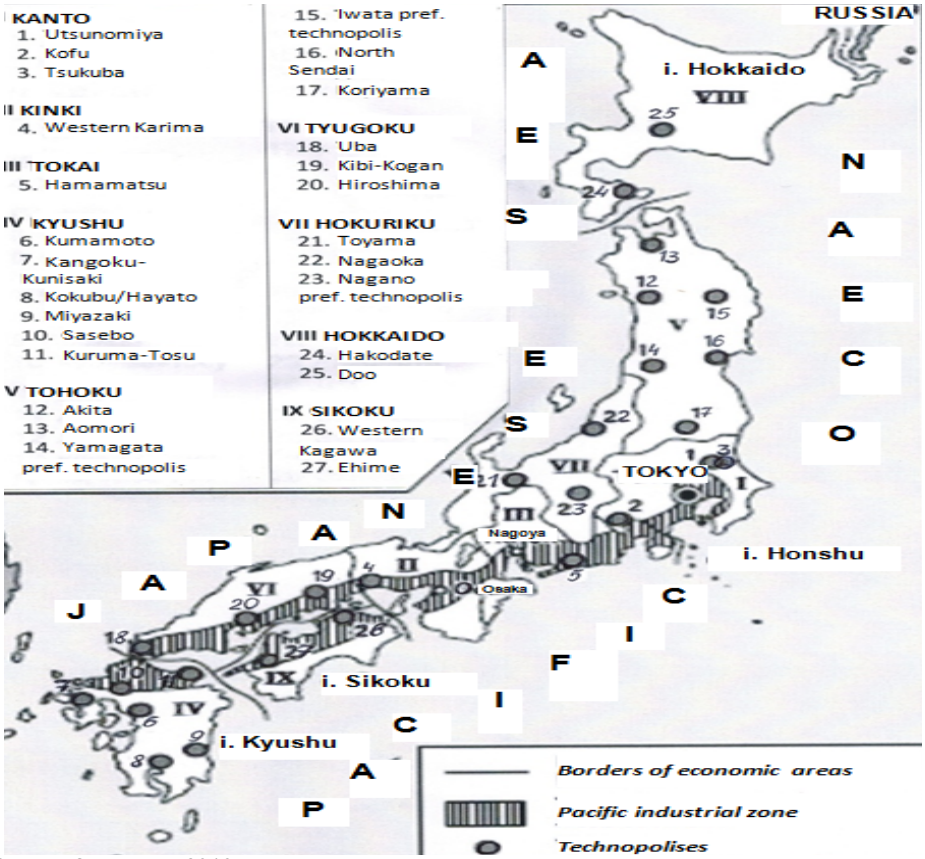
In order to concentrate both scientific and application researches in innovative fields, and knowledge-intensive industrial manufacturing facilities, brand new cities — technopolises — were created in 1982. "Technopolis" project (technopolises creation project) became national strategy, aimed at development of the country's economy based

on the idea of interaction of business structures (production facilities) with universities and institutes (education and science), and with government and local authorities (governing level).

Firstly 19 zones were selected for creation of technopolises; they were evenly distributed throughout four islands. Build-up of the technopolises was carried out taking into consideration certain requirements. Each technopolis should be located in a close proximity to an airport or a railway hub, allowing the member of such innovation process reach Tokyo, Nagoya, or Osaka and return the same day. Also a technopolis should include major scientific and production complexes, state or private universities, research institutions or laboratories in conjunction with comfortable residential districts, provided with all necessary cultural and recreation infrastructure objects.

Today Japan has more than 20 technopolises of national scale, influencing greatly the development of the country's economy (Figure 1.)

Figure 1. Japanese technopolises



Source: Solov'yova 2016.

The oldest and the most famous Japanese technopolis is Tsukuba, *a.k.a.* "brain city". It is situated in Kanto region and has a vast transport infrastructure, connecting the city with all other parts of the country. Tsukuba is a home for 40 of total 98 leading state research laboratories of Japan. This small city is one of the biggest scientific centers of the whole world: its population is slightly bigger than 200,000, and 19,000 of them are scientists, who carry out research and scientific work, and this value constitutes 40% of total number of scientists in the country (Technopolis Tsukuba 2011).

Hamamatsu, Nagaoka, Toyama, Hiroshima, Yamagata are other major technopolis cities. Each of them is responsible for its part of research and scientific work, carried out with regard to needs of its own region (prefecture) and uses its strategically important industry fields as a basis in its work. According to this Japanese government provides enterprises performing research and scientific work a range of benefits, including tax credits. Among such

benefits there is an annual tax credit equal to 10% of current and capital expenses for research and development activity, as well as an additional tax credit equal to 5% of expenses increment for research and development activity compared to expense amount for the previous three years. Both government of Japan and its business structures pay much attention to creation of technopolises, reasonably considering them to be a key source of technologies, defining both economic growth of the country and its future.

3.5. Chinese model

Reforms put in place in 1970s and 1980s, and adopted national development programs, based on these reforms constituted a basis of integration of the state, science, education, and business structures in China. On March 1986 national high technology and science development program, also known as "Program 863" was adopted; it has determine such priority fields of economy, as microelectronics, information technology, airspace, fiber optic technology, genetic engineering and biotechnology, power saving technology and health care. The program contained both fundamental and application researches, development on new technology based on conventional fields of industry development.

Implementation of this program was carried out quite efficiently. Thus, for the first 10 years of its implementation more than 1000 major scientific and technological achievements were made, among them 560 inventions were internationally acclaimed, 73 were awarded with State Prizes, 266 were patented abroad (Experience of Chinese technological parks functioning: Analytic information 1999).

After two years China has started implementation of a program called "Torch", aimed at commercialization and industrialization of knowledge-intensive fields of technology. In 1988 the first technological park — Experimental Beijing Zone of High Technology Development — was established by a decree of Chinese State Council (further it was renamed into a Zhongguancun Scientific and Industrial Zone or shortened to Z-park) (Zhongguancun Science Park 2013).

It is no wonder that Z-park is located to the north from Beijing. Here is the place where more than 100 scientific institutions and laboratories are situated, as well as major Chinese universities — Beijing University and Tsinghua University. They became those supporting elements of the whole technological park: the universities supplied all of scientific studies, companies promoting such studies, and qualified manpower for high-technology business.

Integration component has territorial structure in China; diversification into new and high technologies development zones, which are, in fact, scientific and technological parks, and were formed in mid 80s of XX century lies in its basis. Today China has 120 new and high technologies development zones of different levels, including 53 ones of a strategic importance (Experience of Chinese technological parks functioning: Analytic information 1999).

Among Chinese new and high technologies development zones the ones, located in central parts of China (Beijing, Shenyang), as well as in seashore regions (Shanghai, Hainan) are worth mentioning. The second biggest and most important technological park of China (Nanhu), which received a status "national" in 1991, is located in one of the central regions of the country. Shenyang, at the territory of which the said technological park is located, has 12 institutes and universities, 30 research institutions, 210 research laboratories, 220 operating enterprises dealing with new and high technologies (30 of them have a share of a foreign capital stock). For all the period of the zone existence about 600 new types of highly technological products were designed and put into production (Solov'yova 2016).

National policy of China aims at global support of innovative and high-tech enterprises, technological park structures, efficient development of the country's economy, basing on its own scientific potential. Thus, in accordance with China's national program adopted in 2006, governmental authorities are obliged to allocate a part of its funds for purchasing products of innovative Chinese companies exclusively (without regard to economic feasibility of such purchases). According to the new rules the governmental authorities may purchase foreign products only in case its substitutes are not produced in China.

3.6. Southern Korean model

Technological parks of Southern Korea are the result of cooperation of a state with scientific and production facilities, aimed at implementation of promising production technologies and inventions. Technological park structures, supported by government, supply experts, carry out researches and development in conjunction with local enterprises (both private and governmental ones) (Science and technology in Korea 2010).

At the stage of technological parks creation, they are oriented to characteristic features of the region, where they are built (among them there are natural and climatic, historical, technological, infrastructural and other ones). Table 3 shows major technological parks of Southern Korea and fields of their activity.

Table 3. Technological parks of Southern Korea

Description	Location	Main fields of activity
Taedok	Daejeon	Creation of high-technological products, new technologies and materials. Fundamental researches are also carried out (including the ones for Samsung and LG).
Ulsan	Ulsan	Research and development for machine-building industry. Development in field of chemical industry and high technology for ship-building industry. Automobile Parts Innovation Center (APIC). Hybrid electric vehicles.
Gangwon-do	Gangwon-do	Fields of activity, which are of high priority for small-scale innovative companies in medical instrument-building industry, high technology, and biomedicine.
Chungbuk	Cheongju	Development of biotechnology, ICT, media and multimedia, telecommunication systems, biological science, medical science and technology
	Gwangju	Chemistry / Chemical technology, Electronic and microelectronic technology
Gyeonggi	Ansan-si	Industrial technology, biotechnology, electronic and microelectronic technology, ICT, media and multimedia, telecommunication systems
Korea International Complex Gr/	Guru-dong, Guro-gu	Aeronautical science, airspace, astronautical science, electronic and microelectronic technology, technological systems, automation, robot technology, assembly, material science, new materials, mechanics, industrial service, industrial design, engineering
Innovation city Daedeok/Daejeon	Daejeon	Biotechnology, electronic and microelectronic technology, ИСТ, media and multimedia, telecommunication systems, technological systems, automation, robot technology, assembly, nanotechnology, optics, optic electronic, laser technology
Jeju	Jeju	Biotechnology, computers and peripheral equipment, culture industry, service technology, energy and renewable sources of energy, environment, ICT, media and multimedia, telecommunication systems
Small-scale business center GSBC	Suwon-si	Biotechnology, electronic and microelectronic technology, environment, ICT, media and multimedia, telecommunication systems

Source: Compiled by the authors.

3.7. Taiwanese model

At the territory of Taiwan there is situated Hsinchu Science Park, which is not only a center of semi-conductive and computer industry of Taiwan, but also one of the biggest technological parks of Asian and Pacific Region. When the technological park was created in 1980 on the basis of the biggest national universities (Chiatung and Tsinghua) with application of both Japanese and US experience in creation of technological park structures (Hsinchu Science Park Bureau 2016).

Main field of activity of the Hsinchu Science Park is development of new high-tech production facilities, including development and putting into production computers, semiconductor-based devices, inventions in fields of biotechnology and fine chemistry, optic electronics.

At the territory of the Hsinchu Science Park there are, among others, the following entities: Industrial technology research and development institute, electronic technology research and development institute, biotechnology development center, microelectronics development united corporation, the major sem-conductive products manufacturing company. The technological park houses more than 380 companies, including such large-

scale ones, as Philips, TSMC, United Microelectronics Corporation, Holtek, AU Optronics, Epistar (Companies in the Park 2016). As a result, the Park has the highest income level within Taiwan.

Total number of technological parks on Taiwan is three; they are called after their geographical location: the aforementioned Hsinchu, and also Southern and Central ones.

3.8. Russia

Technology transfer system existing in Russia today has a range of features, inherent to transient period. Efficiently developing economy features domination of knowledge-intensive new technologies in the structure of imports, and, in its turn, output of mature technologies domination in the export structure. The search for breakthrough innovative technologies is the main task for both the state and the subsurface user (Ageev and Chernyaev 2012). According to information provided by the State Statistic Service, the structure of exports in technology sector has scientific researches dominating in total of all subject matters of transactions, and other subjects import share prevails greatly over export one. At the moment, total import is significantly dominating over export (one and a half as much) in technology transfer system with foreign partners (Table 4), what means predominant import of technology, which has poor degree of novelty from perspective of the global technology market. 89% of developed advanced technologies are brand new for Russia, and as little as 10% of them are brand new for the global technology market (Table 5).

Table 4. Technology trade with foreign countries under subjects of transactions in 2014

Subject of transaction	EXPORT			IMPORT		
	Number of transactions	Subject cost, mln. USD	Total annual income, mln. USD	Number of transactions	Subject cost, mln. USD	Total annual outcome, mln. USD
TOTAL	2061	8991,6	1279,2	2842	7724,6	2455,8
Including for the following subjects of transactions:						
Invention patent	3	0,1	0,1	15	75,8	20,9
Patent license for an invention	95	90,9	26,6	137	367,0	100,8
Utility model	2	0,1	0,04	10	3,0	4,1
Know-how	19	99,1	11,5	67	203,8	121,7
Trademark	17	4,6	2,8	154	777,1	381,2
Commercial prototype	4	53,4	2,0	6	1,0	0,2
Engineering services	708	7516,5	707,7	1363	4617,5	1147,9
Scientific researches	606	966,2	356,5	371	351,4	151,5
Others	607	260,9	172,0	719	1327,8	527,6

Source: Russia in numbers – 2015.

Table 5. Categorized advanced production technologies developed in 2014 (items)

Advanced production technology	Total number of technologies	Category		
		New for Russia	Brand new	The ones using patented inventions during development
TOTAL including:	1409	1245	164	712
Design and engineering	445	390	55	214
Production, processing and assembly	506	450	56	267
Automated uploading / downloading actions; materials and parts transporting	22	20	2	13
Automated surveillance (monitoring) devices	110	84	26	56
Communication and control	202	187	15	110
Production informational systems	65	59	6	27
Integrated control and monitoring systems	59	55	4	25

Source: Russia in numbers – 2015

Technology transfer system basis was established in USSR in 1950s, when significant integration processes were launched in academic and educational environment. As a result of interaction between scientific entities and sectorial ministries and agencies, a great number of academic institutes had created scientific and technological associations, scientific and educational centers and laboratories. In educational sector a number of organizations carrying out scientific research and development activities were formed. Research institutes, design organizations, , departments, designing and technological bureaus in institutes and faculties with own practice bases, scientific groups and sectors, observatories, joint departments with organizations of academic and industrial fields of science are established. Dedicated and sectorial laboratories, botanic gardens, regional inter-institutional complexes, experimental and research farms were established.

In 1970s in USSR inter-institutional complexes, uniting scientific groups of a number of educational institutions dealing with comprehensive scientific, research, and technological problems appear. During this period organizational forming of institutional level science in educative establishments takes place. A distributed infrastructural network is created based on cooperation between educational institutions related to joint application of research and development, experimental and production base, computing and scientific technological centers, *etc*. Educational scientific and production complexes are formed in educational sector (Solov'yova and Shkvarya 2012).

In 1990s in Russia, on the one hand, a certain range of educative and scientific structures was formed (university complexes, educational and scientific, and other centers were formed), and on the other hand — against the backdrop of drastic reduction of design and development organizations, experimental plants, scientific and technological services of enterprises (*i.e*. structures, aimed at ensuring transfer of technology into innovations field), up to the beginning of 2000s growth of research institutions was observed due to creation of new research institutes or fragmentation of the existing ones. As Hohberg (2003) notes, this process took place by establishment of new legal entities, but not due to expanding of scientific and research base of universities and enterprises, which, in particular, compose the framework for innovative systems in countries with developed market economies. All these factors have led to disproportion in an institutional structure of science: while in 1992 there was registered 3,437 independent research institutions, design bureaus and development organizations, in 2014 their number reduced to as little as 2,038 entities, and number of design and research organizations reduced 15.5 times (Table 6).

Table 6. Organizations, earlier involved into research and development activities

Number of organizations	1992	1995	2000	2005	2007	2008	2010	2012	2013	2014
TOTAL, inclusing:	4555	4059	4099	3566	3957	3666	3492	3566	3605	3604
Scientific research organizations	2077	2284	2686	2115	2036	1926	1840	1744	1719	1689
Design bureaus	865	548	318	489	497	418	362	338	331	317
Design and research organizations	495	207	85	61	49	42	36	33	33	32
Experimental plants	29	23	33	30	60	58	47	60	53	53
Professional higher educational institutions	446	395	390	406	500	503	517	562	673	700
Scientific, design and development departments within organizations and enterprises	340	325	284	231	265	239	238	274	266	275
Other entities	303	277	303	234	550	480	452	555	530	538

Source: Russia in numbers – 2013; Russia in numbers – 2015.

In the existing technology transfer system, created due to transformation of the country's economy, there arises a need in formation of special practices of innovative processes organization, ensuring efficient interaction among all its participants - government, industrial enterprises, scientific and educational institutions, financial institutions. In this case a foreign experience in organizing transfer of technology can be very useful. The first-order condition of its efficient implementation is formation of the appropriate innovative infrastructure in Russian economic environment. This includes:

- legislative base, aimed at energizing innovative enterprises and warranting protection of intellectual property rights;

- specialized scientific and educational centers, scientific (innovative, technological) parks, technology transfer and commercialization centers, business-incubators, innovative firms, ensuring transformation of promising scientific ideas and knowledge in productive, informational, and technological innovations;
- financing research and development activities from enterprises sector by creation of legal and financial guarantees, concessional loans, various out-of-budget and joint funds, governmental awards;
- telecommunication infrastructure for information supply of Russian science, connection of local informational networks to the global ones, increase of number of electronic libraries and distribution of the Internet, expanding of access of Russian scientists to international data banks;
- development of venture firms and funds, small-scale inculcation companies, and other components of innovation infrastructure.

Regional aspect plays also a great role in forming of efficient innovative system in conditions of Russia. Each region forms its approach to transfer of technology, taking into consideration its resource reserves, as well as climatic, sectorial, and other regional features by developing its regional innovative policy, aimed at development on scientific and technological component and production field.

Conclusion

In spite of sufficient progress in theoretical base of innovative process study, there remains a lot of poorly studied and controversial matters. For example, dynamics of innovative and technological development of countries and regions, application of efficient tools and practices of knowledge and technology transfer, management of innovative processes using different institutional structures *etc*.

Establishment of required organizational structure, aimed at supporting of the process of acquisition, implementation, and distribution of research and development results involving all participants of the innovative process, *i.e*. government, science, educational institutions, and business leads to improvement of transfer of technology efficiency. Creation of a system based on integration between scientific, educational and production fields of economy will help forming of competitive high-technology production facilities, improvement of structure of exports due to increase of high-technology share in it, and decrease of raw materials sector, improvement of the state stand on the global technology market.

It's worth notice that economies of the member countries of Asian and Pacific Economic Cooperation are the most dynamically developing countries in the world with a large internal market of commodities and services, having capacity for a significant economic and technology development based on implementation of regional programs of technological integration.

Quick rate of economic growth due to expansion of productive capacities, improving of personnel qualification along with substantial investments into real sector of economy, large-scale implementation of state-of-the-art technologies are observed in the region (Asia-Pacific Economic Cooperation 2016). It allows using production facilities and natural resources more efficiently. As a summary to this study we believe, perspectives of development of global economy in the upcoming period will depend on development of major regional economic zones, including the ones of the Asian and Pacific region.

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Why We Cannot Fully Understand the Variability of the Insurance Portfolio

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Abstract:

Proper risk assessment, its modeling, classification of risk intensity using appropriately selected variables is generally important information for any firm regarding its further economic strategy, but especially for insurance companies. Objective of this paper is to present the issue of variability of risks that have not measurable moments and show that in these types of risks we have limited ability to understand the variability of such risks throughout the portfolio of certain types of risks, as well as in tariff groups.

Keywords: risk factors; rating variables; tariff variables; pooling of the risks; unobservable moments; variability of portfolio

JEL Classification: C02; G17

Introduction

Intensity of the risk depends in general on a number of risk factors, some of which may not be measurable, or in some cases eve not identifiable or even may change in time. For these reasons as a substitutes for risk factors in insurance are used so-called rating factors, also known as rating variables, tariff variables, factors determining premium rates. Rating factors (variables) may in some cases be consistent with risk factors.

The rating variable may have the character of quantitative or qualitative variable and must acquire at least two, but a finite number of values. Similarly, the number of rating variables has to be finite. Rating variables should be independent and statistically significant and the values that take these variables should be easily and reliably identifiable. Rating variables are therefore risk characteristics that can be used for the distribution of risks (insurance portfolio) into classes with different anticipated claims ratio. Each class includes risks that are similar to each other (at best identical), and distinct from the risk of another class. These classes of risk are called tariff groups. If we divide portfolio of risk into tariff groups with k rating variables $Rp_1, Rp_2,\ldots,Rp_k$, where i-th rating variable ($i = 1, 2, 3,\ldots, k$) shall take n_i values, we will get $n_1 \cdot n_2 \cdot\ldots\cdot n_k$ tariff groups. Tariff group includes pooled homogeneous insurance policies. In this paper we will show that our ability to understand the variability of a total portfolio is limited.

1. Two types of individual risks

In insurance we encounter two types of individual risks. Those:

- moments are unobservable (their observation does give almost no useful information on the claims ratio);

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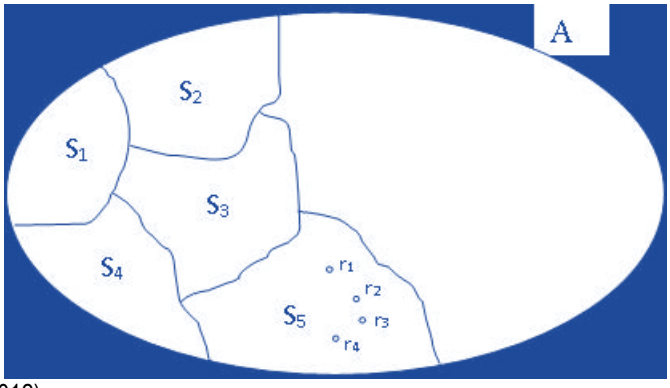
- moments are observable (premium rate depends on the frequency of losses and amount of claims in previous periods).

The information available on the majority of individual risks are such minimal that the observation of individual risks does give almost no useful information about the probability distribution of their amount and frequency during one insurance period (such risks are a typical example for the responsibilities insurance). Even worse it is that the risk may change with time, especially as a result of losses (*e.g.* installation of alarms and deadlocks after theft). A typical example of second type of risk is insurance for motor vehicles, whether accidental or third party liability insurance for damage caused by motor vehicles. In case of these risks insurer generally applies so-called bonus-malus system respectively NCD (no-claim discount) systems. The height of premium depends on the claims ratio in the previous insurance period. In that case we talk about a posteriori risk tariffication, as opposed to a priori risk tariffication, where premium for the risk will be determined at the time of its acceptance in the insurance portfolio.

2. Individual risks, those moments are unobservable

Now we will discuss the first type of risk and examine some of their characteristics in the context of the entire portfolio, respectively tariff group. We call process of classification of risks into tariff groups also pooling of the risks.

Figure 1. Classification (pooling) of risks into tariff groups (pools)



Source: Fecenko (2012)

Figure 1 schematically shows classification of individual risks of the pool marked with symbol A according to values of rating variables into pools marked with symbol S_i (any further pool we will refer instead S_i just S). Individual risks are marked with symbols r_1, r_2.

Let X/r be the amount of losses under *r-th* individual risk with mean of amount of individual loss $E(X/A)$ and variance $D(X/A)$ of random selection from all of the risks of a pool A. These are the values from entire portfolio and they represent a characteristic of any risk of the portfolio A if there were no classification of risks into individual pools. For example $E(X/A)$ would be a net insurance premium for all risks associated to pool A and $D(X/A)$ would be a rate of variability of the cost of claims of individual risk which is randomly selected from A.

If the pool of risk is sufficiently large, these moments can be estimated using sample moments:

$$\hat{E}(X/A) = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{1}$$

$$\hat{D}(X/A) = \hat{E}(X^2/A) - \hat{E}^2(X/A) = \frac{\sum_{i=1}^{n} x_i^2}{n} - \left(\frac{\sum_{i=1}^{n} x_i}{n}\right)^2 \tag{2}$$

where: n is number of risks in the pool *A* and x_i is cost of claims in one insurance period belonging to *i-th* insurance policy (risk).

Thus variables *E(X/A)* and *D(X/A)* are observable.

Similarly, we can express moments *E(X/S)* and *D(X/S)* belonging to some sub-pool. Again *E(X/S)* we can interpret as net insurance premium for corresponding insurance policies associated in sub-pool *S* and *D(X/S)* as variance of cost of claims of individual risks in sub-pool *S*.

A different situation exists for moments *E(X/r)* and *D(X/r) r-th* individual risk, where *E(X/r)* represents mean of cost of claims in one insurance period for specific risk and *D(X/r)* variance of random variable *X/r*. Each of the individual risks has its own distribution of cost and frequency of claims, which may even change with time. We expect that moments of these risks are observable, therefore we consider these moments again as random variables with its own probability distribution.

Conditional probabilities *E(E(X/r)/r∈A)* and *D(E(X/r)/r∈A)*, where *E(E(X/r)/r∈A)* represents expected value (in general) of random variable *E(X/r)* for risk which is randomly selected from pool *A*. From theory of probability, according to complete mean value implies that this value could be expressed simpler as *E(E(X/r)/r∈A) = E(X/A)*. Because we can estimate *E(X/A)*, then *E(E(X/r)/r∈A)* is observable value. On the other hand, *E(X/r)* are unobservable, so *E(X/r) – E(E(X/r)/r∈A)* is unobservable and therefore *D(E(X/r)/r∈A)* is even unobservable. Similarly, we can think about moments *E(D(X/r)/r∈A)* and *D(D(X/r)/r∈A)*, which are also unobservable.

From the complete mean value implies that *E(E(X/r)/r∈S)*. So expected value of mean of individual risk from sub-pool *S* is observable value. If we know *E(X/S)* for each sub-pool, we can estimate *E(E(X/S)/S∈A)*, because *E(E(X/S)/S∈A) = E(X/A)*.

We can express mean of individual risk as the sum of three components:

$$E(X/r) = E(X/A) + \left[E(X/S) - E(X/A)\right] + \left[E(X/r) - E(X/S)\right] \quad (3)$$

where: E(X/A) is mean value for entire pool, which determines general level of insurance rate for the entire portfolio; *E(X/S) – E(X/A)* is difference between mean for the particular sub-pool and the mean of the whole pool; These differences (with changing *S*) reflects in the rate classification structure that is applied to risks in the pool; *E(X/r) – E(X/S)* is difference between the mean for a particular risk and the mean of the sub-pool to which that risk belongs. This difference is called *solidarity premium*.

If the policyholder perceives the difference *E(X/r) – E(X/S)* as a positive value, then we talk about *positive perception of solidarity risk*, otherwise we talk about *negative perception of solidarity risk*. Positive perception of risk means that policyholder expects that his average claim in one period should be higher than the premium, this time simpler expressed with net premium *E(X/S)*. With negative risk perception it is quite the opposite. Although we can estimate classification structure of risks in portfolio, there is still heterogeneity between risks in particular pools. This is expressed with solidarity premium, which we cannot measure in these types of risks. According to some actuaries (Booth 1986), the success of an insurance company often depends not so much on the height of premiums (albeit it is very important), than from the perception of solidarity premium, positive or negative.

3. The variability of portfolio

We will examine variance of cost of claims of pool *A*. From theory of probability, according to conditional variance follows:

$$D(X/A) = E(D(X/S)/S \in A) + D(E(X/S)/S \in A) \quad (4)$$

where: *E(D(X/S)/S∈A)* is within risks variance and *E(E(X/S)/S∈A)* between risks variance in pool *A*.

Likewise the sub-pool *S*:

$$D(X/S) = E(D(X/r)/r \in S) + D(E(X/r)/r \in S) \quad (5)$$

After substitution (5) into (4) we get:

$$D(X/A) = E\left(E\left(D(X/r)/r\in S\right)/S\in A\right) + E\left(D(E(X/r)/r\in S)/S\in A\right) + D\left(E\left(X/S\right)/S\in A\right) =$$
$$= E\left(D(X/r)/r\in A\right) + E\left(D(E(X/r)/r\in S)/S\in A\right) + D\left(E\left(X/S\right)/S\in A\right) \quad (6)$$

where: *E(D(X/r)/r∈A)* is mean of unobservable variances of cost of claims of individual risks about their respective means, which is the inherent variation that makes insurance necessary, $D(X/r) = E((X/r - E(X/r))^2)$.
E(D(E(X/r)/r∈S)/S∈A) is mean value of variances (also unobservable) of mean of individual risk about observable means of their respective sub-pool.

This is variation between risks, which has not been quantified in rating structures and can also be described as the variation in the solidarity premium according to

$$D\left(E\left(X/r\right)/r\in S\right) = E\left[\left(E\left(X/r\right) - E\left(E\left(X/r\right)/r\in S\right)\right)^2/r\in S\right] = E\left[\left(\underbrace{E\left(X/r\right) - E\left(X/S\right)}_{\text{solidarity premium}}\right)^2/r\in S\right] \quad (7)$$

where: *D(E(X/S)/S∈A)* is variance of means of individual risks in respective sub-pool about mean of individual risks in whole pool – this represents the tariff structure of pool

$$D\left(E\left(X/S\right)/S\in A\right) = E\left(\left(E\left(X/S\right) - E\left(X/A\right)\right)^2/S\in A\right) \quad (8)$$

The theoretical considerations presented imply that even if we can estimate variance of cost of claims for whole pool or sub-pools, we cannot measure contribution of inherent variability of individual risks *D(X/r)* and variability between individual risks in each sub-pool, which in its own way represents variability in solidarity premium. Therefore we have limited capabilities to understand the variability of the whole pool or sub-pool.

In the following example we will try to interpret the limited ability of understanding variability of whole pool or sub-pool on simple structured risk pool with two sub-pools. In fact, as already mentioned, each individual risk has its own distribution of cost of claims, which is different from distribution of cost of claims of other risks. According to leading Australian actuaries, "there are no two identical risks" (Booth 1986). We will assume that we know distribution of cost of claims of individual risks, otherwise we could not make any theoretical calculations. For simplification we will assume that there are two types of "similar" risks in first sub-pool and three types of "similar" risks in second sub-pool. In fact they were risks that moments are not observable.

E.g: In pool *A* there are associated 5 000 independent risks (insurance policies), which are divided into two sub-pools S_1 and S_2. In sub-pool S_1 there are 1 000 risks with cost of claims in one insurance period, which is described by variable X_1 and 1 000 risks with cost of claims X_2 :

X_1	0	1
p	0,5	0,5

X_2	0	1,5
p	0,5	0,5

(9)

In sub-pool S_2 there are 3·1000 risks X_3, X_4, X_5 with distribution of cost of claims in one insurance period:

X_3	0	3
p	0,5	0,5

X_4	0	3,5
p	0,5	0,5

X_5	0	4
p	0,5	0,5

(10)

Realization of each risks in pool *A* is equally possible. Let´s analyze the variability of individual sub-pools and the whole risk pool. Estimate the claims distribution in pool in one insurance period and estimate measurable moments of variables in whole portfolio and in particular sub-pools.

Solution: Let us first consider the characteristics of claims that would be observable in the whole pool and within individual sub-pools. Pool *A* will in average generate 500 claims in insurance period with cost of claim 1 unit of account (*u. a*.), 500 claims with cost of claim 1,*5 u. a*., 500 claims with cost of claim 3 *u. a*., 500 claims with cost of claim 3,5 *u. a*., 500 claims with cost of claim 4 *u. a.* Then according to (1):

$$E\left(X/A\right)=\frac{1}{n}\sum_{i=1}^{n}x_i=\frac{1}{5000}\left(500\cdot 1+500\cdot 1{,}5+500\cdot 3+500\cdot 3{,}5+500\cdot 4\right)=1{,}3 \tag{11}$$

what represents net premium for all insurance policies in pool *A*, if there is no distribution of risks into particular sub-pools.

Similarly, we can measure (estimate) variance of cost of claims for whole pool and means and variances of cost of claims for respective sub-pools S_1, S_2:

$$\hat{D}\left(X/A\right)=\frac{1}{5000}\Big(2500\cdot\left(0-1{,}3\right)^2+500\cdot\left(1-1{,}3\right)^2+500\cdot\left(1{,}5-1{,}3\right)^2+500\cdot\left(3-1{,}3\right)^2+$$
$$+500\cdot\left(3{,}5-1{,}3\right)^2+500\cdot\left(4-1{,}3\right)^2\Big)=2{,}36. \tag{12}$$

$$\hat{E}\left(X/S_1\right)=\frac{500\cdot 1+500\cdot 1{,}5}{2000}=0{,}625. \tag{13}$$

$$\hat{D}\left(X/S_1\right)=\frac{1}{2000}\Big(1000\left(0-0{,}625\right)^2+500\left(1-0{,}625\right)^2+500\left(1{,}5-0{,}625\right)^2\Big)=0{,}421875. \tag{14}$$

$$E\left(X/S_2\right)=\frac{500\cdot 3+500\cdot 3{,}5+500\cdot 4}{3000}=1{,}75. \tag{15}$$

$$D\left(X/S_2\right)=\frac{1500\cdot(0-1{,}75)^2+500\cdot(3-1{,}75)^2+500\cdot(3{,}5-1{,}75)^2+500\cdot(4-1{,}75)^2}{3000}=3{,}145833 \tag{16}$$

Similarly to the whole pool *A*, we can also understand the values $\hat{E}\left(X/S_1\right),\hat{E}\left(X/S_2\right)$ for individual sub-pools like estimated means of individual risks belonging to each sub-pools. Similarly, we can interpret the values $\hat{D}\left(X/S_1\right),\hat{D}\left(X/S_2\right)$.

Note that the both sub-pools are heterogeneous. Means and variances of individual risks are:

$$\begin{array}{lllll} E(X_1)=0{,}5, & E(X_2)=0{,}75, & E(X_3)=1{,}5, & E(X_4)=1{,}75, & E(X_5)=2, \\ D(X_1)=0{,}25, & D(X_2)=0{,}5625, & D(X_3)=2{,}25, & D(X_4)=3{,}0625, & D(X_5)=4. \end{array} \tag{17}$$

Our task shall be to calculate the mean of cost of claims for whole pool *A* – we mark it as *E(X/A)* and for individual sub-pools – $E(X/S_1)$, $E(X/S_2)$. Similarly, we will calculate variances of individual claims for those cases. Let us mark, like in theoretical part *X/r* random variable expressing amount of loss of *r-th* individual risk.

Let´s calculate mean of individual risk, which is randomly selected from sub-pool S_1:

$$E\left(X/S_1\right)=\underset{r\in S_1}{E}\left(E\left(X/r\right)\right)=\sum_{r\in S_1}E\left(X/r\right)p\left(X/r\right)=1000\cdot E(X_1)\cdot\frac{1}{2000}+1000\cdot E(X_2)\cdot\frac{1}{2000}=$$
$$=1000\cdot 0{,}5\cdot\frac{1}{2000}+1000\cdot 0{,}75\cdot\frac{1}{2000}=0{,}625 \tag{18}$$

Because in sub-pool occur 1000 individual risks of type X_1, with mean of cost of claims 0,5 and with probability of random selection of specific risk from sub-pool S_1 $p(X/r)=1/2000$. Similarly, we can justify the second term of the sum.

Another method of calculation results directly from the definition of the mean. Risks associated in sub-pool S_1, may acquire height of loss 0, 1, 1,5 with corresponding probabilities. Then:

$$E\left(X/S_1\right)=0\cdot P(X=0/S_1)+1\cdot P(X=1/S_1)+1{,}5\cdot P(X=1{,}5/S_1) \tag{19}$$

We use the abbreviated entries for simplicity. We mark only for this case:

$$P(X=0/S_1)=P(X=0),\ P(X=1/S_1)=P(X=1),\ P(X=1{,}5/S_1)=P(X=1{,}5). \tag{20}$$

Then we get:

$$P(X=0)=P(H_1)\cdot P(X=0/H_1)+P(H_2)\cdot P(X=0/H_2)=\frac{1}{2}\cdot\frac{1}{2}+\frac{1}{2}\cdot\frac{1}{2}=\frac{1}{2} \tag{21}$$

$$P(X=1)=P(H_1)\cdot P(X=1/H_1)+P(H_2)\cdot P(X=1/H_2)=\frac{1}{2}\cdot\frac{1}{2}+\frac{1}{2}\cdot 0=\frac{1}{4} \tag{22}$$

$$P(X=1{,}5)=P(H_1)\cdot P(X=1{,}5/H_1)+P(H_2)\cdot P(X=1{,}5/H_2)=\frac{1}{2}\cdot 0+\frac{1}{2}\cdot\frac{1}{2}=\frac{1}{4} \tag{23}$$

where: H_i, $i = 1; 2$ is event, where risk randomly selected from S_1 is risk, which cost of claims is described with variable X_i.

The calculated value is substituted into (19), we get the same value as in the previous case:

$$E\left(X/S_1\right)=0\cdot\frac{1}{2}+1\cdot\frac{1}{4}+1{,}5\cdot\frac{1}{4}=0{,}625 \tag{24}$$

Or simplified, we assume that in sub-pool S_1 there are only two types of individual risks, which means are 0,5 and 0,75 and there are equal number of them. Then

$$\begin{aligned}E\left(X/S_1\right)&=\underset{r\in S_1}{E}\left(E\left(X/r\right)\right)=E(X_1/r)\cdot P(X_1/r)+E(X_2/r)\cdot P(X_2/r)=\\&=0{,}5\cdot\frac{1}{2}+0{,}75\cdot\frac{1}{2}=0{,}625\end{aligned} \tag{25}$$

where: $P(X_i/r),\ i=1,2$, represents the probability that if the risk will be randomly selected from sub-pool S_1, will be risk described be variable X_i.

Calculated value $E(X/S_1)$ represents a net premium for sub-pool S_1. Notice that 1000 policyholders "perceive" the solidarity premium as being positive and the same number as being negative. We calculate also variance of cost of claims of risk from random selection from sub-pool S_1 :

$$\begin{aligned}&D\left(X/S_1\right)=E\left(D\left(X/r\right)/r\in S_1\right)+D\left(E\left(X/r\right)/r\in S_1\right)=\sum_{r\in S_1}D\left(X/r\right)p\left(X/r\right)+\\&+\sum_{r\in S_1}\left(E\left(X/r\right)-E\left(X/S_1\right)\right)^2p\left(X/r\right)=\frac{1}{2000}\left(1000\cdot 0{,}25+1000\cdot 0{,}5625\right)+\\&+\frac{1}{2000}\left(1000\cdot\left(0{,}5-0{,}625\right)^2+1000\cdot\left(0{,}75-0{,}625\right)^2\right)=0{,}421875\end{aligned} \tag{26}$$

We used the equation: $E\left(E\left(X/r\right)/r\in S_1\right)=E\left(X/S_1\right)$.

Or otherwise:

$$D\left(X/S_1\right)=E\left(D\left(X/r\right)/r\in S_1\right)+D\left(E\left(X/r\right)/r\in S_1\right)=$$

$$=\sum_{r\in S_1}D\left(X/r\right)p\left(X/r\right)+\sum_{r\in S_1}\left(E\left(X/r\right)-E\left(X/S_1\right)\right)^2p\left(X/r\right)=$$

$$=D(X_1/r)\cdot p(X_1/r)+D(X_2/r)\cdot p(X_2/r)+$$

$$+\left(E\left(X_1/r\right)-E\left(X/S_1\right)\right)^2p\left(X_1/r\right)+\left(E\left(X_2/r\right)-E\left(X/S_1\right)\right)^2p\left(X_2/r\right)=$$

$$=0,25\cdot\frac{1}{2}+0,5625\cdot\frac{1}{2}+\left(0,5-0,625\right)^2\cdot\frac{1}{2}+\left(0,75-0,625\right)^2\cdot\frac{1}{2}=0,421875 \quad (27)$$

Or by direct calculation from the definition of variance:

$$D\left(X/S_1\right)=(0-E(X/S_1))^2P(X=0/S_1)+(1-E(X/S_1))^2P(X=1/S_1)+$$

$$+(1,5-E(X/S_1))^2P(X=1,5/S_1)=0,625^2\cdot\frac{1}{2}+(1-0,625)^2\cdot\frac{1}{4}+(1,5-0,625)^2\cdot\frac{1}{4}=0,421875 \quad (28)$$

Similarly, for second sub-pool S_2 we get:

$$E\left(X/S_2\right)=\underset{r\in S_2}{E}\left(E\left(X/r\right)\right)=E(X_3/r)\cdot P(X_3/r)+E(X_4/r)\cdot P(X_4/r)+E(X_5/r)\cdot P(X_5/r)=$$

$$=1,5\cdot\frac{1}{3}+1,75\cdot\frac{1}{3}+2\cdot\frac{1}{3}=1,75 \quad (29)$$

We calculate variance

$$D\left(X/S_2\right)=E\left(D\left(X/r\right)/r\in S_2\right)+D\left(E\left(X/r\right)/r\in S_2\right)=\sum_{r\in S_2}D\left(X/r\right)p\left(X/r\right)+$$

$$+\sum_{r\in S_2}\left(E\left(X/r\right)-E\left(X/S_2\right)\right)^2p\left(X/r\right)=\frac{1}{3000}\left(1000\cdot2,25+1000\cdot3,0625+1000\cdot4\right)+ \quad (30)$$

$$+\frac{1}{3000}\left(1000\cdot\left(1,5-1,75\right)^2+1000\cdot\left(1,75-1,75\right)^2+1000\cdot\left(2-1,75\right)^2\right)=3,145833$$

We get an alternative method of calculation when we assume that in sub-pool S_2 there are only three types of individual risks with mean values 1,5, 1,75 and 2 and with variances 2,25, 3,0625 and 4 and their number is equal. Then we can write:

$$D\left(X/S_2\right)=E\left(D\left(X/r\right)/r\in S_2\right)+D\left(E\left(X/r\right)/r\in S_2\right)=$$

$$=\sum_{r\in S_2}D\left(X/r\right)p\left(X/r\right)+\sum_{r\in S_2}\left(E\left(X/r\right)-E\left(X/S_2\right)\right)^2p\left(X/r\right)=$$

$$=D(X_3/r)\cdot p(X_3/r)+D(X_4/r)\cdot p(X_4/r)+D(X_5/r)\cdot p(X_5/r)+$$

$$+\left(E\left(X_3/r\right)-E\left(X/S_2\right)\right)^2p\left(X_3/r\right)+\left(E\left(X_4/r\right)-E\left(X/S_2\right)\right)^2p\left(X_4/r\right)+$$

$$+\left(E\left(X_5/r\right)-E\left(X/S_2\right)\right)^2p\left(X_5/r\right)=$$

$$=2,25\cdot\frac{1}{3}+3,0625\cdot\frac{1}{3}+4\cdot\frac{1}{3}+\left(1,5-1,75\right)^2\cdot\frac{1}{3}+\left(1,75-1,75\right)^2\cdot\frac{1}{3}+\left(2-1,75\right)^2\cdot\frac{1}{3}=3,145833. \quad (31)$$

Or directly using the formula $D(X/S_2) = E(X^2/S_2) - E^2(X/S_2)$.

$$D(X/S_2) = E(X^2/S_2) - E^2(X/S_2) = 0^2 \cdot \frac{1}{2} + 3^2 \cdot \frac{1}{6} + 3{,}5^2 \cdot \frac{1}{6} + 4^2 \cdot \frac{1}{6} - 1{,}75^2 = \frac{151}{48} = 3{,}145833 \quad (32)$$

We have assumed that we know *E(X/r), D(X/r)* and that they do not change during the year. But in fact it may not be so. In that case we have to consider them as random variables. Even if they were constants, from the assumption that we analyze risks, which moments are not measurable (18), we cannot determine, what is the contribution of each individual risks in the total value *E(X/S₁)*. Similar it is in calculation of *E(X/S₂)*, *E(X/A)*. We do not know how individual risks overall contribute to variance *D(X/S₁)* in average (first part of equation (26)), or to variance of unobservable means of individual risks about mean value of particular sub-pool. That in fact represent variability in solidarity premium, which we cannot measure. We would not know estimate none of the summands in equation (26).

Let´s analyze the variability of whole pool.

$$E(X/A) = E\left(E(X/S)/S \in A\right) = E(X/S_1)\,p(X/S_1) + E(X/S_2)\,p(X/S_2) = 0{,}625 \cdot \frac{2}{5} + 1{,}75 \cdot \frac{3}{5} = 1{,}3 \quad (33)$$

where: $p(X/S_i)$, $i = 1;2$ is probability that random risk from pool *A*, will be the risk which belongs to sub-pool S_i.

Or direct calculation:

$$E(X/A) = 0 \cdot P(X = 0/A) + 1 \cdot P(X = 1/A) + 1{,}5 \cdot P(X = 1{,}5/A) + 3 \cdot P(X = 3/A) +$$
$$+3{,}5 \cdot P(X = 3{,}5/A) + 4 \cdot P(X = 4/A) = 0 \cdot \frac{1}{2} + 1 \cdot \frac{1}{10} + 1{,}5 \cdot \frac{1}{10} + 3 \cdot \frac{1}{10} + 3{,}5 \cdot \frac{1}{10} + 4 \cdot \frac{1}{10} = 1{,}3 \quad (34)$$

where: for example

$$P(X = 0/A) = P(X = 0) = P(H_1) \cdot P(X = 0/H_1) + P(H_2) \cdot P(X = 0/H_2) +$$
$$+P(H_3) \cdot P(X = 0/H_3) + P(H_4) \cdot P(X = 0/H_4) + P(H_5) \cdot P(X = 0/H_5) =$$
$$= \frac{1}{5} \cdot \frac{1}{2} + \frac{1}{5} \cdot \frac{1}{2} + \frac{1}{5} \cdot \frac{1}{2} + \frac{1}{5} \cdot \frac{1}{2} + \frac{1}{5} \cdot \frac{1}{2} = \frac{1}{2} \quad (35)$$

where: H_i, $i = 1, 2, \ldots, 5$ is event that random risk from pool *A* is risk, which cost of claims is described by variable X_i, $i = 1, 2, \ldots, 5$.

Calculation of variance:

$$D(X/A) = E\left(D(X/S)/S \in A\right) + D\left(E(X/S)/S \in A\right) \quad (36)$$

$$E\left(D(X/S)/S \in A\right) = D(X/S_1)\,p(X/S_1) + D(X/S_2)\,p(X/S_2) = \quad (37)$$
$$= 0{,}421875 \cdot \frac{2}{5} + 3{,}145833 \cdot \frac{3}{5} = 2{,}05625$$

$$D\left(E(X/S)/S \in A\right) = \left(E(X/S_1) - E(X/A)\right)^2 p(X/S_1) + \left(E(X/S_2) - E(X/A)\right)^2 p(X/S_2) = \quad (38)$$
$$= (0{,}625 - 1{,}3)^2 \cdot \frac{2}{5} + (1{,}75 - 1{,}3)^2 \cdot \frac{3}{5} = 0{,}30375$$

Then, summing up last two results we get

$$D(X/A) = 2{,}05625 + 0{,}30375 = 2{,}36. \quad (39)$$

Note that the first summand in equation (36) can be further described as follows (equation (6))

$$E\left(D\left(X/S\right)/S\in A\right)=E\left(D\left(X/r\right)/r\in A\right)+E\left(D\left(E\left(X/r\right)/r\in S\right)/S\in A\right) \tag{40}$$

where:

$$E\left(D\left(X/r\right)/r\in A\right)=\sum_{r\in A}D\left(X/r\right)p\left(X/r\right)=$$

$$=\frac{1}{5000}\left(1000\cdot 0,25+1000\cdot 0,5625+1000\cdot 2,25+1000\cdot 3,0625+1000\cdot 4\right)=2,025$$

$$E\left(D\left(E\left(X/r\right)/r\in S\right)/S\in A\right)=D\left(E\left(X/r\right)/r\in S_1\right)p\left(X/S_1\right)+D\left(E\left(X/r\right)/r\in S_2\right)p\left(X/S_2\right)=$$

$$=\frac{2}{5}\cdot\sum_{r\in S_1}\left(E\left(X/r\right)-E\left(X/S_1\right)\right)^2p\left(X/r\right)+\frac{3}{5}\sum_{r\in S_2}\left(E\left(X/r\right)-E\left(X/S_2\right)\right)^2p\left(X/r\right)=$$

$$=\frac{2}{5}\cdot\frac{1}{2000}\left(1000\cdot\left(0,5-0,625\right)^2+1000\cdot\left(0,75-0,625\right)^2\right)+$$

$$+\frac{3}{5}\cdot\frac{1}{3000}\left(1000\cdot\left(1,5-1,75\right)^2+1000\cdot\left(1,75-1,75\right)^2+1000\cdot\left(2-1,75\right)^2\right)=0,03125 \tag{41}$$

Then:

$$E\left(D\left(X/S\right)/S\in A\right)=2,025+0,03125=2,05625 \tag{42}$$

and that is the same result as in the previous calculation in equation (37). Note that all of the theoretical calculations of means and variances of individual risks of pool *A*, as well as sub-pools S_1, S_2 match with estimated values.

Conclusion

In this paper we have shown that the total variance within a pool of risks can be estimated.
On the other hand it is not possible to determine the contribution to this variance from the variance between risks and the variance within risks. This is the case either individually or on average. Our ability to understand the variability of a total portfolio is because of this limited.

Acknowledgements

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The Effect of the European Central Bank's Unconventional Monetary Policies to the Financial Stability of the Eurozone

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Abstract:

Monetary policy plays a major role in an economic development of a country. Financial system is stable when it is able to allocate economic resources efficiently in order to manage financial risk through proper measurements and self-correction, when he was under the influence of external shocks. That is why we take into account that the financial system, regardless of its size or complexity, is stable when it is able to contribute to the economy of speech and correct imbalances arising from significant shocks. The European Central Bank (ECB) adopted a non-standard measures of monetary policy to respond to external shocks during the global financial crisis and in order to improve the financial stability of the Eurozone and its support for the economic recovery. The main purpose of research is to analyse the impact of non-standard monetary policy measures for the financial stability of the Eurozone. Statistical data have been collected from a variety of resources and the econometric model was created in the course of the study. The proposed econometric model was analysed and tested for all diagnostic tests using the software package GRETL. As a result of the scientific study the conclusion is that the ECB's non-standard monetary policy measures have a positive impact on the financial stability of the euro area.

Keywords: monetary policy; financial stability; European Central Bank; econometric model; econometric diagnostic tests.

JEL Classification: E43, E44, E50, E52, E58.

Introduction

The recent global financial crisis triggered many central banks to design and implement new directions of the monetary policy. The European Central Bank (ECB) adopted so called 'unconventional' monetary policy measures which would react to changes in inflation and output by altering interest rate. One of the latest non-standard

measures is quantitative easing, which focused on domestic effects analysing several channels of domestic transmission (Hassan and Brown 2012).

The non-standard measures taken by the Euro system have been targeted mainly at the banking sector, owing to its important role in the transmission of monetary policy and the financing of the economy in the euro. Many of the non-standard measures have exploited the flexibility of the existing operational framework of the ECB (Fratzscher, Lo Duca and Straub 2014). The non-standard measures taken as the financial turmoil turned into a crisis comprise the Enhanced Credit Support and the Securities Markets Programme (Falagiarda, Mc Quade and Tirpak 2015).

1. Literature review and background of research

Economist Smriti Chand (2015) believes, that monetary policy is the most commonly advocated policy in solving the problem of fluctuations. Furthermore, Marvin Goodfriend and Robert G. King (2009) also consider that monetary policy is a powerful instrument, thus stabilization policy based on monetary policy, and mentioned that monetary policy able to manage inflation. According to Charles Bean, Matthias Paustian, Adrian Penalver and Tim Taylor (2010), Olivier Blanchard *et al*. (2010), the recent global financial crisis led to rethinking of monetary policy focused mainly on supporting price stability, as price stability has proven not to be a sufficient condition for financial stability and lack of financial stability can have a negative impact on price stability. Menzie D. Chinn (2013) believes that unconventional monetary policy measures can have an impact on asset prices and economic activity, a formal tracing out of the channels by which these effects on asset prices, let alone the real economy, are propagated has not yet been undertaken. According to Oxana Babecka Kucharcukova, Peter Claeys and Borek Vasicek (2014) the ECB's unconventional measures were aimed at specific segments of the Euro area financial system and maintained economic adjustment contributing to market functioning, and partially restoring the banking system.

Global financial crisis triggered money market function, more precisely affected banks directly through a sharp increase of liquidity risk and credit risk. That is why the ECB launched non-standard measures in order to help banks extend credit to the real economy. For instance, the ECB launched EONIA swaps (euro overnight index average) and the EURIBOR futures (euro interbank offered rate) to secure the market. In June 2014 the ECB launched number of non-standard measures, which are called "the credit easing package, focusing on the targeted longer-term refinancing operations (TLTROs), and the expanded asset purchase programme (APP), focusing on the public sector purchase programme (PSPP)". In January of 2015 the ECB adopted the most recent complement to its suite of instruments – the public sector purchase programme (PSPP), popularly referred to as quantitative easing. Together with a programme of targeted liquidity provision and a programme of private sector asset purchases, the PSPP marked a new phase of the ECB's unconventional monetary policy. It was absolutely clear from the above discussion that liquidity risk and credit risk has skyrocketed dramatically during the recent global financial crisis. Thus, the ECB launched alternative monetary policy measures, unconventional or non-standard policy tools in order to maintain price stability, to support financial situation and credit flows, stabilize overall economy.

2. Methodology

The statistical method, economic analysis and econometric methods were used during the investigation. On the basis of statistical data collected, as well as other information available in the public domain, the authors have made an analysis of European monetary policy. When collecting analytical data, the authors used foreign and domestic works and documents.

3. Case studies

The financial stability elevates series of sophisticated issues of definition and measuring. Such concept has no unique definition, accepted by all the economists and all the central banks. The financial stability plays a vital role regarding the financial system and the overall economy. Taking into account the functions of the financial system, one might value it is stable when it's able to distribute the economic resources efficiently (both in space, and inter-temporal), to operate the financial risks through a proper measuring and to self-correct when it is influenced by

external shocks (Simionescu, Niculae and Nedelut 2013). That is why, we may take into consideration that a financial system, irrespective of its size or complexity, is stable when it is able to promote the performances of an economy and to correct the unbalances occurring as a result of the significant adverse shocks (Christiano *et al.* 2010). Commonly used Financial Stability indicators established by IMF are assets, financial real estate, profitability, liquidity ratio, interest rate, exchange rate, real GDP growth rate, inflation including HICP, PPP, labour income, saving, current account, capital flows, total debt, total consumption, corporate defaults, risk premia, capital adequacy, bank credit rating, corporate bond spreads, market liquidity, volatility, *etc.* (Gersl and Hermanek 2010).

The main aim of the work to find out the effect of the ECB's unconventional monetary policies to Euro area countries. The basic hypothesis underlying the work is that the ECB's unconventional monetary policies improved financial condition and contributed to supporting the normalization of price stability, as well as the ongoing economic recovery.

The main aim of the investigation is to create and estimate an econometric model for describing the evolution of 'actives/GDP' in 19 countries in 2015. 'Actives per GDP' is a proxy for financial stability and it depends on real GDP growth rate, interest rate, exchange rate, PPP, HICP.

The data has been taken from Eurostat database website (Eurostat Database 2016).

Table 1. The main financial stability variables for Eurozone by 2015

№	Countries	Actives/ GDP	Real GDP growth rate	Interest rate	Exchange Rate	PPP	HICP
1	Austria	336,4	1	0,75	99,59	1,07470	1,1
2	Belgium	372,8	1,4	0,84	99,81	1,08206	1,5
3	Cyprus	114,2	1,6	4,54	98,38	0,8830	0,6
4	Estonia	119,1	1,1	0,7	99,81	0,7283	0,2
5	France	420,7	1,3	0,84	99,78	1,0809	0,3
6	Finland	215,8	0,2	0,72	99,73	1,22166	-0,2
7	Germany	326,5	1,7	0,5	99,56	1,03177	0,2
8	Greece	221,7	-0,2	9,67	99,81	0,79983	0,4
9	Ireland	347,6	26,3	1,18	99,79	1,11036	0,2
10	Italy	257,6	0,8	1,71	99,74	0,9800	0,1
11	Latvia	146,9	2,7	0,96	98,75	0,6657	0,4
12	Lithuania	80,4	1,6	1,38	99,78	0,604715	0,2
13	Luxembourg	215,9	4,6	0,37	99,81	1,17767	0,9
14	Malta	186,3	6,4	1,49	100,01	0,80194	1,3
15	Netherlands	402,4	2	0,69	99,78	1,08491	0,5
16	Portugal	335,4	1,5	2,42	99,87	0,778542	0,3
17	Slovenia	147,1	2,9	1,71	99,53	0,78740	-0,6
18	Slovakia	84	3,6	0,89	128,13	0,65403	-0,4
19	Spain	337,4	3,2	1,73	99,82	0,88523	0,1

Source: Eurostat Database (2016)

The above given table indicates the real GDP growth rate, Interest rate, Exchange rate, Purchasing Power Parity (PPP) and Harmonised Index of Consumer Prices (HICP) measures of 19 Euro area countries by 2015. GRETL econometric package program has been used in order to create a model and to estimate it.

Ordinary Least Squares (OLS) estimator was used to run an econometric regression (see Appendix 1). There are overall 19 observations and 5 independent variables.

The dependent variable 'Actives/GDP' and independent variables are RealGDP, IR, ER, PPP, HIPC. c_i in the model is a constant, u_i is error term. Intuitively thinking, we can assume that all variables are statistically significant. The dependent variable has been transformed to logarithmic form (Log_Actives/GDP) and it is obvious that we used 'semi-log' model. Logarithmic form in the model shows percentage change of the variables. R-squared is equal to 0.55658, which implies around 56% of variation in 'Actives per GDP' can be explained by variations in Real GDP rate, interest rate, exchange rate, PPP, HIPC. Overall, all parameters in the model are jointly significant.

Almost all coefficients except ER have positive impact to the result. According to the given model above, one percent increase of Real GDP growth rate, actives per GDP increases by 0.0042. Holding all other variables constant, 1% increase of interest rate, actives/GDP goes up around by 0.013. Holding all other factors constant, 1% increase of exchange rate, actives per GDP declines by 0.013. If PPP growths by 1%, actives/GDP goes up by 1,77. If HICP increases by 1%, actives/GDP dependent variable increases by 0.096.

We tested the model to joint significance (Appendix 2). According to the joint significance test, in which hypotheses mean:

Null hypothesis (H_0): $\beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$

Alternative hypothesis (H_1): at least one of the coefficients does not equal to zero (is different from 0).

We got the following result. Test statistic: F(5, 13) = 3.2636, with p-value = 0.0397375 As we can see p-value less than 5% significance level, that is why we reject H_0 and conclude that at least one of the coefficients is different from zero, overall model is jointly significant.

The econometric model has been tested for diagnostics such as Ramsey's RESET, test for normality of residuals, Jarque-Bera Test, test for heteroscedasticity (White's Test).

First of all, Ramsey's RESET is the test for linearity of the functional form, where hypotheses mean:

H_0: No omitted nonlinearity; functional form is correct, no misspecification

H_1: Omitted nonlinearity; functional form is not correct, misspecification

We got the following result (Appendix 3). Test statistic: F = 2.665387, with p-value = P(F(2,11) > 2.66539) = 0.114. As we can see p-value is greater than 0.05 (5% significance level). There is 11,4% chance of Type I error if we reject H_0. That is why we do not reject H_0 and conclude there is no omitted nonlinearity, functional form is correct, no misspecification.

Secondly, we have done the test for heteroscedasticity, White's Test (Appendix 4), where hypotheses imply:

H_0: Homoscedasticity

H_1: Heteroscedasticity

We got the following result:

Test statistic: TR^2 = 14.595836, with p-value = P(Chi-square(10) > 14.595836) = 0.147506

There is 14,75% chance of Type I error if we reject H_0. That is why we accept H_0 as p-value is greater than 0.05 (5% significance level). Therefore we assume that there is not enough evidence to reject the homoscedasticity hypothesis and conclude there is homoscedasticity.

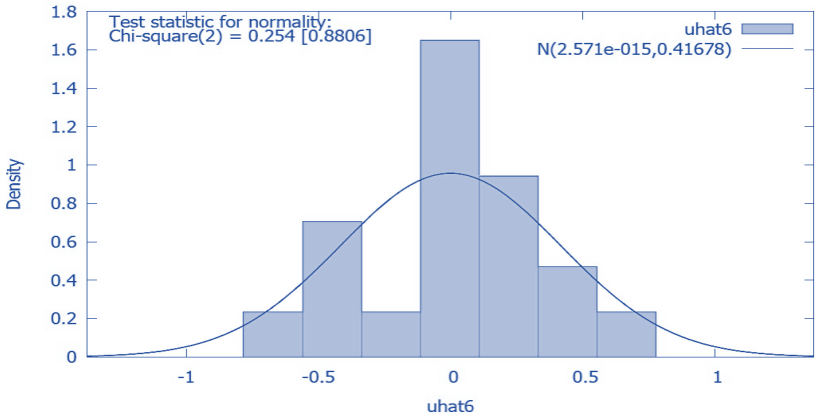
Thirdly, we tested the model for normality of residuals (Appendix 5), where hypotheses mean:

H_0: Normally distributed

H_1: Not normally distributed

As a result, test for null hypothesis of normal distribution: Chi-square(2) = 0.254 with p-value 0.88064, which is greater than 5% significance level. There is 88% chance of Type I error if we reject H_0. We accept H_0, and come to conclusion that the residuals are normally distributed.

Figure 1. Test statistic for normality of residuals



In addition, we have done Jarque-Bera Test and it confirmed the normality of residuals (Appendix №6). In order to implement Jarque-Bera Test we saved residuals and tested 'uhat1' residuals for normality. The result of the Jarque-Bera test = 0.30104, with p-value 0.860261. There is 86% chance of Type I error if we reject H_0. P-value is greater than 0.05, we cannot reject H_0 and conclude the residuals are normally distributed.

It is important to check the model for multicollinearity (Appendix 7). As we can notice from the table above, there is no multicollinearity problem in our model. All values are around 1, which indicates the model does not have a collinearity problem. The proposed model has been tested for all diagnostics and the results are good enough and robust to conclude that our model is valid. The table below illustrates the data by 2008.

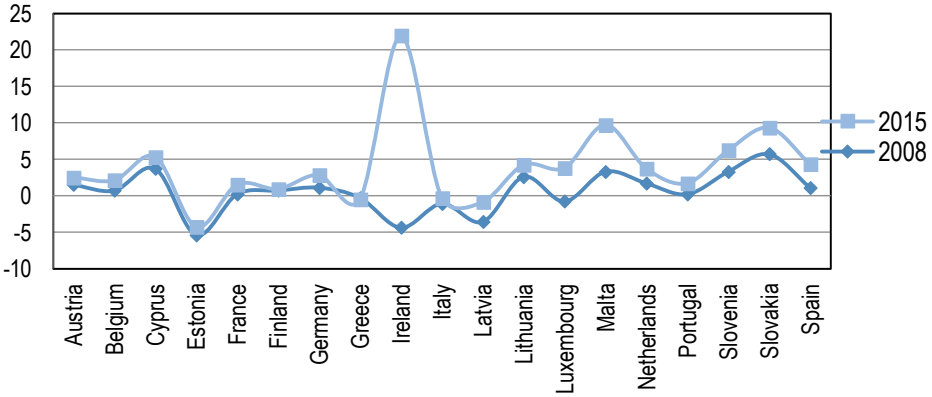
Table 2. The main financial stability variables for Eurozone by 2008

№	Countries	Actives/ GDP	Real GDP growth rate	Interest rate	Exchange Rate	PPP	HICP
1	Austria	249,4	1,5	4,36	99,67	1,09133	3,2
2	Belgium	288,8	0,7	4,42	99,85	1,14113	4,5
3	Cyprus	30,2	3,7	4,6	98,41	0,87700	4,4
4	Estonia	35,1	-5,4	4,75	99,85	0,70250	10,6
5	France	336,7	0,2	4,23	99,82	1,12945	3,2
6	Finland	131,8	0,7	4,29	99,78	1,17472	3,9
7	Germany	242,5	1,1	3,98	99,64	1,03905	2,8
8	Greece	137,7	-0,3	4,8	99,85	0,89740	4,2
9	Ireland	263,6	-4,4	4,53	99,83	1,21812	3,1
10	Italy	173,6	-1,1	4,68	99,79	1,00988	3,5
11	Latvia	62,9	-3,6	6,43	98,84	0,719292	15,3
12	Lithuania	15,4	2,6	5,61	99,83	0,619299	11,1
13	Luxembourg	131,9	-0,8	4,61	99,85	1,160120	4,1
14	Malta	102,3	3,3	4,81	100,03	0,717206	4,7
15	Netherlands	318,4	1,7	4,23	99,82	1,078320	2,2
16	Portugal	251,4	0,2	4,52	99,89	0,831094	2,7
17	Slovenia	63,1	3,3	4,61	99,61	0,812069	5,5
18	Slovakia	13,7	5,7	4,72	123,52	0,688700	3,9
19	Spain	253,4	1,1	4,37	99,85	0,921884	4,1

Source: Eurostat Database (2016)

Financial stability variables for Euro area countries by 2008 are given in the table above. We have chosen the 5 key indicators of financial stability, more precisely real GDP growth rate, interest rate, exchange rate, PPP and HICP.

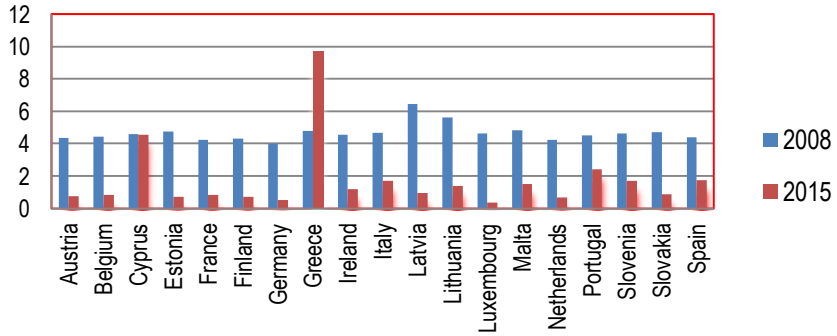
Figure 2. The comparison of real GDP growth rate by 2008 and 2015



The graph above represents the comparison of real GDP growth by 2008 and 2015. As we can see real GDP growth rate has increased by 2015 compared to 2008 in all given Eurozone countries. Interestingly, the GDP growth rate of Ireland has skyrocketed sharply by 2015.

The histogram below shows interest rate comparison by two given periods of time. As we can notice, interest rate has fallen almost in all given countries by 2015, in contrary interest rate in Greece has increased dramatically by 2015 compared with 2008.

Figure 3. Interest rate comparison by 2008 and 2015



'Actives/GDP' ratio is a proxy for financial stability and its change, increase or decrease depends on the indicators given in the model. Overall 5 independent variables were represented in our model. As we mentioned before, the volumes of the variables in the model have changed by 2015 in comparison with 2008. As an example, interest rate decreased, real GDP growth rate increased in 2015. As a result, 'Actives/GDP' ratio has raised by 2015 in comparison with 2008.

Table 3. The comparison of 'actives/GDP' ratio by 2008 and 2015

Country	2008	2015
Austria	249,4	336,4
Belgium	288,8	372,8
Cyprus	30,2	114,2
Estonia	35,1	119,1
France	336,7	420,7
Finland	131,8	215,8
Germany	242,5	326,5
Greece	137,7	221,7

Country	2008	2015
Ireland	263,6	347,6
Italy	173,6	257,6
Latvia	62,9	146,9
Lithuania	15,4	80,4
Luxembourg	131,9	215,9
Malta	102,3	186,3
Netherlands	318,4	402,4
Portugal	251,4	335,4
Slovenia	63,1	147,1
Slovakia	13,7	84
Spain	253,4	337,4
Average:	163,2578	245,6947

Figure 4. The comparison of 'Actives/GDP' ratio by 2008 and 2015

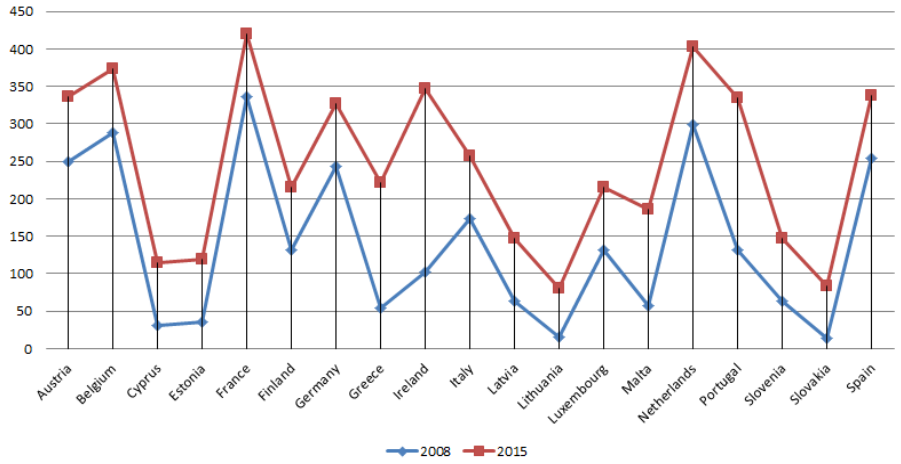
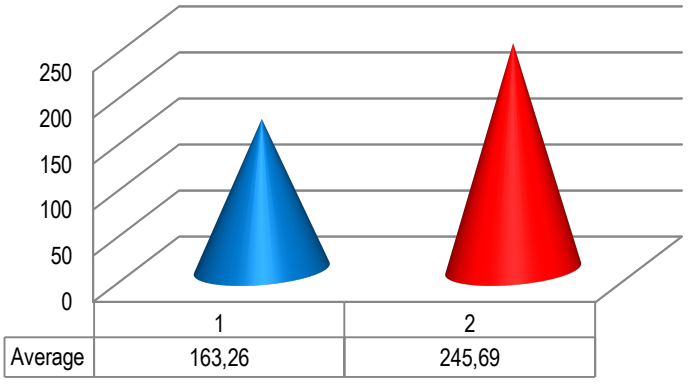


Figure 5. The comparison of an average 'actives/GDP' ratio by 2008 and 2015



We can finalize that financial stability has been improved in 2015 compare to 2008. Assets ('actives' in the model) in banks increased and 'Actives/GDP' ratio grew in 2015 in comparison with 2008, which implies credit stability in banks and general financial stability improvement, and price stability as well. As it is represented in the chart above, the average 'Actives/GDP' ratio of 2007 is 163,26, while the average 'Actives/GDP' ratio of 2015 is 245,69. There was a significant increase in 'Actives per GDP' ratio in 2015 compared to 2008. As we mentioned

before 'actives/GDP' is a proxy for financial stability indicator. Higher value of financial stability index (actives/GDP ratio in our model) represents favorable financial conditions.

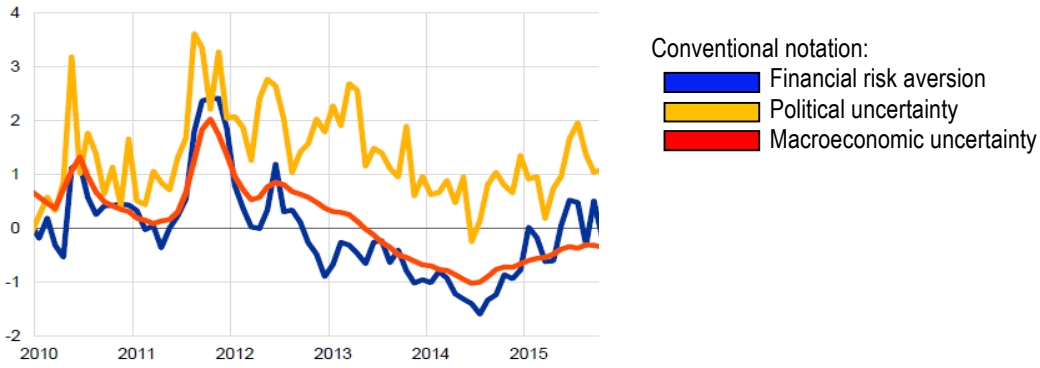
From financial stability point of view, the factors such as interest rate, real GDP growth rate, PPP, HICP, exchange rate play a main role in financial condition of the countries (Smets 2014). Therefore, the key indicators of the financial stability index have been taken in our model. There are links between monetary and financial stability, as monetary conditions will be affected by asset prices and vice versa. In our model asset prices are given as 'actives'. It is clear that we took 'actives/GDP' ratio to interact with each other monetary policy and financial stability.

A crucial question is to what extent unconventional monetary policy or non-standard measures have been able to affect interest rates, thereby restoring the monetary policy transmission process and supporting the Central Bank objectives. Since April 2015 headline inflation has turned positive but remains very low, affected by the renewed decline in oil prices. Core inflation, excluding food and energy, continues however to firm, reflecting the ongoing economic recovery which is evolving in accordance with the ECB's baseline scenario. The latest round of the ECB's staff macroeconomic projections indicates that by 2017 inflation will be below, but close to 2% and that GDP growth will also be hovering around 1.9%.

The empirical method has been used to identify the effectiveness of unconventional measures launched by the ECB. While this adds to a divergence of results, the overall conclusion is that central banks' liquidity support has significantly reduced money market rates and thereby supported financial transmission and the whole economy. Likewise, studies about the effectiveness of the non-standard policies rely on different methodologies and data frequencies, but generally conclude that the asset purchases had a positive effect on market functioning by reducing liquidity premia and lowering the level as well as the volatility of yields. Finally, we have offered new evidence on the effectiveness of the ECB's unconventional monetary policy measure, i.e. increase and extend of actives/GDP ratio. The results suggest that the ECB's non-standard interventions in general had a favorable effect on financial stability and improved financial condition of Eurozone.

The hypothesis of the work highlights a positive effect of the ECB's unconventional monetary policy measures to the Euro area and financial condition improvement, ongoing economic recovery as well. The empirical results confirmed financial and economic improvements by 2015 in the Eurozone. The Euro area economic recovery has continued in 2015 and early 2016. Domestic demand remained the main pillar of growth, with a temporary slowdown in private consumption towards the end of last year being substantially compensated for by a contemporaneous pick-up in private investment activity and government spending (Constancio 2015). The figure below describes ongoing economic recovery in the Euro area.

Figure 6. Macroeconomic and political uncertainty as well as financial risk aversion in the Euro area (January 2010 – April 2016; standard deviation from mean).



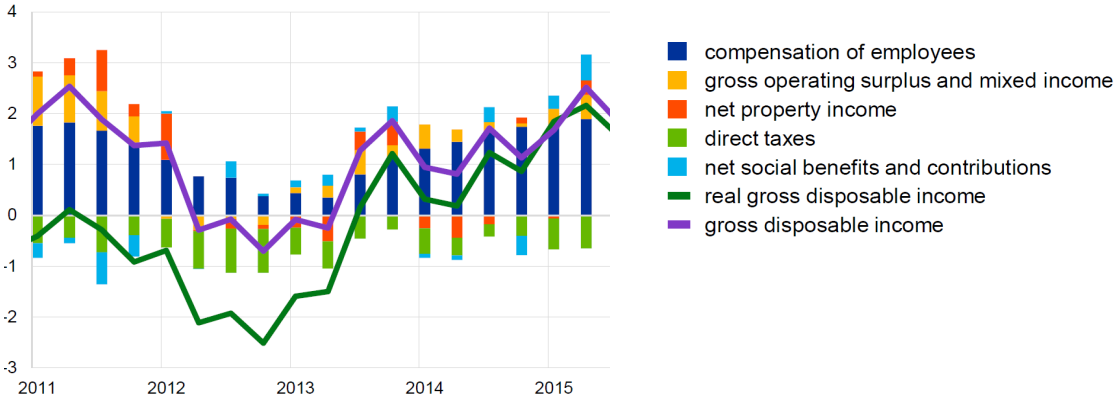
Source: Financial Stability Review, May 2016

It is clear that economic recovery in the Euro area is being primarily maintained by the very convenient monetary policy stance, more precisely non-standard or unconventional monetary policy measures. As it is introduced in the chart above, political and financial market uncertainty has declined considerably and renewed

political strains at both the national and EU levels as well as enhanced financial market ambiguity as a result of global growth concerns. All in all, it became clear that non-standard monetary policy measures influenced positively to Euro area countries' financial stability and macroeconomic condition (Financial Stability Review 2016).

Figure below represents that a gradually improving income position maintains households' debt servicing capabilities.

Figure 7. Euro area households' gross disposable income



Source: Eurostat Database (2016)

As displayed in the chart above, income and earning risks has been continuing to decline gradually. The Euro area household sector has restore. Improved labour market conditions weighed on households' income perspectives. Observed improvements in household net worth on the back of gradually strenghening housing market dynamics across the Euro area should help bolster households' balance sheets and counterbalance the negative influence of the descents in the positive contributions of capital gains on financial asset holdings and net savings to household wealth since mid-2015. Similarly in the line with ongoing gradual economic restoration, the number of corporate insolvencies remained to diminish in the Euro area. Overall, households' income has increased significantly and corporate insolvencies has been declining gradually.

Favourable financing provisions in euro erea contributed to a restoration in bank lending. The financing conditions of non-financial firms continue to be favourable and continue to support the financing of investment. Alongside improving supply and refining demand-side conditions, the ECB's non-standard (or unconventional) monetary policy measures, *i.e* credit easing measures such as covered bond purchase program (CBPP), the targeted long-term refinancing operations and the asset-backed securities – together with other non-standard policy instruments – promote the recovery of bank credit, while also lowering funding costs in both financial and non-financial sectors.

All in all, according to the hypothesis the ECB's unconventional monetary policies improved financial condition and contributed to supporting the normalization of price stability, as well as the ongoing economic recovery. Our results indicate that unconventional policy measures had a favorable (positive) effect to Eurozone's financial stability and economic condition. To conclude, we accept the hypothesis and assume that the financial stability in Euro area has been improved thanks to unconventional monetary policies of the ECB.

Conclusion

To conclude, the Euro area's economic recovery and financial stability are supported by non-standard monetary policy measures of the ECB. As we displayed in charts macroeconomic, political uncertainties have declined and financial risk aversion has dropped by 2015. Moreover, value added and employment have increased particularly strongly in the Eurozone. In addition to this, income and earning risks have diminished significantly. Favourable financing conditions in euro erea, which were positively affected by the ECB's non-standard monetary policy measures, contributed to a recovery in banking sector.

The hypothesis of the research states a positive effect of the ECB's unconventional monetary policy measures to the Euro area and financial condition improvement, ongoing economic recovery as well. We accept hypothesis and finalize that non-standard monetary policy measures had a favorable effect for financial stability and economic condition of the Euro area countries. As we saw before, the empirical results confirmed financial and economic improvements by 2015 in the Eurozone.

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APPENDICES

APPENDIX 1

Model 1: OLS, using observations 1-19

Dependent variable: log_Actives/GDP

Heteroskedasticity-robust standard errors, variant HC1

	Coefficient	Std. Error	t-ratio	p-value	
Const	5.05619	1.22992000	4.1110	0.0012	***
RealGDP	0.00419765	0.00706693	0.5940	0.5627	
IR	0.01290520	0.03458300	0.3732	0.7150	
ER	−0.01361030	0.00732610	−1.8578	0.0860	*
PPP	1.77881000	0.62737300	2.8353	0.0140	**
HICP	0.09592870	0.14195700	0.6758	0.5110	

Mean dependent var	5.384245		S.D. dependent var	0.531913
Sum squared resid	2.258200		S.E. of regression	0.416783
R-squared	0.556586		Adjusted R-squared	0.386043
F(5, 13)	40.39851		P-value(F)	1.80e-07
Log-likelihood	−6.726056		Akaike criterion	25.45211
Schwarz criterion	31.11875		Hannan-Quinn	26.41113

Log_Actives/GDP = c_i + 0,0042Real GDP + 0,012 IR – 0,0136 ER +1,77 PPP + 0,095 HIPC + u_i

APPENDIX 2

Restriction set
1: b[RealGDP] = 0
2: b[IR] = 0
3: b[ER] = 0
4: b[PPP] = 0
5: b[HICP] = 0

Test statistic: F(5, 13) = 3.2636, with p-value = 0.0397375

Restricted estimates:

coefficient std. error t-ratio p-value

---

const 5.38424 0.122029 44.12 8.47e-020 ***
RealGDP 0.000000 0.000000 NA NA
IR 0.000000 0.000000 NA NA
ER 0.000000 0.000000 NA NA
PPP 0.000000 0.000000 NA NA
HICP 0.000000 0.000000 NA NA

Standard error of the regression = 0.531913

APPENDIX 3

Auxiliary regression for RESET specification test
OLS, using observations 1-19
Dependent variable: log_ActivesGDP

coefficient std. error t-ratio p-value

---

const 23.7190 854.967 0.02774 0.9784

RealGDP 0.0698577 1.10216 0.06338 0.9506
IR 0.155192 3.38816 0.04580 0.9643
ER −0.153574 3.51880 −0.04364 0.9660
PPP 27.3612 467.783 0.05849 0.9544
HICP 1.47258 25.2445 0.05833 0.9545
yhat^2 −0.285465 49.0717 −0.005817 0.9955
yhat^3 −0.130276 3.04650 −0.04276 0.9667

Test statistic: F = 2.665387,
with p-value = P(F(2,11) > 2.66539) = 0.114

APPENDIX 4

White's test for heteroskedasticity
OLS, using observations 1-19
Dependent variable: uhat^2

coefficient std. error t-ratio p-value

---

const −27.9026 32.7454 −0.8521 0.4189
RealGDP 0.0240518 0.0267548 0.8990 0.3949
IR 0.276037 0.0671553 4.110 0.0034 ***
ER 0.522315 0.585720 0.8917 0.3986
PPP −4.11773 1.94947 −2.112 0.0676 *
HICP 0.168625 0.0973055 1.733 0.1213
sq_RealGDP −0.00125409 0.000992945 −1.263 0.2422
sq_IR −0.0256614 0.00637200 −4.027 0.0038 ***
sq_ER −0.00228977 0.00257065 −0.8907 0.3991
sq_PPP 2.49137 1.08261 2.301 0.0504 *
sq_HICP −0.184214 0.0794099 −2.320 0.0489 **

Unadjusted R-squared = 0.768202

Test statistic: TR^2 = 14.595836,
with p-value = P(Chi-square(10) > 14.595836) = 0.147506

APPENDIX 5

Frequency distribution for uhat4, obs 1-19
number of bins = 7, mean = -9.34925e-016, sd = 0.416783
interval midpt frequency rel. cum
< -0.56114 -0.67281 1 5.26% 5.26% *
-0.56114 - -0.33780 -0.44947 3 15.79% 21.05% *****
-0.33780 - -0.11447 -0.22613 1 5.26% 26.32% *
-0.11447 - 0.10887 -0.0027969 7 36.84% 63.16% **********
0.10887 - 0.33221 0.22054 4 21.05% 84.21% *******
0.33221 - 0.55555 0.44388 2 10.53% 94.74% ***
>= 0.55555 0.66721 1 5.26% 100.00% *
Test for null hypothesis of normal distribution:
Chi-square(2) = 0.254 with p-value 0.88064

APPENDIX 6

Test for normality of 'uhat1':

Doornik-Hansen test = 0.254217, with p-value 0.880638

Shapiro-Wilk W = 0.971343, with p-value 0.802968
Lilliefors test = 0.138997, with p-value ~= 0.42

Jarque-Bera test = 0.30104, with p-value 0.860261

APPENDIX 7

Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

RealGDP 1.056
IR 1.131
ER 1.263
PPP 1.320
HICP 1.182

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:

variance proportions ---

lambda	cond	const	RealGDP	IR	ER	PPP	HICP
4.286	1.000	0.000	0.004	0.013	0.000	0.000	0.005
0.873	2.216	0.000	0.030	0.010	0.000	0.000	0.277
0.584	2.709	0.000	0.172	0.043	0.000	0.000	0.091
0.248	4.161	0.000	0.021	0.899	0.001	0.001	0.030
0.009	21.641	0.002	0.771	0.000	0.060	0.377	0.561
0.001	86.530	0.998	0.001	0.036	0.939	0.622	0.036

lambda = eigenvalues of X'X, largest to smallest
cond = condition index
note: variance proportions columns sum to 1.0

Status of Financial Literacy Among Small Scale Entrepreneurs: A Case Study

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Abstract:

The purpose of this paper is to study the status of financial literacy among small scale entrepreneurs (SSEs) in a small district of Tamil Nadu state in India. The study is based on factors influencing small scale entrepreneurs to know about financial services; the problems faced by SSE while availing financial services; their satisfaction towards banking services; and appropriate measures to be taken for improving financial literacy among SSEs.
The study implemented a mixed methodology research design using both qualitative and quantitative methods. A survey was conducted among 150 selected small scale entrepreneurs using convenient sampling technique. The results of Garrett Ranking Technique showed that majority of respondents are influenced by knowledge about financial products, followed by knowledge of financial numeracy, money management, budgeting, timely payment of bills, intensity to save, propensity to consume, risk aversion and trusted financial advice. Results of Chi-Square test revealed that the demographic profiles are not significantly related to the problems of the SSEs.

Keywords: financial literacy; small scale entrepreneurs; financial services; banking services; financial knowledge; money management

JEL Classification: Z23; M13

Introduction

Financial literacy is necessary for the small scale entrepreneurs who have low level of awareness and lack of knowledge about financial products leading to major cause of failure in businesses. Campbell (2006) discussed that many investors failed to refinance their mortgages during a period of falling interest rates due to lack of financial literacy. Those investors also seem less likely to know the terms of their mortgages, including the interest rates they pay (Bucks and Pence 2006). Moore (2003) discussed about financially illiterate borrowers landing up with debts and high-cost mortgages.

The present study explores factors influencing small scale entrepreneurs to know about financial services, problems faced by small scale entrepreneurs while availing financial services, the small scale entrepreneurs' satisfaction towards the banking services and kind of assistance expected by small scale entrepreneurs from the bank.

1. Financial literacy and entrepreneurs

1.1. Financial literacy

Financial literacy is a global concern. The Organization for Economic Co-operation and Development (OECD 2011) has defined financial literacy as: "A combination of awareness, knowledge, skill, attitude and behavior necessary to make sound financial decisions and ultimately achieve individual financial wellbeing." It is the process by which financial consumers/investors improve their understanding of financial products and concepts. Also a financial literate person will be able to develop his skills and confidence to become more aware of financial risks and opportunities to make informed choices; to know where to go for help; to take effective actions to improve his

financial wellbeing (OECD 2005) and effective decisions about the business development. Financial literacy consists of five separate components, namely keeping track of finances, planning ahead, and choosing financial products, staying informed and financial control (Worthington 2016).

Financial literacy covers certain financial products and services like microfinance, debit card, credit card, e-banking, mobile banking, bank guarantee, standing instructions, banc-assurance, buying and selling of shares, financial advice and overdraft facility. While banks and banking services are available for those familiar with financial resources, the poor are inaccessible to banks, with lack of opportunities for financial products and services. Increasing poverty rate, lack of awareness and lack of financial knowledge create opportunity for unorganized banking sectors namely indigenous bankers, money lenders, chit funds and pawn brokers who often use the financially illiterate people to satisfy their own ends of wealth creation (Nalini 2011).

1.2. Small scale entrepreneurship

Small Scale Entrepreneurship plays a catalytic role in the economic development of a country, and entrepreneurial competence makes all the difference in its growth rate. In India, medium and small enterprises (MSEs), form 95% of the industrial units, accounting for almost 40% of the total industrial production and 34% of the exports, providing employment to about 312.5 lakh persons in 128.5 lakh units in 2006-2007 (Kular *et al*. 2010).

Through several Entrepreneurship Development and Training Programmes conducted by the Indian government, entrepreneurs have attained the skills and knowledge of financial, technical and managerial aspects of business. Economists have recognized entrepreneurs as an essential agent in generating investment opportunities (Latha and Murthy 2009). Presently the micro, small and medium enterprises sector have put the economy on a fast track growth and today Indian economy has become the second fastest growing economy in the world, even during the worst economic recession period. India has been seeing an increasing rate of entrepreneurs and new start-ups over the last five years, 2016 has been a major breakthrough year for all of the investors and shareholders in the Indian ecosystem to seek and provide support in sustaining the biggest and rapid growth of entrepreneurship to date, especially the launch of "Startup India" action plan to provide entrepreneurs with various subsidies, as well as relaxed norms for starting up business in India (Thakur 2016).

1.3. Financial literacy and entrepreneurs

The growth of micro, small and medium enterprises (MSMEs) holds the key role to resolve the problems of poverty and unemployment in the country. For entrepreneurs to appraise risk and prospects between competitive options, they must understand the financial concepts and skills relevant to business operations. However, most of the entrepreneurs engaged in micro, small and medium enterprises are financially illiterate. Lack of personal financial literacy impacts negatively on the financial management of new ventures and can lead to possible failures of small scale entrepreneurs (Kotze and Smit 2008). Researches on financial literacy have shown that most individuals including entrepreneurs don't understand the concept of compound interest and some don't actively seek out financial information before making financial decisions (Mbazigwe 2013). Both individuals and entrepreneurs are asked to make difficult financial decisions in many aspects of life, whether in their personal finances or as business owners (Drexler 2010).

The following objectives have been outlined for the study:

- to study the factors influencing small scale entrepreneurs to know about financial services and analyze the problems faced by small scale entrepreneurs while availing financial services;
- to study satisfaction and expectation towards the banking services by small scale entrepreneurs;
- to suggest appropriate measures for improving financial literacy of small scale entrepreneurs.

2. Related works

Lusardi (2008) demonstrates widespread financial illiteracy among the U.S. population, particularly among specific demographic groups. This paper shows that most individuals cannot perform simple economic calculations and lack knowledge of basic financial concepts, such as the working of interest compounding, the difference between nominal and real values, and the basics of risk diversification.

Financially literate people are better at budgeting, saving money and controlling expenditure (Moore 2003); participating financial markets (Van Rooji *et al*. 2011), handling debts and mortgages (Campbell 2006) and also planning for retirement (Lusardi and Mitchell 2008). There is a strong association between financial literacy, the ability to make good financial decisions and household well-being and business survival (Cole and Fernando 2008).

Financial literacy affects financial decision-making; ignorance about basic financial concepts can be linked to lack of retirement planning, lack of participation in the stock market, and poor borrowing behavior. According to a survey on Global Financial Literacy in 2012 conducted by VISA, only 35% of Indians were financially literate and India was among the least financially literate countries (Santoshi 2012); a new survey by Standard and Poor found that 76% of Indian adults do not understand basic, key financial concepts (India Today 2015).

Financial literacy enables individuals and entrepreneurs to make better financial decisions and to understand/manage risk (Fatoki 2014) and financial literacy is essential for effective money management. Miller *et.al*. (2009) ascertain that financial literacy can help the consumers to prepare during the financial crisis, and minimize risks such as accumulating savings, expanding assets, and purchasing insurance.

Bruhn and Zia (2011) when investigated the impact of financial literacy program on young entrepreneurs, found that entrepreneurs with higher levels of financial literacy show better performance in business and sales. Sucuahi (2013) points out that a good financial foundation helps micro-entrepreneurs play significant role in financial management. Freiling and Laudien (2013), and Naqvi (2011) found that financial illiteracy contributed to the failure of new businesses.

3. Research methodology

The survey was conducted in Thoothukudi District, which covers areas namely Tiruchendur, Kayalpatnam, Arumuganeri, Authoor and Thoothukudi. The empirical approach consists of data collection through a designed questionnaire in a survey circulated among few academicians and research scholars. With a view to study the "Financial Literacy of Small Scale Entrepreneurs", 150 samples were selected at random by adopting convenient sampling technique.

The following null hypotheses were framed:

- there is no significant association between age, investment, experience, monthly income, years of transaction with bank, and the problems of the small scale entrepreneurs;
- there is no significant association between gender, marital status, educational qualification, type of business, type of bank, and the satisfaction of the small scale entrepreneurs towards banking services.

The information collected through the survey was analyzed with the help of Likert's scaling technique. For the responses of positive statements, weight of 5 points was given for 'strongly agree', 4 for 'agree', 3 for 'no opinion', 2 for 'disagree' and 1 for 'strongly disagree'. In case of negative statements, the scores are reversed. Besides percentages, descriptive statistics like mean and standard deviation have also been used for data analysis. In addition to this, Garrett ranking technique, Spearman's rank co-efficient of correlation, Chi-square test and Two-Way ANOVA are applied.

4. Findings of the study

The major findings of the study were presented below:

- gender wise classification: out of 150 respondents, 79.3% of the respondents were male and 20.7% of them were female. Thus, majority of the respondents were male;
- age wise classification: out of 150 respondents, 44.7% of the respondents were 40 – 60 years of age, 40.7% of them were 20 – 40 years of age, 8% of them were above 60 years of age and 6.7% of them were below 20 years of age. Thus, majority of the respondents were in the age group of 40 – 60 years;
- marital status wise classification: out of 150 respondents, 77.3% of the respondents were married and 22.7% of them were unmarried. Thus, majority of the respondents were married;
- educational qualification of the respondents: out of 150 respondents, 38.7% of the respondents were completed upto SSLC, 26.7% of them had no formal education, 15.3% of them were completed higher

secondary, 11.3% of them were graduates and 8% of them were diploma holders. Thus, majority of the respondents were completed upto SSLC;

- business wise classification: out of 150 respondents, 32% of the respondents had grocery shops, 21.3% of them had fruit stalls, 18% of them had fancy stores, 14.7% of them came under the category of others which include petty shops, rice shops and medical shops and 14% of them had bakery shops. Thus, majority of the respondents had grocery shops;
- reason for being in this business: out of 150 respondents, 42% of the respondents were being in this business due to personal interest, 22.7% of them were being in this business for more income, 19.3% of them were being in this business due to low investment and 16% of them were being in this business because of family business. Thus, majority of the respondents were being in this business due to personal interest;
- investment wise classification: out of 150 respondents, 46% of the respondents had invested below Rs.2,00,000, 32.7% of them had invested Rs.2,00,000 – Rs.4,00,000, 32.7% of them had invested Rs.2,00,000 – Rs.4,00,000, 13.3% of them had invested Rs.4,00,000 – Rs.6,00,000 and 8% of them had invested above Rs.6,00,000. Thus, majority of the respondents had invested below Rs.2,00,000;
- experience wise classification: out of 150 respondents, 44% of the respondents had an experience of below 5 years, 32% of them had an experience of 5 – 10 years and 24% of them had an experience of above 10 years. Thus, majority of the respondents had an experience of below 5 years;
- income wise classification: out of 150 respondents, 39.3% of the respondents earn monthly income of Rs.10,000 – Rs.15,000, 30% of them earn monthly income of Rs.15,000 – Rs.20,000, 17.3% of them earn monthly income above Rs.20,000 and 13.3% of them earn monthly income below Rs.10,000. Thus, majority of the respondents earn monthly income of Rs.10,000 – Rs.15,000;
- holding bank account: out of 150 respondents, 86.7% of the respondents had a bank account and 13.3% of them were not having a bank account. Thus, majority of the respondents had a bank account;
- account holding bank: out of 130 respondents who were holding bank account, 50% of the respondents had an account in the public sector bank, 31.5% of them had an account in the private sector bank, 10.8% of them had an account in the co-operative bank and 7.7% of them had an account in the regional rural bank. Thus, majority of the respondents had an account in the public sector bank;
- type of account: out of 130 respondents who were holding bank account, 70.8% of the respondents were holding savings bank account, 10.8% of them were holding recurring deposit account, 10% of them were holding current account and 8.5% of them were holding fixed deposit account. Thus, majority of the respondents were holding savings banks account;
- number of years of transaction with the bank: out of 130 respondents who were holding bank account, 46.2% of them had transaction of 2 – 4 years with the bank, 31.5% of them had transaction of above 4 years with the bank and 22.3% of them had transaction of below 2 years with the bank. Thus, majority of the respondents had transaction of 2 – 4 years with the bank;
- availed banking services: out of 130 respondents who were holding bank account, majority (87.7%) of the respondents had not availed microfinance and 12.3% of them had availed microfinance. Majority (97.7%) of the respondents had availed debit card service and 2.3% of them had not availed debit card service. Majority (97.7%) of the respondents had not availed credit card service and 2.3% of them had availed credit card service. Majority (98.5%) of the respondents had not availed e-banking service and 1.5% of them had availed it. Majority (64.6%) of the respondents had availed mobile banking service and 35.4% of them had not availed it. Majority (81.5%) of the respondents had not availed bank guarantee and 18.5% of them had availed it. Majority (57.7%) of the respondents had not availed standing instruction service and 42.3% of them had availed it. Majority (76.2%) of the respondents had not availed bancassurance and 23.8% of them had availed it. Majority (83.1%) of the respondents did not buy and sell the shares through banks and 16.9% of them were involved in it. Majority (52.3%) of the respondents had availed financial advice from the bank and 47.7% of them had not availed it. Majority (90%) of the respondents had not availed overdraft facility and 10% of them had availed it;

- borrowing loan from the bank: out of 130 respondents who were holding bank account, 85.4% of the respondents had borrowed loan from the banks and 14.6% of them had not borrowed any loan from the banks. Thus, majority of the respondents had borrowed loan from the banks;
- reasons for availing loan: out of 111 respondents who borrowed loan, 49.5% of the respondents availed loan for business expansion, 29.7% of them availed loan for domestic consumption and 20.7% of them availed loan for starting new business. Thus, majority of the respondents availed loan for business expansion;
- reasons for preferring bank loan: out of 111 respondents who borrowed loan, 30.6% of the respondents preferred bank loan due to low interest rate, 28.8% of them preferred bank loan because of easy availability 19.8% of them preferred bank loan because of simple procedure, 18.9% of them preferred bank loan because of timely delivery and 1.8% of them preferred bank loan as no collaterals required. Thus, majority of the respondents preferred bank loan due to low interest rate.

Table 1. Demographic profile

Description	No. of respondents (n=150)	Percent
Gender		
Male	119	79.3
Female	31	20.7
Age		
Less than 20 years	10	6.7
20-40 years	61	40.7
40-60 years	67	44.7
More than 60 years	12	8
Marital Status		
Married	116	77.3
Single	34	22.7
Education		
No education	41	27.6
Completed School Certificate	57	38.7
Completed High School Certificate	23	15.3
Diploma holders	12	8
Graduates	17	11.3
Business		
Grocery shop	48	32
Fruit Stall	32	21.3
Fancy store	27	18
Bakery shop	21	14
Other (Petty Shop, Rice shop, Medical shop)	22	14.7
Reason for being in this business		
Personal interest	63	42
For more income	34	22.7
Low investment	29	19.3
Family Business	24	16
Investment		
Below INR. 200000	69	46
INR. 2000000-400000	49	32.7
INR. 400000-600000	20	13.3
Above INR. 600000	12	8
Experience		
Below 5 years	**66**	44
5-10 years	48	32

Description	No. of respondents (n=150)	Percent
Above 10 years	36	24
Income		
INR 10000-15000	59	39.3
INR 15000-20000	45	30
INR less than 10000	26	17.3
Having Bank Account		
Yes	130	86.7
No	20	13.3

Table 2. Bank account holders

Description	No. of respondents (n=130)	Percent
Public Sector Bank	65	50
Private Sector Bank	41	31.5
Co-operative Bank	14	10.8
Regional Rural Bank	10	7.7
Savings Bank Account	92	70.8
Recurring Deposit	14	10.8
Current Account	13	10
Fixed Deposit	11	8.5
Years of Account with Bank		
2-4 years	60	46.2
Above 4 years	41	31.5
Below 2 years	29	22.3
Bank Services-		
Microfinance (MF)		
Yes	16	12.3
No	114	87.7
Debit Card Service		
Yes	127	97.7
No	3	2.3
Credit Card Service		
Yes	3	2.3
No	127	97.7
E-Banking Service		
Yes	2	1.5
No	128	98.5
Mobile Banking Service		
Yes	84	64.6
No	46	35.4
Bank Guarantee		
Yes	24	18.5
No	106	81.5
Standing instruction		
Yes	55	42.3
No	75	57.7
Bancassurance		
Yes	37	28.3
No	99	76.2
Shares through Bank		
Yes	22	16.9

Description	No. of respondents (n=130)	Percent
No	108	83.1
Financial Advice		
Yes	68	52.3
No	62	47.7
Overdraft Facility		
Yes	13	10
No	117	90
Bank Loans		
Yes	111	85.4
No	19	14.6

Table 3. Reasons for applying for bank loan

Description	No. of respondents (n=111)	Percent
Reasons for Bank Loan		
Business Expansion	55	49.5
Domestic Consumption	33	29.7
Starting New Business	23	20.7
Bank Loan Preference		
Low Interest Rate	34	30.6
Easy Availability	32	28.8
Simple procedure	22	19.8
Timely delivery	21	18.9
No Collaterals required	2	1.8

Table 4. Borrowing fund from the informal lenders

Description	Number of respondents (n=150)	Percent
Yes	100	66.7
No	50	33.3

Out of 150 respondents, 66.7% of the respondents had borrowed fund from informal lenders and 33.3% of them had not borrowed fund from informal lenders. Hence, it is evident that major part of the respondents had borrowed fund from informal lenders.

Table 5. Type of informal lender

Description	Number of respondents (n=100)	Percent
Borrowed from friends/relatives	48	48
Borrowed from money lenders	42	42
Borrowed from pawn brokers	10	10

Out of 100 respondents who borrowed fund from the informal lenders, 48% of the respondents had borrowed from friends/relatives, 42% of them had borrowed from money lenders and 10% of them had borrowed from pawn brokers. Thus, majority of the respondents had borrowed fund from friends/relatives.

Table 6. Attitude towards changing the bank

Description	Number of respondents (n=130)	Percent
Yes	23	17.7
No	107	82.3

Out of 130 respondents who were holding bank account, 82.3% of the respondents were not interested to change their bank and 17.7% of them wished to change their bank. Hence, it is evident that majority of the respondents was not interested to change their bank.

Table 7. Suggesting the bank to others

Description	Number of respondents (n=130)	Percent
Yes	87	67
No	43	33

Out of 130 respondents who were holding bank account, 66.9% of the respondents were willing to suggest their bank to others and 33.1% of them were not willing to suggest their bank to others. Hence, it is evident that majority of the respondents were willing to suggest their bank to others.

5. Data analysis and interpretation

5.1. Factors influencing small scale entrepreneurs to know about financial services

The factors influencing small scale entrepreneurs to know about financial services is ranked using Garrett ranking technique. It is presented in Table 8.

Table 8. Results of Garrett Ranking Technique

No.	Factors	Rank									Mean Score	Rank
		I	II	III	IV	V	VI	VII	VIII	IX		
1.	Knowledge about financial products	20	38	42	42	18	14	14	32	40	54.92	I
2.	Basic money management skills	82	26	30	28	22	22	12	20	18	53.71	III
3.	Financial numeracy	16	28	32	28	42	34	42	18	20	53.88	II
4.	Budgeting	32	54	24	26	32	20	20	28	24	52.00	IV
5.	Timely payment of bills	28	34	28	24	20	32	42	24	28	48.57	V
6.	Trusted financial advice	24	20	34	30	30	26	40	34	22	45.61	IX
7.	Risk aversion	12	12	34	28	32	38	24	54	26	45.88	VIII
8.	Intensity to save	36	32	28	32	42	32	18	12	28	48.07	VI
9.	Propensity to consume	10	16	8	22	22	42	48	38	54	47.37	VII

Table 8 reveals that, the majority of the respondents are influenced by knowledge about financial products in knowing about financial services. So, it is placed in the first position. The second and third ranks are allotted to financial numeracy and basic money management skills, it is followed by budgeting, timely payment of bills, intensity to save, propensity to consume, risk aversion and trusted financial advice.

5.2. Profile and expectations of the small scale entrepreneurs

With a view to identify the correlation between profile of the respondents and expectations of the small scale entrepreneurs, Spearman's Rank Co-efficient of Correlation is applied. The age and expectations of the small scale entrepreneurs from the bank were summarized and presented in the Table 9.

Table 9. Age and expectations of the small scale entrepreneurs

No.	Expectations	Age	
		below 40 years	above 40 years
1.	Low interest rate	2	2
2.	Customer service	1	1
3.	Low transaction cost	4	3
4.	Minimum paper work	3	4
5.	Extending operating time	5	5

Spearman's Rank Correlation:

$$r = 1 - \frac{6\sum D^2}{N^3 - N} \quad (1)$$

Value = 0.99

Table 9 shows that there is a correlation between the ranks given by the respondents who belonged to the age group of below 40 years and above 40 years on their expectations from the bank. Because the spearman's rank correlation co-efficient 0.99 lies between -1 to +1. Hence, the two group respondents' opinion is the same.

5.3. Investment and expectations of the small scale entrepreneurs

The investment and expectations of the small scale entrepreneurs from the bank were summarized and presented in the Table 10.

Table 10. Investment and expectations of the small scale entrepreneurs

No.	Expectations	Investment	
		below Rs.4,00,000	above Rs.4,00,000
1.	Low interest rate	2	2.5
2.	Customer service	1	1
3.	Low transaction cost	4	2.5
4.	Minimum paper work	3	4
5.	Extending operating time	5	5

Spearman's Rank Correlation:

$$r = 1 - \frac{6\sum D^2}{N^3 - N} \quad \text{Value} = 0.99 \quad (2)$$

Table10 shows that there is a correlation between the ranks given by the respondents who invested below Rs. 4,00,000 and above Rs.4,00,000 on their expectations from the bank. Because the spearman's rank correlation co-efficient 0.99 lies between -1 to +1. Hence, the two group respondents' opinion is the same.

5.4. Experience and expectations of the small scale entrepreneurs

The experience and expectations of the small scale entrepreneurs from the bank were summarized and presented in the Table 11.

Table 11. Experience and expectations of the small scale entrepreneurs

S.No.	Expectations	Experience	
		below 5 years	above 5 years
1.	Low interest rate	2	2
2.	Customer service	1	1
3.	Low transaction cost	3	4
4.	Minimum paper work	4	3
5.	Extending operating time	5	5

Spearman's Rank Correlation:

$$r = 1 - \frac{6\sum D^2}{N^3 - N} \quad \text{Value} = 0.99 \quad (3)$$

Table 11 shows that there is a correlation between the ranks given by the respondents who had an experience of below 5 years and above 5 years on their expectations from the bank. Because the spearman's rank correlation co-efficient 0.99 lies between -1 to +1. Hence, the two group respondents' opinion is the same.

6. Hypotheses testing

H_1: There is no significant association between age, investment, experience, monthly income, years of transaction with bank, and the problems of the small scale entrepreneurs.

With a view to identify the significant relationship between profile of the respondents and the problems of the small scale entrepreneurs, Chi – Square test is applied.

6.1. Profile and the problems of the small scale entrepreneurs

Table 12. Consolidated Results of Chi-square Test

No.	Profile	d.f.	CV	TV*	Result
1.	Age	2	2.03	5.99	NS
2.	Investment	2	2.26	5.99	NS
3.	Experience	2	0.56	5.99	NS
4.	Monthly Income	2	0.37	5.99	NS
5.	Number of years of transaction	2	0.26	5.99	NS

Note: *5% level of significance; NS – Not Significant; S – Significant; df – Degrees of freedom; CV – Calculated Value; TV – Table Value

Table 12 (Chi Square test) shows - The demographic profiles age, investment, experience and monthly income and number of years of transaction with the bank are not significantly related to the problems of the small scale entrepreneurs. Therefore, Hypothesis is fully supported.

H_2: There is no significant association between gender, marital status, educational qualification, type of business, type of bank, and the satisfaction of the small scale entrepreneurs towards banking services.

With a view to identify the significant relationship between profile of the respondents and the satisfaction of the small scale entrepreneurs towards banking services, two – way ANOVA test is applied.

6.2. Profile and satisfaction on banking services

Table 13. Consolidated Results of F- test

No.	Profile	d.f (V_1, V_2)	CV	TV*	Result
1.	Gender	2, 2	4.885	19.000	NS
		1, 2	8.765	18.513	NS
2.	Marital Status	2, 2	1.781	19.000	NS
		1, 2	4.603	18.513	NS
3.	Educational Qualification	2, 8	14.39	4.4590	S
		4, 8	6.28	3.8378	S
4.	Type of business	2, 8	16.45	4.4590	S
		4, 8	2.09	3.8378	NS
5.	Type of bank	2, 6	10.544	5.1433	S
		3, 6	10.177	4.7571	S

Note: *5% level of significance; NS – Not Significant; S – Significant; df – Degrees of freedom; CV – Calculated Value; TV – Table Value

Results of F-test (Table 13) shows that Hypothesis is partially supported due to the following evidences:

- the demographic profiles gender and marital status are not significantly related to the satisfaction level of the small scale entrepreneurs towards banking services;
- the demographic profile educational qualification and the other profile type of bank are significantly related to the satisfaction level of the small scale entrepreneurs towards banking services;
- with regard to the satisfaction level of the small scale entrepreneurs, the demographic profile type of business is significantly related within itself.

Suggestions and conclusion

The following suggestions were recommended from this study to various beneficiaries like banks, and small scale entrepreneurs. The banks should be more flexible in their attitude to enable the borrowing units to overcome any temporary difficulties; should provide adequate and timely credit at reasonable rate of interest, without collaterals; should conduct awareness programmes in various industrial areas to increase the utilization of financial services; should establish separate counters in the bank for offering financial services; banking facilities should be made available to the remotest and backward areas where bank branches do not exist. The small scale entrepreneurs should come forward to know about the various financial products and services offered by banks; should utilize the loan for their business purpose rather than domestic consumption; should repay the loan regularly which will enhance the credit worthiness of the entrepreneurs.

Financial literacy is a very useful tool for financial growth of small scale entrepreneurs. The small scale entrepreneurs face various problems while availing financial services such as lack of technical knowledge, inadequate knowledge about financial products, complex procedural formalities, inadequate credit etc. Hence, the banks should take necessary steps to enhance the financial literacy among small scale entrepreneurs by providing adequate and timely credit at reasonable rate of interest and conducting awareness programmes.

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The Dynamic Model of Elements' Interaction Within System of Science-Intensive Production Under Unstable Macroeconomic Conditions

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Abstract:

The proposed article is devoted to the important issue of monetary regulation of high-tech industry system under the effect of unstable macroeconomic situation. The proposed methods and models are an effective method of resolving problems of monetary policy. The emphasis is on the qualitative analysis of the impact of monetary policy and external shocks on economic dynamics in the country. In this work, we produced an interpretation of the types of monetary policy shocks. The factors of exogenous shocks are matched with manifestation of the shocks of preferences, expectations and technological aspects. For the strategic risks-analysis of total flow of risks a mathematical model is made. The model takes into into account the economic, technological shocks and financial instability factors. As the result a mathematical description of the status of economic actors and conditions competitive equilibrium in the economy is generated.

Keywords: risk-management; risk flow; model of an economic shock; monetary policy; the model of the economic entity.

JEL Classification: C6; E5

Introduction

One of the most underlying causes of inflation in developing market economies is its low level of development (underdevelopment) and an inefficient structure of economy. These factors are manifested by high production costs, noncompetitiveness of national producers as well as inability to manufacture high-tech products.

An analysis of scientific materials has been conducted, which revealed that the scholars concentrate on the existing methods of monetary and fiscal means to exert influence on the economy in order to reduce prices: R. Kollmann (2008) applies the method of mathematical modeling to various means of state policy (interest rate, tax rate) and its impact on inflation and the population's welfare; Caporale, T. and Caporale, B. (2008) analyze the influence of political regimes (liberal and left-leaning) on inflation and the negative profit received by society from it; in his article Hofstetter (2008) analyzes the influence of different factors (oil price shocks; the growth of food prices; the economy's transparency; currency rates; political regime (and its stability) *etc.*) on the retention of anti-inflation policy results over time; Cevik, Dibooglu, Kutan (2016) state that the financial liberalization is a necessary

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condition of curbing inflation as exemplified by Spain, Greece and Portugal; Cobham's (2008, 2010) article contains analysis on the degree of freedom in central banks' actions and the inflation rate; an unusual approach to price reduction is worthy of note, *i.e*. the recession created by the Federal Reserve to curb inflation. Among the advantages of this approach is that in case of success the post-recession economic recovery will be achieved without implementing additional monetary policies as it was described by Carrillo (2007), Masseron (2010) and others.

There's a need to point out that the issue of monetary policies, economic shocks and their influence on the economy of developed countries (mostly the US and the EU) is thoroughly studied. The issue is less thoroughly studied for developing economies. The review of the research results is included in the treatises by Christiano, Eichenbaum and Evans (2005).

There are several approaches to informative interpretation of monetary policy shocks (Christiano *et al*. 1999, Altig *et al.* 2011). Firstly, a monetary policy shock can be considered an exogenous shock of central bank preferences happened as a result of a casual change of relative importance attributed to inflation and unemployment rate by a central bank and economic agents, for instance, by the transformation of the management's attitude.

Secondly, monetary policy shocks can emerge as a result of a strategic interaction between a central bank and economic agents as described in the following scientific works (Chari *et al.* 1998). A central bank can be trying to escape incurring social costs determined by a divergence from the private sector expectancies (Narin 1997). In particular, the model demonstrates that a realization of a temporary shock of real variables can lead to a rise of the expected inflation rate. The economic agents' expectations may be self-fulfilling and cause exogenous changes in monetary policy.

The third source of exogenous changes in monetary policy is the technical characteristics of central banks' carrying out operations of management of the bank sector liquidity (Bernanke and Mihov 1998). Thus, an interest rate on currency market serving as an operational benchmark of monetary policy can diverge from the target level as a result of central banks' erroneous forecast of liquidity demand from lending institutions (Anzuini *et al.* 2012, Galí 2015). One more technical factor to cause exogenous shocks of monetary policy is in the fact that while making decisions the central banks' board of directors takes into account the preliminary economic data with possible inaccuracies (Bekaert *et al.* 2013, Bruno and Shin 2015, Calza *et al*. 2013).

In the context of economic slowdown, low oil prices and lesser accessibility of international capital markets an efficient monetary policy can absorb the external shocks and protect real and financial sector of the economy from the impact of negative factors (Davig and Doh 2014). At the same time, the price of error increases repeatedly as an inefficient policy may deteriorate the negative effects (Castelnuovo 2013).

The methods proposed in the article can serve an effective instrument of handling monetary policy issues. In the view of this, the emphasis lays on qualitative analysis of monetary policies' impact and external shocks on economic dynamics in a country. Analysis and assessment of strategic risks of the general risk flow is the essential element of activity and a requirement of maintaining companies' competitiveness in science-intensive industries (Chursin and Danyluk 2014).

The issue of uncertainty impact phenomenon is that during the transitional period the mechanisms of monetary control works worse lagging behind instantaneous distortions on the market or mismanaging (Vlasov and Chursin 2015). In the context of unstable crisis situation the national monetary policy undergoes considerable external influence of macroeconomic fluctuations. An additional negative effect creates uncertainty on the international fuel and energy market as well as general changes production process structure (Sadovskaya *et al.* 2012). Therefore, the creation of strict and practical economic-mathematical models with a design to study the availability and efficiency of monetary policy instruments is of utmost importance (Kulikov 2011).

Let us create an economic-mathematical model adjusted for economic and technological shocks and other factors of financial instability in order to analyse the strategic risks of the general risk flow. While designing the model, the complex of all four types of shocks is to be taken into consideration, *i.e*. the shock of demand on science-intensive products, the shock of margins expected by producers, the technological shocks and the monetary policy shocks with a consideration of private banks performance (Chursin and Makarov 2015).

The proposed model is designed to describe the performance of all parties on the market: households, enterprises and the bank sector adjusted for the respective three types of shocks: the shock of individual preferences, the shock of product margin and the monetary policy shock. Alongside with technological shocks, these economic shocks bring about fluctuations of production volume, inflation rate and the interest rate value (Borio and Zhu 2012).

1. Methods

The existing section describes the economic-mathematical model which will allow studying the financial state of elements engaged in science-intensive production:

- the total of private banks and the central bank (Caporale 2008);
- particular consumer of science-intensive products (Chursin and Makarov 2015);
- enterprises engaged in production of science-intensive products (Chursin and Makarov 2015);
- the total of enterprises (*N*) producing intermediate products (I ∈ [1,N] - index of an enterprise) (Gertler and Karadi 2014, Rey 2015).

Let us assume that at every moment of time $t = 0,1,2$ the enterprises produce goods different from other enterprises. We suggest we study each subject of the proposed model separately.

1.1. Bank sector

The enterprises of science-intensive industries require monetary funds (credits) from banks to pursue innovative policy on their plants and factories and to pay wages till the moment when they make profit from selling science-intensive products. Private banks can serve as intermediaries between individuals and enterprises by means of obtaining individuals' savings and lending these funds to enterprises. The enterprises combine capital and labour while producing science-intensive goods, while private banks use deposits to provide loans.

Let us assume that every time period (t) is characterized with two moments of time, therefore we will denote the initial instant as t^- and the end point of the reviewed period as t^+. Supposedly, the end point (t^+) coincides with $(t+1)^-$ time period. The bank receives deposits from households (denoted in the model as d_t) at the moment denoted as t^-, uses them alongside the bank's capital (denoted as A_t) and procures loans instantaneously. The enterprises require bank loans to achieve the necessary amount of current capital at the initial instant t^-. Personnel is hired and paid with loans received at the t^- moment. The enterprises use hired labour and current capital to manufacture science-intensive end-point products which are ready to be produced at t^+ moment. The enterprises redeem the loan and the interest ($R_{bt}b_t$,) to a bank at t^+ moment. The profits made by enterprises and private banks respectively (π^f_t and π^b_t) are distributed as well between individuals in the form of interest on deposits (R_td_t). Individuals distribute these funds between consumption (c_t) and savings in the form of single-phase bank deposit (d_{t+1}). Inside each period, the State collects taxes and uses the acquired sum to cover its expenses which comprise governmental expenditures ($\overline{g}$) and possibly other transfers with a design to recapitalize the bank system.

1.2. The consumers of science-intensive products

Let's assume that the life span of individuals' generation is not limited and they determine the volume of consumption, the supply of labour (time spent on labour activity) and amount of bank deposits $\{c_t, h_t, d_{t+1}\}_{t=1}^{\infty}$ themselves, so that they could maximize the discounted utility function

$$\sum_{t=1}^{\infty} \beta^t U\left(c_t, l_t\right) \tag{1}$$

where: β corresponds with standard discounting multiplier and U is a strictly concave, increasing, differentiable with both variables function, which depends on consumption (c_t) and individuals' leisure time (l_t).

Time within the model is normalized to one in a way that the supply of labour is described by the formula $h_t=1-l_t$. The issue of utility maximization presents a budget constraint,

$$c_t + d_{t+1} + T_t \le \left(1-\tau_t\right)\omega_t h_t + R_t d_t + \left[\pi_t^f + \pi_t^b\right]; \quad t \ge 0 \tag{2}$$

which limits individuals' expenses and does not exceed their revenues at any given moment. Sources of revenues comprise net (aftertax) income from labour, gross income from bank deposits and dividends. Net income from labour depends on pay rates (ω_t), value of labour supply (h_t) and income tax rate (τ_t). Bank deposits (τ_t) is the only form of savings widely available for households and it's compensated with gross interest rate (R_t). Besides, individuals receive profits respectively (π_t^f and π_t^b). Individuals distribute their resources between savings (d_{t+1}), in other words deposits redeemed in the next period; consumption (c_t) and the redemption of lump-sum tax (T_t).

The sequence $\left\{c_t, h_t, d_{t+1}\right\}_{t=1}^{\infty}$ seems optimal from the individual's point of view if it satisfies the limitation of resources in formula (2) and the condition of equation and if the $t \ge 0$ condition is complied:

$$\frac{U_l(t)}{U_c(t)} = \left(1-\tau_t\right)\omega_t \tag{3}$$

$$U_c(t) = \beta U_c(t+1) R_{t+1} \tag{4}$$

where: $U_c(t)$ and $U_l(t)$ is a partial derivative utility function for consumption and leisure time at the moment denoted as *t*.

The equation (3) compares the marginal rate of substitution for consumption at after-tax income tax rate and the equation (4) is a standard condition of dynamic efficiency for savings, which determines an optimal distribution of deposits. Income tax decreases net income received by individuals which in its turn diminish the proportion "consumption – leisure time".

1.3. Science-intensive enterprises

Further on, we will review enterprises which possess fixed assets ($\bar{k}$) combined with labour (h_t), with a goal to manufacture end-user production (y_t) at the same time the current profits from large-scale manufacturing are used and the following equation is fulfilled:

$$y_t = f\left(\bar{k}, h_t\right) \tag{5}$$

Science-intensive enterprises have a necessity in bank loans to pay wages till the moment when they make profit from selling their production. In such a manner, science-intensive enterprises draw bank loans ($b_t = \varpi_t h_t$). Profits made by these enterprises are distributed between individuals. Science-intensive enterprises use h_t to maximize their profits $\pi_t^f = R_{bt}\omega_t h_t$ where ϖt corresponds with pay rate, and Rbt corresponds with interest rate on credit. The optimal value for the profit equation will be achieved if the following equation is fulfilled:

$$R_{bt}\omega_t = f_h\left(\bar{k}, h_t\right) \tag{6}$$

and the function of production inherent of linear likeness allows us to write down the profit functions as follows:

$$\pi_t^f = \bar{k} f_k\left(\bar{k}, h_t\right) \tag{7}$$

which presents the current assets profitability in science-intensive enterprises.

1.4. Commercial banks and bank crisis

Let's assume that commercial banks receive one-period deposits, d_t, from individuals and use them together with bank capital for crediting b_t:

$$b_t = \min\left(\gamma A_t, d_t\right); \quad \gamma \in (0, \infty) \tag{8}$$

where: A_t – bank capital that belongs to a commercial bank and that is fixed $(\bar{A})$ in pre-crisis balance. Bank chooses d_t to maximize its profit $\pi_t^b = \left(R_{bt} - 1\right) b_t - \left(R_t - 1\right) d_t$, where R_{bt} – interest rate on a credit and R_t –deposit rate.

The issue of bank profit maximization leads to the following optimality condition:

$$b_t = d_t = \gamma A_t \tag{9}$$

We consider that a bank crisis is an unpredictable, caused by the external risk factors bank capital reduction. Let's assume that economic decline appears at any time t^c, however at this time bank capital A_t diverges from the bank capital amount within pre-crisis condition $\bar{A}\left(\forall t > t^c\right)$.

It can be seen in the equation (9) that the crisis destroying a part of bank capital appears in consequence of variance of credit offers.

2. Government and Central bank

Within the crisis and the continuing recapitalization, we will consider that the government has a sustainable level of wasteful expenditure, $\bar{g}$, that are financed at the expense of the lump-sum tax.

This assumption solves two tasks:

- correspondence of the normal level of state expenditures to the productivity standard in the emerging countries;
- isolation of financing effect within the programme of bank recapitalization from the normal state expenditures financing.

Considering the situation in the countries faced the crisis, it can be assumed that the government will be involved in the programme of bank sector recapitalization. When the government is involved in the programme of recapitalization due to the crisis, the government is to spend additional money in the x_t amount together with fixed expenses $\bar{g}$ in order to inflow in bank system capital. Additional injections increase bank capital in accordance with the formula $A_{t+1} = A_t + x_t$. This procedure supposes the fact that only the government can recapitalize the bank sector.

The general form of state budget limitation is defined with the help of the following formula:

$$\bar{g} + x_t + R^* b_t^g = \tau_t \omega_t h_t + b_{t+1}^g + T_t \tag{10}$$

where: b_t^g – amount of state international debt at a moment of time *t*; R^* – interest rate of international debt.

3. Results

Model of competitive equilibrium in economics

In the function of competitive equilibrium, we will consider equilibrium distribution of magnitudes $\{c_t, h_t, d_{t+1}, A_{t+1}\}_{t=0}^{\infty}$, price path $\{\omega\}_{t=0}^{\infty}$, sequence of interest rates $\{R_t, R_{bt}\}_{t=0}^{\infty}$, sequence of rates stated by the government $\{x_t, \tau_t, T_t, b_{t=0}^g\}_{t=0}^{\infty}$

where: a) individuals solve the task of efficiency maximizing within the condition of limitation, *i.e.* while implementing (2)-(4); b) enterprises maximize their profit, *i.e.* formula is implemented (6) and the basic capital is fixed; c) banks maximize their profit thus the formula (9) is implemented; d) the condition of state budget restriction; e) market of labour, products, deposits and credits are free.

Optimal state programmes on bank recapitalizing

From the above described equilibrium solution, taking into account that for each programme of recapitalizing or financing or more general for each sequence of state rates, there will be a set of conditions of competitive equilibrium. It is natural to use rates that maximize the functions of individual efficiency within competitive equilibrium conditions (Mumtaz and Zanetti 2013, Kimura and Nakajima 2016).

However, such task differs from the standard one, when the government is to finance the flow of the state un-efficient expenditures. In this case, the government is to multiply resources for the bank system recapitalization as well as contribute to bank capital to provide credits in such a way that government is to finance productive expenditures. Providing the way of optimal recapitalization, state is to make revenues from bank system recapitalization equal to the expenditures on resources increase for its implementation. Considering the value, even without consumption expenditures, state is to take into account additional economic fluctuations appearing as a result of chosen policy implementation. Recapitalization benefit is to provide as many credits at low interest to science intensive companies that influence the economic growth by means of job place increase, science intensive production output as well as its consumption.

Let's formulate the state's task in accordance with three recapitalization finance sources:

- recapitalization is financed by income tax revenues;
- recapitalization is financed by lump-sum tax;
- the government takes loans on international credit market, however, payments on this loan can be done by collecting income tax that distort actions.

3.1. Income tax taxation

Let's consider the case when the government is collecting income tax to finance bank system recapitalization programme.

Let's suppose that $\forall t,\ T_t - \bar{g}$ и $b_t^g = 0$, thus, budget restriction (10) will be the following:

$$x_t = A_{t+1} - A_t = \tau_t \omega_t h_t \tag{11}$$

The principle of system functioning in the conditions of restriction for the government is represented by means of optimality conditions exchange for individuals, enterprises and commercial banks similar to correlation of enterprises and commercial banks profit with individuals' budget restrictions:

$$U_c(t)\left[c_t + \gamma A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right)\right] = U_l(t) h_t \tag{12}$$

Resources restriction is implemented by combining individuals and government budget restrictions:

$$c_t + \bar{g} + (1+\gamma) A_{t+1} = (1+\gamma) A_t + f\left(\bar{k}, h_t\right) \tag{13}$$

The government task on optimization of efficiency function will be the following:

$$\max_{\{c_t,h_t,d_{t+1},A_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U\left(c_t, l_t\right) \tag{14}$$

Let's suppose that $\beta^t \mu_t$ - index of restriction implementation and $\beta^t v_t$ - index of resource restriction. Supposing that $U_{lc}\left(\cdot\right) = U_{cl}\left(\cdot\right)$, optimality conditions are implementation and resources restrictions:

$$\begin{aligned} U_c\left(t\right) &= \mu_t\left[U_c\left(t\right) + U_{cc}\left(t\right)\left\{c_t + \gamma A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right)\right\}\right] + v_t \\ U_l\left(t\right) &= \mu_t\left[U_l\left(t\right) - U_{ll}\left(t\right) + U_c\left(t\right) f_h\left(\bar{k}, h_t\right)\right] + v_t f_h\left(\bar{k}, h_t\right) \\ \mu_t U_c\left(t\right)\gamma + v_t\left(1+\gamma\right) &= \beta v_{t+1}\left(1+\gamma\right) \end{aligned} \tag{15}$$

Correlation (15) is a condition of first order in relation to c_t, h_t, A_{t+1} correspondingly. In this case, while bank system recapitalization, the government uses the fact that income tax depraves the balance inside the "consumption-free time" relation. Expenditures part is disappearing when the government has access to the lump-sum tax taxation even if individuals still need to release a significant part of consumption in favour of immediate costs on bank recapitalization.

3.2. Lump-sum tax

In case when, on the one hand, the government has access to the lump-sum tax to finance recapitalization programme, but, on the other hand, the economy has no access to international credit market, $b_t = \tau_t = 0$, so government budget restriction can be written as follows:

$$\bar{g} + A_{t+1} - A_t = T_t \tag{16}$$

it is also clear that in conditions of recapitalization programme absence $\bar{g} = T_t$. Individuals' budget restriction, in such case, will be the following:

$$c_t + d_{t+1} + T_t \le \omega_t h_t + R_t d_t + \left[\pi_t^f + \pi_t^b\right]; \quad t \ge 0 \tag{17}$$

In standard task, when the government has the access to the lump-sum tax and there are no other fluctuations in economy, the solution includes the argument of objective function of individuals who maximize the function to resources restrictions within the scale of economy. In our case, however, the current capital restrictions operate as other fluctuation in economy that requires carrying out the following restriction within the government planning task:

$$U_c\left(t\right)\left[c_t + \left(1+\gamma\right)A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right) - A_t\right] = U_c\left(t\right)h_t \tag{18}$$

This restriction appears in case of substitution in the individuals' budget restriction in the correlation (18) the function of profit for enterprises and banks as well as conditions of optimality for individuals, banks and the amount of the capital infusion provided by the government. The resources restriction for the economy is almost the same as the previous one and looks as the following:

$$c_t + \bar{g} + \left(1+\gamma\right)A_{t+1} = \left(1+\gamma\right)A_t + f\left(\bar{k}, h_t\right) \tag{19}$$

The task, in this case, is the following:

$$\max_{\{c_t,h_t,A_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U\left(c_t, l_t\right) \tag{20}$$

Let's suppose that $\beta^t \mu_t$ and $\beta^t v_t$ - indexes of constructive restriction and resources restriction correspondingly. Taking into account the assumption that $U_{lc}(\cdot) = U_{cl}(\cdot)$ the optimal solution will be achieved after performing the following conditions:

$$\begin{aligned} U_c(t) &= \mu_t \left[U_c(t) + U_{cc}(t)\left\{c_t + (1+\gamma)A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right)\right\} - A_t\right] + v_t \\ U_l(t) &= \mu_t \left[U_l(t) - U_{ll}(t) + U_c(t) f_h\left(\bar{k}, h_t\right)\right] + v_t f_h\left(\bar{k}, h_t\right) \\ \mu_t U_c(t)(1+\gamma) &+ v_t(1+\gamma) = \beta\mu_{t+1} U_c(1+t) + \beta v_t(1+\gamma) \end{aligned} \tag{21}$$

where: correlations (21) are the conditions of the first order on the relation c_t, h_t, A_{t+1} correspondingly.

Even under condition that taxes are not depraving, recapitalization programme includes resources that are to be allocated in the consumption. The government is to make costs of the current consumption decline equal to the current and future profit of more capitalized bank system that characterizes the optimal way of recapitalization.

Government has access to the international credit

When the government has access to the international credit and lump-sum tax is available only to finance the state fixed costs, $\bar{g}$, resource restriction for the economy will be the following:

$$c_t + \bar{g} + (1+\gamma)A_{t+1} + R^* b_t^g = (1+\gamma)A_t + f\left(\bar{k}, h_t\right) + b_{t+1}^g \tag{22}$$

In this case the implementation restriction will be the following:

$$U_c(t)\left[c_t + \gamma A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right) - A_t\right] = U_l(t) h_t \tag{23}$$

The state task in case of possessing access to the international credit will be the following:

$$\max_{\{c_t,h_t,A_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t U\left(c_t, l_t\right) \tag{24}$$

As before, let's suppose that $\beta^t \mu_t$ - index of restriction implementation and $\beta^t v_t$ - index of resource restriction, then we suppose that $U_{lc}(\cdot) = U_{cl}(\cdot)$ and the optimal solution will be achieved under the following conditions:

$$\begin{aligned} U_c(t) &= \mu_t \left[U_c(t) + U_{cc}(t)\left\{c_t + \gamma A_{t+1} + \bar{g} - f\left(\bar{k}, h_t\right)\right\}\right] + v_t \\ U_l(t) &= \mu_t \left[U_l(t) - U_{ll}(t) + U_c(t) f_h\left(\bar{k}, h_t\right)\right] + v_t f_h\left(\bar{k}, h_t\right) \\ \mu_t U_c(t)\gamma &+ v_t(1+\gamma) = \beta v_{t+1}(1+\gamma) \\ v_t &= \beta v_{t+1} R^* \end{aligned} \tag{25}$$

where: correlations (25) are the conditions of the first order in the relation to c_t, h_t, A_{t+1} correspondingly.

When the government estimates profits and costs of bank system recapitalization programme, it takes into account, that international loan can guarantee the necessary sum for bank recapitalization programme financing, and thus, overcome the necessity to exclude all the required resources from the consumption. The cost of this strategy, however, in the future will correspond to the liquidation of the debt for the bank system recapitalization. It will use depraving income taxes.

4. Discussion of practical value and conclusions

The model of macroeconomic relations and economic subject actions allows predicting various scenarios of negative economic situations development under pressure. Such approach allows considering such significant aspects as external impact from the global market in terms of level, intensity and duration of exogenous effects. The knowledge about the pessimistic trajectory of development process allows intentionally regulate the condition of economic system and sustain the stable state development (Yusufov 2011).

The difficulty of the precise evaluation of the stress, shock circumstances is that such type of situation is more complicated in the precise interpretation, in the adequate identification of the direct shock factor, its features and characteristics as well as the significance of the impact and the following post-shock development of events. Formulated mathematical models are only the basis for the analysis of the processes of economic subjects' interaction, however, they properly describe connections' mechanisms and the influence of the factors against each other.

In the current work we created the model that allows evaluating the strategic risks of the general risk flow on the basis of the economic, technological shocks and financial instability. We took into consideration four types of shocks: shocks of household preferences, shocks of margins expected by producers, shocks of the central bank's monetary policy and technological shocks. In order to evaluate the model characteristics, we used the method of maximum credibility, then we performed the analysis of the degree to which different shocks influence the volume of production, inflation rate and interest rate.

The full-rate understanding of the mechanisms of the actual impact of the monetary policy on the specific economic subjects provides the possibility to make productive strategic decisions that increase self-sufficiency and independence of national economy.

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Analytical Review of the Contemporary State of the Russian Scientific Organizations from the Development Management Positions

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Abstract:

The paper substantiates the need to improve the management tools of scientific organizations on the basis of the methodology of change and development management. The authors showed that the existing methodological framework for assessing the effectiveness of scientific organizations do not fully provide an information base for further organizational development. On the basis of concept's analysis, the definition of the term "development management of scientific organizations" was proposed. It includes the criteria that determine its existence in the investigated structures. Based on the developed methodology an assessment of the current state of scientific organizations in the Russian Federation from the perspective of development management was made. The obtained results and the conclusions drawn on their basis are a significant source for the creation of a general methodological basis for the development management of scientific organizations and its practical implementation.

Keywords: scientific organization; model and type of development; development management; organizational development

JEL Classification: I23

Introduction

In the message of the Russian Federation's President to the Federal Assembly for 2017 a great attention is paid to the development of the country's scientific and technological complex. As indicated in the document it will provide a new level of development of the economy and social sectors. Those countries that can generate a flow-through technologies will have a long-term advantage, an opportunity to receive huge technological rent. Those countries which do not that will be in a dependent, in vulnerable position.

The President of the Russian Federation notes the need for the development of individual collectives, structures, organizations; "in the scientific sphere as elsewhere we will develop competition, will support the strong ones, that able to give a practical result."

At the state level a policy to increase the effectiveness of scientific organizations' activity is actively being developed. Thus in accordance with Governmental Decree No. 312 dated April 8, 2009, an annual monitoring of

the effectiveness of scientific organizations' activity that performing research, design and experimental and technological work for civil purposes is conducted. The purpose of this monitoring is to evaluate scientific organizations' the activity by those federal executive bodies under the supervision of in which they are.

In accordance with evaluation results management decisions aimed at reorganizing or liquidating those structures that shows very low values of studied indicators are made.

In accordance with the basic principles of the restructuring of scientific organizations of the Federal Agency of Scientific Organizations of the Russian Federation, first of all, the possibility of joining to leading scientific organizations those organizations which are eventually classified as 3rd category and have lost their scientific activity as the main activity and development prospects is taking into account. Herewith the adjustment of the main profile (fundamental / applied) and the further redistribution of the amount of funding for research based on the types of research that actually performed is substantiated.

Obviously this approach ensures the optimization of scientific organizations' network and is able to create prerequisites for reducing the negative trends in their activity. At the same time representatives of the scientific community are skeptical about this issue.

Thus Mindeli and Chernykh (2015) pointed out the enlargement of scientific organizations as their main direction of transformations. However, as the scientists write no one has yet proved that the "agglomeration" of research organizations in science in itself automatically improves the effectiveness of scientific researches and eliminates the problems listed above.

Similarly, a high assessment of scientific organization's activity in a particular period does not always characterize the favorable prospects for its development in the future, nor is it an indication that all directions of its functioning correspond to modern requirements.

As Kulagin (2016) points out in his work the success in general does not mean that the scientific organization is doing well. In the strongest institution there can be unproductive scientific collectives and conversely in the weakest institution there can be some very strong divisions. Integral performance indicators do not provide detailed evaluation. In addition, the low productivity of researches can be explained by temporary random factors, the creation of a scientific reserve on the problem that can later become the basis for outstripping development.

In most cases in the process of assessing the current effectiveness of scientific organizations the issues related to the further rapid development of the structures remain beyond the boundaries of these studies. It is the search for optimal development directions of scientific organizations depending on the achieved results and the available potential that can ensure achievement of high indicators of performance monitoring in the long view and create a basis for creation of scientific reserves and specific scientific and technical products for the real sector of the economy and the social sphere.

1. Research background

In accordance with the Federal Law No. 127-FZ dated August 23, 1996 "About Science and State Scientific and Technical Policy" scientific organizations are legal body regardless from organizational and legal and ownership form, the public association of scientists who carry out scientific and / (or) scientific and technical activity.

In accordance with the same document scientific (scientific and research) activity is activity aimed at obtaining and applying new knowledge including fundamental, applied and exploratory research.

Scientific and technical activity is activity aimed at obtaining, applying new knowledge to solve technological, engineering, economical, social, humanitarian and other problems, ensuring the functioning of science, technology and production as a unified system.

Thus the main specific difference between scientific organizations and other economic entities in terms of the content of activities is receiving and application of new knowledge, *i.e*. management questions of scientific organizations' internal processes are closely intertwined with the field of management - "knowledge management". (Maltseva *et al* 2016).

From the standpoint of classification which allow us to identify scientific organizations' essential characteristics they include research and development organizations, higher education institutions, design

departments, industrial organizations that has research and development units. The vast majority of scientific organizations are state-owned.

In the framework of this research we mainly consider research and development organizations since other structures has pronounced additional types of activity that can has a significant impact on their operating.

The paper provides a comprehensive analysis of existing approaches to determining the essential characteristics of change management and development management as well as interrelations between them.

Summarizing the points of view given in the modern literature such as: Oakland and Tanner (2007), Pitt, Murgolo-Poore and Dix (2001), Wyborn (2009), Tam (1999), Yi Zou and Sang-Hoon Lee (2008) we can highlight the following important essential characteristics of the changes:

- they characterized by a certain length of time and can be measured in dynamics;
- there is a transformation of key characteristics of activities and management, corporate culture, *etc*.;
- they can be measured by quantitative characteristics of speed and intensity;
- in most cases there is a target vector that determines the direction of the changes.

At the same time the concept and the process of change are multifaceted and therefore in the literature (New philosophical encyclopedia 2001) reversible and irreversible, directed and non-directed, spontaneous, self-organized and organized changes are highlighted.

Key characteristics of organizational development were singled out based on the systematization of the works of domestic and foreign researchers:

- structural characteristics: a multi-level system including change (development) object, development type, the existing formalization of change, resistance to change (Funtov 2010);
- resource characteristics:
  - the process of building internal and external potential within one organizational form (Nekrasova 2004);
  - development of the organization's competencies (Kay 1993, Kreitner and Kinicki 2001) and resources necessary to implement the strategy and to achieve its long-term goals (Antropov and Chichikin 2008), to improve organizational effectiveness (Ellerby and Taylor 2005);
- substantial characteristics:
  - the emergence of a new quality that strengthens the stability and harmony of the functioning of the social and economic system or that creates fundamentally new conditions for its functioning (Spivak 2016);
  - the variety and constant updating of forms and types of activity in accordance with the shifts in technologies, value system, organization, market situation and it is associated with some changes occurring in the company or its relations with the outside world (Funtov 2010);
  - changing or modifying organizational structures based on decentralization of various operations, searching and introducing innovations, de-bureaucratization and increasing the creative feedback of employees (Galdikas and Voiku 2013);
  - a long-range effort supported by top management to improve an organization's problem-solving and renewal processes, particularly through a more effective and collaborative diagnosis and management of organizational culture - with special emphasis on formal work teams, temporary teams, and intergroup culture, with the assistance of a consultant and the use of the theory and technology of applied behavioral science, including action research (French and Bell 1984).

During the analysis structural, resource and substantial characteristics were identified. The structural characteristics of development demonstrate its key components from the formal-methodological positions*, i.e*. those key elements that should be determined in the process of development strategy.

Resource characteristics can be identified as development indicators, namely the growth of external and internal potential that includes organization's competencies and resources that characterizes significant performance over a certain period and is the basis for further development of the organization.

Sustainable development can be considered as a special type of development that can be identified as the process of maintaining the tendency to building the capacity in the context of changing organizational forms of the enterprise in dynamic business conditions (Nekrasova 2004), the ability to carry out a progressive advance,

purposeful progression towards the goal, achieving maximum effect in all areas of its functioning by transforming the internal environment and establishing a productive and stable interaction with the external environment (Kondaurova 2015). So, sustainable development is characterized by its key trends over a long period of time.

The identification of relationship between development and effectiveness of the organization is significant for the purposes of the study. Thus according to Korotkov (2003) the state of development is characterized by an increase of its effectiveness over time; at stagnation the efficiency of the organization in the course of time does not change; the state of transformation reflects an impulsive change of efficiency, it can decrease slightly then grow again; degradation characterizes a steady decline in the effectiveness of the organization. Obviously the converse statement is also true: to ensure the growth of organization's effectiveness is necessary its purposeful development.

Summarizing results of terminological analysis that are given above it seems reasonable to affirm the existence of a significant relationship between changes and development, namely development is a positive qualitative, purposeful changes and not all changes are development. Thus, for the purpose of achieving a positive effect of changes a clear pre-planned order of actions formed on the basis of the scientific methodology of development management is necessary.

In the most general case change management is a purposeful impact on a system (institution, enterprise, organization, *etc*.) or process (development of normative documents, design of management structure, *etc*.) in order to master new ideas or behaviors (Spivak 2016). Change management is implemented as a set of actions aimed at the adoption, testing, active dissemination and development of new approaches to the conduct of activities by the organization (Gibson *et al.* 2000).

If we consider development as a special positive and well-planned type of changes then development management can be defined as a purposeful impact on the system, a set of activities that ensure the capacity building of the system, the acquisition of new qualities and characterized by increasing its effectiveness. Unlike management of functioning that aims at maintaining the current stability and effectiveness of the system development management refers primarily to issues of strategy and represents the management of the growth of the system potential quality (Tumbinskaya 2012).

Blinov and Rudakova are particularly noted that development management is an iterative process whose tasks include coordinating the changes in the company's activity in all its areas thereby achieving a synergistic effect that determines the trends of long-term sustainable development of the enterprise.

Drozdov (2001) in his study notes that the management of functioning is oriented to the present and development management is aimed for the future. It should provide an adequate understanding of the needs (not only those that have already approved themselves but also those needs that will make actual in the future) and development opportunities, the setting of clear and realistic goals, the choice of rational ways to achieve them, the interest of the work collective in achieving development goals, reliable control over the course of transformative activity and timely decision-making.

Comparing the essential characteristics of change and development management we can point out the following features:

- development management is a special case of change management;
- change management becomes development management only if the changes are clearly planned, systemic and has a positive effect for the organization in all areas of transformation;
- change management can pursue the solution of both tactical tasks related to obtaining benefits from transformations in the current period as well as strategic ones aimed at sustainable growth and profitability of the organization in the long term while development management can pursue the solution of the latter ones;
- if development management eventually does not provide the current and prospective growth of key performance indicators and significant positive qualitative changes it can be consider as change management;
- development management should take into account the mutual influence of the ongoing transformations and promote the emergence of positive synergies from changes in the organization.

On the basis of terminological analysis results for the purposes of the study we introduced the following definitions:

- change management in scientific organizations is a set of actions aimed at the adoption, testing, active dissemination and development of new approaches to conducting activities by the scientific organization;
- development management of scientific organizations is a well-planned complex of management activities, regular targeted influence on the internal processes and organizational elements of the scientific organization that ensures their transformation aimed at increasing current and future performance, performance indicators, increasing the resource potential, it positively affects the quality characteristics of final scientific and technical products and the development of its new promising species.

The basic definitions explaining the essence definitions that are given above and including the characteristics of specifics of scientific organizations are:

- internal processes of scientific organization;
- organizational elements of the scientific organization;
- performance and effectiveness of the scientific organization;
- resource potential of scientific organization.

In accordance with the classical approach the following types of business processes in companies that can be transformed into the activity of scientific organizations can be pointed out:

- *The main processes* (they create added value, a product that valuable for an external client, the income of the organization): processes of obtaining new knowledge (R&D, development and engineering); processes of applying new knowledge (commercialization of results of intellectual activity, educational activity, expert and analytical activity, scientific and technical services).
- *Supporting processes* (they support the organization's infrastructure and promote the effective implementation of the main processes): material and technical supply; ensuring the uninterrupted operation of equipment, including scientific one; security; information support; accounting and legal support of activity, *etc*.
- *Management processes* (ensure the functioning of the organization, management of current activity): strategic management; financial management; marketing management; personnel management.
- *Development processes* (ensure organization's improvement and development).

The main differences between the internal processes of scientific organizations from others for example commercial structures are primarily in the focus of the main processes. The processes of development that among other things are the subjects of this research occupy a special niche in the system of internal organization processes and primarily has a project nature. For ensuring the systematic development of scientific organizations the main processes should become the most important object of management for the purposes of this research, which does not exclude the development of measures to improve the supporting and management processes.

Internal processes are mainly dynamic while the impact on the static characteristics of the system - scientific organization - also in a number of cases provides a significant effect. Such characteristics (organizational elements) include:

- mission and strategy of the scientific organization;
- organizational management structure;
- system of internal and external communications;
- corporate culture, image, *etc*.

Priority and expediency of changes that are given above and other organizational elements of scientific organizations directly follows from the principle of priority the structure over the functions that underlie the process approach in already established organizations (Gridchina *et al.* 2015).

Transformed for the purposes of managing of scientific organizations the pyramid of organizational development can be used for more fully and accurately determination the static characteristics of the system. Their

directed change will serve as the basis for the development of the scientific organization (see Figure 1). (Flamgolts 2012)

At the present stage the issues of performance and effectiveness of scientific organizations are given special attention. As mentioned above regulatory frameworks for assessing the effectiveness of scientific organizations were developed and their evaluation is regularly carried out.

A typical methodology for assessing the performance of scientific organizations executing research and development, development and engineering and technological works of civil purpose, that was approved by Order of the Ministry of Education and Science of the Russian Federation No. 161 dated March 5, 2014, includes the following characteristics:

- effectiveness and relevance of scientific researches;
- development of human resources;
- integration into the world scientific space, dissemination of scientific knowledge and increasing the prestige of science;
- resource support for the activity of a scientific organization.

The evaluation is carried out by a special commission which is created by federal executive bodies (the Ministry of Education and Science of Russian Federation) and includes a scientometrical and expert assessment of scientific organizations' activity's main results, an analysis of the dynamics of activity results of scientific organization's and its comparison with results of other similar scientific organizations in Russia and abroad.

In general performed in the methodology the system of indicators covers the most significant aspects of scientific organizations' activity including certain aspects of their development. At the same time performance is more a characteristic of the covering period while development is stipulate prospects.

The controversy about these issues does not abate that is due to the very specific nature of science's field, in most cases the incompatibility of the results and effects obtained by various scientific organizations and also in some cases promising benefits that cannot be assessed based on the results of the reporting period.

Kulagin (2011) in his work "Evaluation and self-assessment of a scientific organization" raises the question of the need to distinguish the concepts of "performance" and "efficiency" for scientific organizations. The author gives the concrete examples when in view of the need to improve the effectiveness of activity scientific organizations lowered the quality of conducted researches and experiments that ultimately led to their low performance and create a layer of researches called pseudoscience.

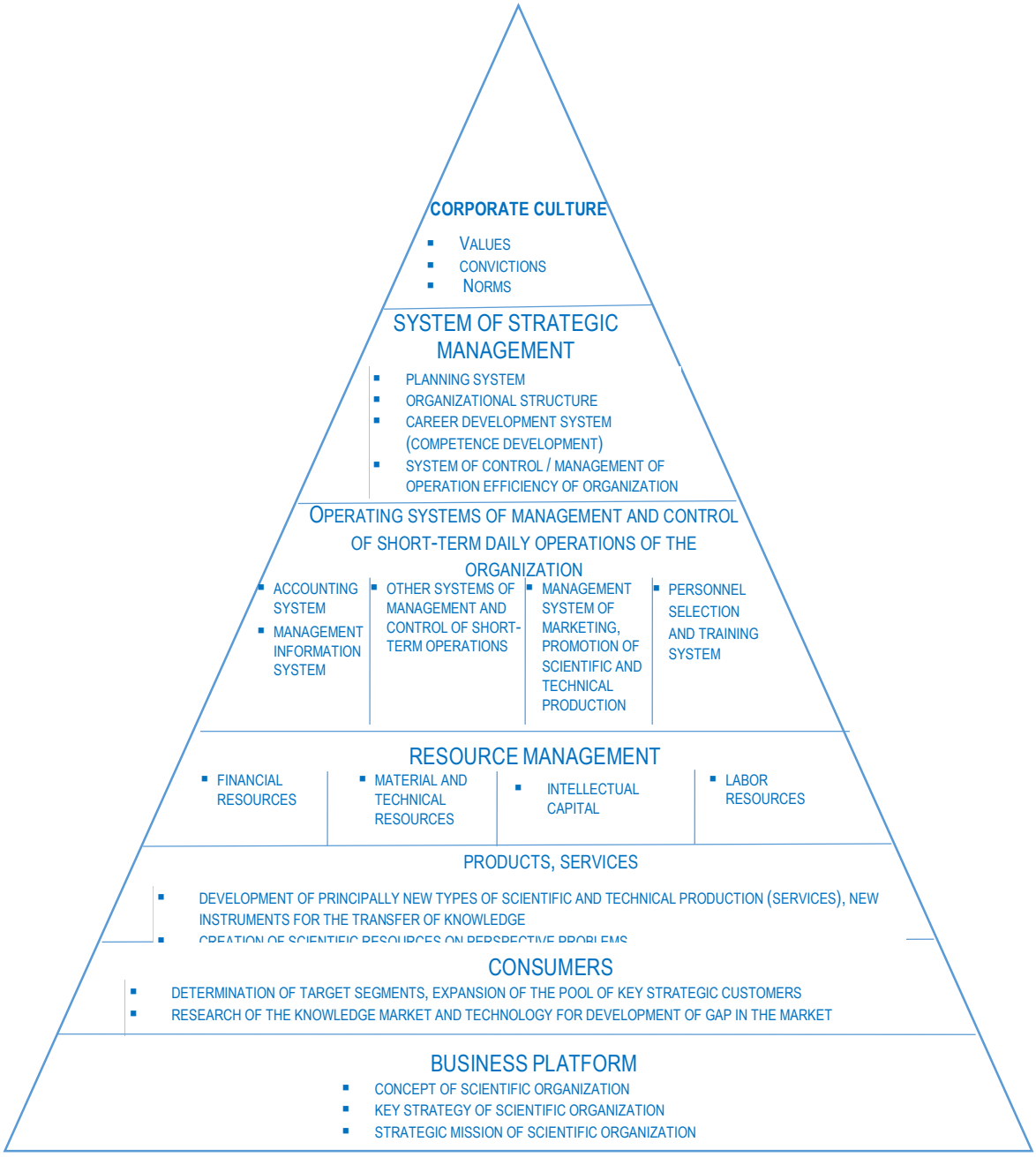
Effectiveness of a scientific organization, according to the scientist, is the opinion of the founder: what is the cost of a full and high-quality performing of assigned tasks by scientific organization. The performance of a scientific organization is the ability to receive results on specific scientific and technical projects or problems.

The author suggests to create a system for assessing and managing scientific organizations based on a mission that can be different in terms of founders, customers (consumers), the organization (team) itself, business partners. At the same time, it should be aimed at satisfying the stakeholders groups that mentioned above as well as the scientific community and ensuring that scientific results that meet the world standards.

When we transform this view on the problem of the interrelation of "performance" and "effectiveness" of a scientific organization the authors collective sharing Kulagin's opinion came to the conclusion that it is necessary to combine them optimally with the prevalence of the first.

This conclusion is obvious for a scientific organization: a qualitatively conducted study the result of which was the implementation with a given commercial efficiency will guarantee with a high probability a further cooperation with the customer and as a result the growth of the profitability and financial stability of the organization.

Figure 1. Pyramid of organizational development of scientific organization



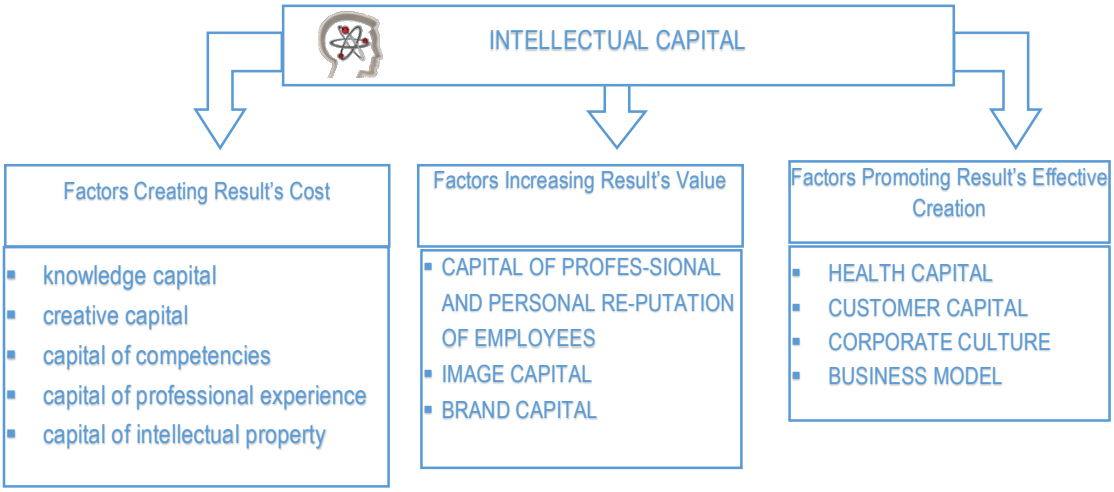
Thus the indicator of scientific organization's development should be performance indicators that are normatively fixed at the federal level and ensure their regular evaluation, as well as the qualitative growth of the content characteristics of scientific research results that can be identified exclusively by an expert method with the involvement of specialists from relevant fields of knowledge.

When one defined the resource potential of a scientific organization first of all, special types of resources are allocated for the creation of scientific and technical products as the key result of their activity: material (unique equipment) and intangible (human capital, possessing knowledge and competencies in the subject area, creative

abilities, created intellectual property using other tangible and intangible resources). An increase of the organization's assets as a whole or some of its types will be indicator of the growth of material resources. The standard methodology is not applicable to assess intangible factors.

In same research papers, the issue of intellectual capital is the basis for creating new knowledge, *i.e.* the key direction of the scientific organization's activity was actively studied. On the basis of systematization of theoretical sources (Bradley 1997, Brooking 1996, Edvinsson and Malone 1997, Harris 2000, Stewart 1994, Sveiby 1997) in relation to the specifics of scientific organizations, the following definition was proposed (Maltseva and Monakhov 2014). The intellectual capital of a scientific organization is a key non-material resource that allows carrying out activity's basic types and increasing consume value and the added value of their results, capable to self-growth under the condition of effective management. Within the framework of the research carried out by the authors the intellectual capital of scientific organizations was structured (Figure 2).

Figure 2. Intellectual capital's types classification by the degree of influence on the result of scientific organizations activity



Because of the immateriality and complexity of assessing intellectual capital as a resource it seems appropriate to concentrate it around the factors that create result's value, the build-up of such factors will indicate the development trends of the organization (Maltseva *et al.* 2015). This is due to the fact that these factors have a direct impact on the generation of new knowledge in the process of creating scientific and technical products. Knowledge capital and capital of competences transforms codified scientific knowledge into a specific scientific and technical product under the influence of creative capital and capital of professional experience. The capital of intellectual property can become both the basis and the result of the creation of new scientific knowledge.

A brief description of these elements is below (Maltseva *et al.* 2016):

- Knowledge capital is the knowledge of workers and the knowledge system of the organization that is the basis for generating new knowledge in the production of scientific and technical products.
- Creative capital is the ability to apply knowledge in practical fields in a non-standard way, including finding "points" for their application to the solution of the task.
- Capital of competences is practical knowledge and skills that are used in professional activity by employees.
- Capital of professional experience is the accumulated knowledge about the solution of tactical and strategic tasks in professional activity.
- Capital of intellectual property is intangible assets, copyright objects, objects of patent law, know how, which belong to a scientific organization. It is a formalized representation of new knowledge created in the process of structure functioning and that has a variable commercial value.

Thus taking into account the necessary clarifications the definition of "management of the development of scientific organizations" in the study is disclosed that is the basis for the creation of research methodology.

2. Experiments

For the purposes of assessing the current state of scientific organizations within the framework of the study key characteristics that make possible to assess their development were identified.

In accordance with the definition which was given in the work the development of scientific organizations is expressed in the growth of current and long-term performance, performance indicators, build-up of the resource potential, qualitative characteristics of the final scientific and technical products and the development of its new promising species.

Due to the peculiarities of scientific organizations and the specifics of their activity the evaluation of its qualitative aspect is a rather laborious process requiring expert knowledge in various fields as well as the availability of information sources about the substantive aspects of obtained scientific results which is difficult in many cases. Within the framework of this study only quantitative characteristics based on the data of the Federal System for Monitoring Scientific Organizations (FSMSO) executing research and development, development and engineering and technological works will be used as the basis.

The basic characteristics of development for the purposes of assessing scientific organizations are:

- growth of current performance;
- performance indicators' growth;
- build-up of the resource potential.

The basis for assessing current performance is the approach considered in the works of Kulagin (2011) who proposes to use the degree of correspondence of the mission of the scientific organization as a basic criterion. According to the author the mission should be based on the following grounds:

- founder's satisfaction;
- obtaining significant scientific results;
- scientific community's satisfaction.

In this paper we investigate the structures subordinate to the state authorities as criteria for the founder's satisfaction one should choose those that are fixed in the fundamental state documents. In accordance with the Decree of the President of the Russian Federation dated May 7, 2012 No. 599 "About measures to implement the state policy in the field of education and science" the following priority tasks were identified:

- increasing internal costs for research and development in the domestic gross product;
- he world scientific journals indexed in the database WEB of Science.

Another "May decree" - the Decree of the President of the Russian Federation No. 597 dated May 7, 2012 "About measures to implement state social policy" establishes a requirement to raise the average salary of scientific employees to 200% of the average salary in the corresponding region.

Thus one should choose as indicators characterizing the development of scientific organizations for the "founder' satisfaction" the following:

- internal costs for research and development;
- number of publications indexed in the database WEB of Science;
- salary' expenditures for workers engaged in research and development.

The criterion "obtaining meaningful scientific results" should be considered primarily as a qualitative assessment of the structure's activity while the revenues obtained on a competitive basis from budgets of all levels and on a competitive basis from extrabudgetary sources as well as the number of used results of intellectual activity can be as indirect indicators. Competitive financing includes a preliminary comprehensive assessment of the organization's capacity to perform research and development as well as subsequent acceptance of the results by the customer who confirms its quality and relevance. The use of the results of intellectual activity in the sectors of

the economy as well as in its own activity also confirms the ability of the scientific organization to create meaningful scientific results.

The third block of indicators for evaluating a scientific organization's performance characterizes "the satisfaction of the scientific community" and includes the following indicators:

- total citation of organization's papers indexed in Russian and international information and analytical systems of scientific citation;
- the cumulative impact factor of the journals in which organization's papers are published;
- the number of visits (attendance) of official sites and/or pages of the organization in the Internet.

Indicators of the organization's effectiveness traditionally are recognized profitability indicators representing the relationship of the effect to the costs or resources used to obtain this effect.

As the effect (profit) received by a scientific organization during the reporting period the difference between financial performance and the amount of internal and external costs for research and development can be considered.

It is proposed to evaluate the following indicators for the purposes of the study:

- profit margin (ratio of effect to financial performance);
- profitability of internal costs for research and development;
- profitability of fixed capital (ratio of the effect to the value of fixed assets and intangible assets);
- profitability of personnel performing research and development.

As indicators of the resource potential which the analysis is useful in assessing the development of scientific organizations it is advisable to select indicators that characterizes the organization's personnel and the material and technical base.

General indicators of number of personnel cannot give a complete and accurate assessment of its resource potential while the specific indicators of its quality composition are:

- % of candidates and doctors of sciences in the total number of employees performing research and development;
- % of postgraduate students and candidates for a doctor's degree in the total number of employees performing research and development.

The material and technical basis for research is characterized by the cost of machinery and equipment that includes measuring and regulating instruments and devices, laboratory equipment, including equipment in the centers of collective use of scientific equipment. The system of indicators for assessing the development of scientific organizations is shown in Table 1. It is proposed to use growth indicators that are analyzed in dynamics as the basic characteristics for the assessment. Obviously due to the peculiarities of the functioning of scientific organizations and the instability of the external environment there may be deviations from the basic development trend that can be interpreted as conditional development, and it is advisable to take into account the activity's profile, *i.e*. knowledge generators, technology developers and scientific and technical services (in accordance with Resolution of the Government of the Russian Federation No.312).

Table 1. System of indicators for assessing the development of scientific organizations

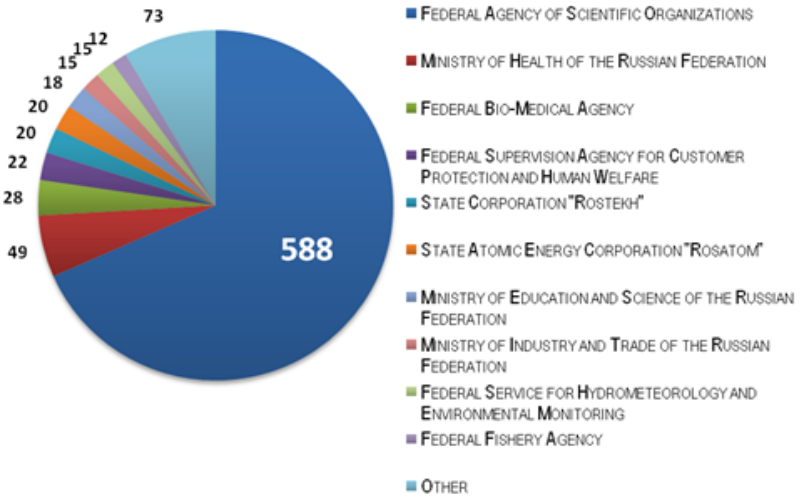
Development criterion	Indicator	Method of calculation
1. Perfomance		
▪ Founder' satisfaction	▪ Internal costs for research and development	
	▪ Number of publications indexed in the database WEB of Science	
	▪ Salary' expenditures for workers engaged in research and development.	
▪ Obtaining meaningful scientific results	▪ Volume of incomes received on a competitive basis from budgets of all levels	

Development criterion	Indicator	Method of calculation
	▪ Volume of incomes received on a competitive basis from extrabudgetary sources	
	▪ Number of used results of intellectual activity	▪ The facts of using the results confirmed by the acts of use (implementation), contracts and agreements for granting licenses as well as the alienation of the right to use the results are take into account
▪ Satisfaction of the scientific community	▪ Total citation of organization's papers indexed in Russian and international information and analytical systems of scientific citation	
	▪ Cumulative impact factor of the journals in which organization's papers are published	
	▪ The number of visits (attendance) of official sites and/or pages of the organization in the Internet.	▪ The calculation is based on the data of independent attendance counters
2. Activity efficiency	▪ Profit margin	▪ (Fp -(Ic + Ec))/ Fp; Fp - financial performance; Ic - internal costs for research and development; Ec - external costs for research and development;
	▪ Profitability of internal costs for research and development	▪ (Fp -(Ic + Ec))/ Ic
	▪ Profitability of fixed capital	▪ (Fp -(Ic + Ec))/ Fa; Fa - cost of fixed and intangible assets
	▪ Profitability of personnel performing research and development	▪ (Fp -(Ic + Ec))/ Ne unde Ne - number of employees performing research and development.
3. Resource potential		
▪ Personnel	▪ % of candidates and doctors of sciences in the total number of employees performing research and development	
	▪ % of postgraduate students and candidates for a doctor's degree in the total number of employees performing research and development	
▪ Material and technical base	▪ Cost of machinery and equipment	

For the purpose of approbation and refinement of the methodology as well as the identification the current trends in the development of scientific organizations of the Russian Federation 860 structures performing research were selected including 854 scientific research institutes and 6 research centers subordinating to federal executive bodies and providing information in FSMSO.

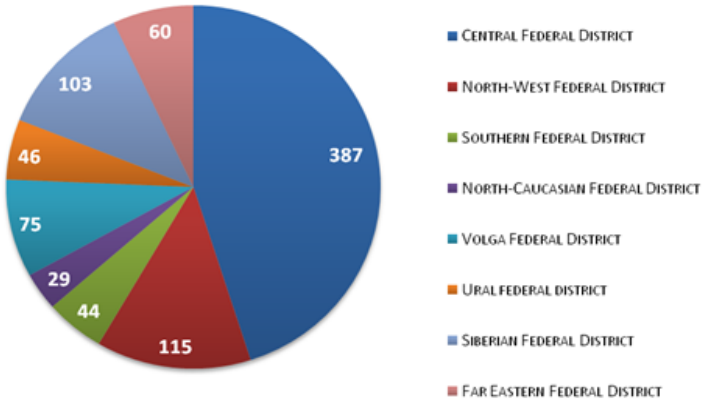
The distribution of scientific organizations by federal executive bodies that oversee these structures shows in Figure 3. 68.4% of scientific organizations are subordinate to the Federal Agency of Scientific Organizations, 5.7% to the Ministry of Health of the Russian Federation, 3.3% to the Federal Bio-Medical Agency, 2.3% of organizations accrue to State Corporation "Rostekh" and "Rosatom" correspondingly, 2,1% - to the Ministry of Education and Science of the Russian Federation.

Figure 3. Distribution of scientific organizations by federal executive bodies



The selected scientific organizations represents 78 subjects of the Russian Federation. About 44% of organizations are located in the Central Federal District while Moscow accounts for 32.3% of all organizations under review, 13.4% and 12% of organizations in the North-West and Siberian Federal Districts respectively (Figure 4).

Figure 4. Distribution of scientific organizations by federal districts



The absolute majority (about 95%) of scientific organizations are state property. In addition, a significant number of them - 89.3% - are non-profit. These are state institutions including federal, budgetary, autonomous ones. If we talk about commercial organizations more than 53% of them are state unitary enterprises, the rest are different types of joint-stock companies and also limited liability companies.

Directions of research and development of scientific organizations cover all fields of science: natural, technical, medical, agricultural, humanitarian, social. It has been revealed that the scientific organizations under consideration carry out researches on 227 scientific directions corresponding to the international classifier OECD. The main of them are biology (120 organizations), microbiology (76 organizations), ecology and agronomy (72 organizations).

During the evaluation according to the developed methodology 25 organizations were excluded from the analysis due to the lack or insufficiency of the information provided in the FSMSO.

According to the methodology 835 organizations are divided into four groups according to the level of success of their development:

- *Group* I - "Rapidly developing" - scientific organizations demonstrating the dynamics of growth of the most significant indicators;

- *Group* II - "Developing" - scientific organizations characterized by positive dynamics of growth of certain significant indicators;
- *Group* III - "Unevenly developing (stagnant)" - structures that demonstrate uneven dynamics of key indicators or their stagnation;
- Group IV - "With negative dynamics of development" - scientific organizations characterized by negative dynamics of the most significant indicators.

The assignment of a scientific organization to a certain group is made on the basis of the following development criteria described above: founder' satisfaction, obtaining significant scientific results, satisfaction of the scientific community, activity efficiency, resource potential.

Each of the criteria is assigned the value "0" or "1" as a result of the evaluation for the time period under consideration. "1" point is assigned to the organization if the growth rates of the indicators attributed to this criterion were non-negative[3]. In other cases the criterion is "0".

The scientific organization is to be assigned to the group I in the considered period of time in case if such performance criteria as "Founder' satisfaction" and "Obtaining significant scientific results" as well as one of three other criteria - "Satisfaction of the scientific community", "Activity efficiency" or "Resource Potential" – has been evaluating as "1".

The scientific organization belongs to group II if under the same conditions as for group I only one of performance criteria - "Founder' satisfaction" or "Obtaining significant scientific results" - has been evaluating as "1". The scientific organization is to be assigned to the group IV if the values of both performance criteria - "Founder' satisfaction" and "Obtaining significant scientific results" - are equal to "0".

In other cases the organization should be assigned to group III.

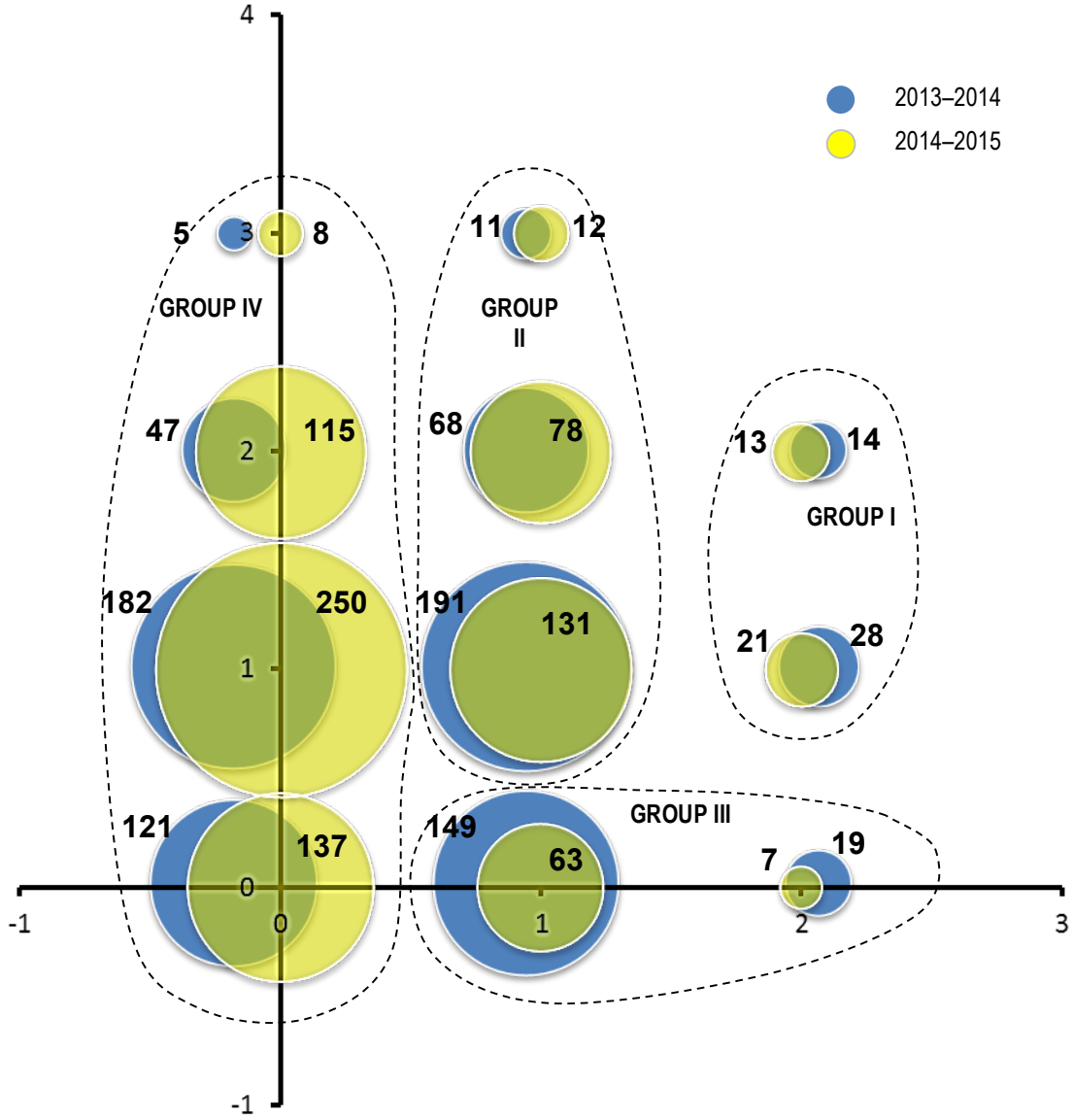
The final group of scientific organization is determined in dynamics for two periods - 2013-2014 and 2014-2015. Notably if the group assigned to the organization in 2014-2015 is higher than in the previous period than the value of the final group will be the result of an increase of group in 2013-2014 per unit. In other cases the final group is defined as the maximum value of the group number for the considered periods.

The analysis made it possible to identify the following structural grouping of scientific organizations according to the level of their development (Figure 5).

In Figure 5 on the horizontal axis the total scores (from 0 to 2) are marked by the two first performance criteria, on the vertical axis are marked the total points (from 0 to 3) for the three remaining criteria. The area of the circle corresponds to the number of scientific organizations that has the same coordinates. In accordance with the methodology scientific organizations with coordinates (0,0), (0,1), (0,2), (0,3), are arranged in group IV - "With negative dynamics of development"; scientific organizations with coordinates (1,0), (2,0) are arranged in group III - "Unevenly developing (stagnant)"; scientific organizations with coordinates (1,1), (1,2), (1,3) are arranged in group II - "Developing"; scientific organizations with coordinates (2,1) and (2,2) are arranged in group I - "Rapidly developing".

[3] The criterion of non-negativity was introduced in the framework of the approbation of the methodology since no investigated scientific organization were demonstrated positive increases in key indicators throughout the entire study period.

Figure 5. Distribution of scientific organizations by level of development



11 organizations were included in the group I based on the results of the performance and effectiveness assessment of scientific organizations activity. Only one scientific organization - the Institute of History, Archeology and Ethnography of the Peoples of the Far East of the Far Eastern Branch of the Russian Academy of Sciences - is demonstrated dynamic stability of growth during the entire studied period.

It should also be noted that 31 organizations from group I in 2013-2014 moved to group IV in 2014-2015 because they significantly worsened their indicators. 19 scientific organizations, on the contrary, moved from group IV to group I.

In the group II - "Developing" – there are 109 scientific organizations, 97 of them are budgetary institutions. 53 organizations show a stable result in the studied periods; 49 organizations are improved their positions moving from group III to group II, and 6 organizations are worsened the result by moving from group I (2013-2014) to group II.

205 scientific organizations (171 of which are budget institutions) were included in group III. 65.4% of the organizations on the list are subordinate to the Federal Agency of Scientific Organizations. Only 12 organizations demonstrate stable positions, the rest ones have variable dynamics of indicators.

Group IV is the largest group; it consists of 510 organizations. In the period 2013-2014, this group included 355 organizations, *i.e.* on average the sample shows a negative trend of negative increases in key indicators in more than a half of the studied scientific organizations.

Table 2 shows the level of compliance of scientific organizations with individual criteria for the resulting groups indicating the number of organizations.

Table 2. Level of compliance with individual criteria by group

2013–2014 / 2014–2015		Founder' satisfaction	Obtaining significant scientific results	Satisfaction of the scientific community	Activity efficiency	Resource potential
Group I	"Rapidly developing"	10	2	5	5	5
		11	11	8	3	3
Group II	"Developing"	96	24	20	35	25
		84	29	75	47	31
Group III	"Unevenly developing (stagnant)"	23	11	43	103	28
		161	70	101	66	36
Group IV	"With negative dynamics of development"	290	85	97	223	118
		0	0	263	187	54

It should be noted that the group "Rapidly Developing" has grown from 2 to 11 organizations due to a significant increase in such criterion as "Obtaining significant scientific results." In addition, the number of organizations with positive growth rates of the criterion "Satisfaction of the scientific community" has increased.

In the group "Developing" there is a slight decrease in the number of organizations that meet the first criterion against a backdrop of growth in all other criteria. A significant increase in the number of organizations (in 3.75 times) is observed in the criterion "Satisfaction of the scientific community". In general, the growth in the number of organizations meeting this criterion is traced in all four groups that is primarily due to the increase in cumulative impact factor of publications.

In the group "Unevenly developing (stagnating)" there is a significant growth in the number of scientific organizations that meet the performance criteria: "Founder' satisfaction" in 7 times, "Obtaining significant scientific results" in 6.4 times, "Satisfaction of the scientific community" in 2.3 times. However, in the view of the fact that the most of these structures has an increase in only one indicator the most of them included in group III. Performance indicators are decreased in 36% of organizations in this group.

290 organizations in group IV in 2014-2015 has a negative dynamics of development of the criterion "Founder' satisfaction", 85 organizations have a negative dynamics of the criterion "Obtaining significant scientific results." Performance indicators were decreased in 36 organizations, indicators of resource potential in 64 organizations.

In general, there is an uneven distribution of scientific organizations in groups with sufficiently soft criteria that were further corrected in the research process to achieve optimal grouping results.

Conclusion

Scientific organizations as objects of research are not sufficiently represented in modern publications while the external environment dictates new requirements for their advanced development. Science and technology are becoming the main factors of economic growth and competitiveness of national economies.

Change management and development management of scientific organizations is able to ensure an increase in their current and prospective performance, to create prerequisites for a qualitative positive dynamics of manufactured scientific and technical products.

Analysis of the essential characteristics of the terms "development" and "changes" ensured the identification of key characteristics and the formulation of criteria in relation to the specifics of scientific organizations.

The basic criteria of scientific organizations' development and their corresponding indicators are pointed out in the paper. Criteria consist of: performance including founder' satisfaction, obtaining significant scientific results, satisfaction of the scientific community; activity efficiency characterized by indicators of profitability; resource potential that is consist of scientific organization's personnel and the material and technical base.

The methodology that was created on the basis of indicators characterizing the criteria is based on the analysis of their growth in dynamics. During the processing of empirical data, the methodology was subjected to modification and adjustment of the criteria in order to obtain an adequate result. It is noted however that for the completeness and accuracy of the studies, the analysis of data with a large time horizon is required that are currently not available since the collection and systematization of materials in FSMSO were carried out in full only from 2013.

As a result of the analysis a negative trend in the development of studied scientific organizations was revealed: more than half of the sample were classified as the group with negative development dynamics. At the same time only 11 organizations are belonging to the rapidly developing structures, and 109 organizations are belong to the developing ones.

Such tendency can be explained by the ongoing processes of reforming the system of scientific organizations in the Russian Federation as well as the impact of the financial and economic crisis. In the result of crisis direct and competitive budgetary funding for scientific organizations which is in most cases is the main source of their income was reduced.

In this case, the peculiarities of the functioning of scientific organizations is the need to create a scientific reserve for performing various kinds of work and a short period of influence of the obtained results on the dynamics of indicators in the changing conditions of technology development.

In general, obtained results are the basis for further research of the key growth factors of scientific organizations as well as the development of necessary management decisions aimed at identifying the reserves for their development.

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