JOURNAL of Applied Economic Sciences

JAES
Journal of Applied Economic Sciences

Volume VIII
Issue 2(24)

Summer 2013

I.S.S.N. 1843-6110

Publisher:

Spiru Haret University
Faculty of Financial Management Accounting Craiova
No 4. Brazda lui Novac Street, Craiova, Dolj, Romania
Phone: +40 251 598265 Fax : + 40 251 598265

European Research Center of Managerial Studies in Business Administration
http://www.cesmaa.eu
Email: jaes_journal@yahoo.com *Web:* http://cesmaa.eu/journals/jaes/index.php

*J*ournal of *A*pplied *E*conomic *S*ciences

Journal of Applied Economic Sciences is a young economics and interdisciplinary research journal, aimed to publish articles and papers that should contribute to the development of both the theory and practice in the field of Economic Sciences.

The journal seeks to promote the best papers and researches in management, finance, accounting, marketing, informatics, decision/making theory, mathematical modelling, expert systems, decision system support, and knowledge representation. This topic may include the fields indicated above but are not limited to these.

Journal of Applied Economic Sciences be appeals for experienced and junior researchers, who are interested in one or more of the diverse areas covered by the journal. It is currently published quarterly with three general issues in Winter, Spring, Summer and a special one, in Fall.

The special issue contains papers selected from the International Conference organized by the European Research Centre of Managerial Studies in Business Administration (www.cesmaa.eu) and Faculty of Financial Management Accounting Craiova in each October of every academic year. There will prevail the papers containing case studies as well as those papers which bring something new in the field. The selection will be made achieved by:

Journal of Applied Economic Sciences is indexed in SCOPUS www.scopus.com, CEEOL www.ceeol.org, EBSCO www.ebsco.com, RePEc www.repec.org and in IndexCopernicus www.indexcopernicus.com databases.

The journal will be available on-line and will be also being distributed to several universities, research institutes and libraries in Romania and abroad. To subscribe to this journal and receive the on-line/printed version, please send a request directly to jaes_journal@yahoo.com.


JOURNAL
of Applied Economic Sciences

Journal of Applied Economic Sciences

ISSN 1843-6110

Table of Contents

THE ACCOUNTING – TAXATION RELATIONSHIP IN THE OPINION OF THE FINANCIAL – ACCOUNTING SERVICES PROVIDERS

Carmen ANTON
Transilvania University of Brasov, **Romania**
carmen.anton@unitbv.ro
Cristinel CONSTANTIN
Transilvania University of Brasov, **Romania**
cristinel.constantin@unitbv.ro

Abstract:
The financial – accounting information, which is the result of the companies that provide accounting services, is meant for a wide range of consumers having various requirements. As result of the economic development the accounting information consumers have a very heterogeneous profile. Consequently a provider of financial – accounting information has to take into consideration the consumers' need of information and to build a strong relationship with these ones. This paper aims at investigating through specific methods of marketing research how the accounting – taxation relationship influences the collaboration between the accounting services providers and their beneficiaries and which is the behavior of the financial – accounting information consumer. The goals of this research aim at knowing the opinions of the accounting professionals regarding the relationship between accounting and taxation, and the importance of these ones for the business activity.

Keywords: financial – accounting information, accounting information provider, accounting – taxation relationship, qualitative research.

JEL Classification: C81, M10, M40

1. Introduction

In the context of highlighting the importance of the financial – accounting services, the development of these services' providers is featured by flexibility which enables them to quickly and efficiently react to the permanent changes in the accounting field, especially taxation. Therefore, the financial – accounting providers must direct their activities to the satisfaction of the customers' interests. These activities must contribute to the improvement of the intelligibility in communicating the information, supporting the client in profit-increasing approaches and to provide him/her a „minimum of comfort" to make out in the "legal wildness". The financial – accounting information consumer is a variable of the services execution process. The nature and the features of the services, the services execution system as a whole lead to a certain customer behavior. The basis of this behavior is the perception of the service, reflected in a gap between the desired expected service and the received, resulted, accepted service, on the one hand and the promised, offered service and the effective, created, delivered service on the other hand (Olteanu 2005).

Consequently, only carrying out the business in a marketing approach may lead to the satisfaction of the consumer's requirements and exigencies, by reduction the gap between what is offered and what is desired.

Nowadays, the services sector is featured by a diversification and an increased complexity, taking into account that the consumer became more and more demanding. It is found that also in the field of the financial – accounting services the consumers act in a professional manner, requesting financial statements that will support the economic decision (Baba 2011). The consumer considers more and more rigorously the features of the financial – accounting services and acts accordingly, while the provider company is concerned with an offer complying with such needs. The consumer of financial – accounting services is interested in a special relationship with the provider, which could lead to its satisfaction. Thus, the purchase is preceded by a series of actions meant to choose a certain service according to customer's needs and requirements (Cetina *et al.* 2006).

The consumer's behavior, in a specific approach, may be defined as a multidimensional concept which results from a system of dynamic relations between various perceptions, attitudes and motivations (Teodorescu 2003).

2. Literature review

In providing financial - accounting services the cooperation between a supplier and a customer will reduce the business risks and the value of the relationship can be increased (Kolarova, Otrusinova 2012). In these relationships the financial-accounting service providers could help their clients to overcome the daily business difficulties. Among difficulties faced by small enterprisers in their business could be mentioned: precarious knowledge about applicable laws, commercial law, but also marketing tools that could be used in order to create a good business image, difficulties caused by banks and potential partners' lack of trust in small companies (Chitu, Tecau, 2012).

In the same time, the accountancy must be in line with the development of the applicable accounting and fiscal law, of the business environment and of the new management methods and techniques. Accounting and taxation are featured by an accentuated practical influence, the accounting – taxation relationship being focused on various practical aspects governing the economic activity (Cuzdriorean, Dumitru 2012). For example, the research in the taxation field monitors the impact of taxation on the consumer of financial – accounting information: the investors, the financial markets, the accounting services providers. On another hand the fiscal policy is a component of the financial policy of a state, together with the budget policy and its essence is the power of charging taxes and duties. Thus, the interdependence between taxation and accounting field starts from the functionality of the taxation system stated in any fundamental law of a state. In Romania the regulation is found in the provisions of Chapter 3 "Fundamental duties", art. 56 of the Constitution (1991-revised in 2003), which, referring to the financial contributions, stipulates: ... (2) the legal taxation system must ensure a fair distribution of the tax burden".

The fiscal mechanism communicates and collects information from the economy where the accounting and taxation have the scope: the organizing and managing a company's business (Ristea 1998). The taxation is interdisciplinary, being an area of activity both for the accounting professionals, the economists, in general, and the professionals in the financial field. The accounting taxation relationship is a quite often researched matter that still generates various interpretations, opinions and assertions.

The influence of taxation on the companies' economic decisions is highly studied by the specialists in the field, and the focus of the accounting professionals in the correct sizing of the taxes and duties completes the information on the accounting – taxation relationship.

The interest in this relationship is highlighted in multiple theoretical or empirical studies found in the specialty literature. In this respect we can mention the studies conducted by: Hoogendoorn, 1996; Lamb *et al*., 1998; Shackelford and Shevlin, 2001; Aisbitt, 2002; Maydew, 2004; Nobes *et al*., 2004; Nobes, 2006; Graham *et al*., 2011.

3. Research objectives and methodology

Starting from the current issues regarding the accounting-taxation relationship we have conducted a qualitative research among some managers of companies that provide financial – accounting services. The main goal of this research was to identify the managers' opinions and the expectations regarding the proper solutions for their own clients taking into account the optimization of the taxation pressure on the company. In this context, the main research objectives are:

- To find the managers' opinions regarding the importance of financial-accounting services.
- To identify the limitations in the relationship between the financial services providers and the beneficiary of financial accounting information.

- To identify the requirements and the expectations of the managers regarding the optimization of the taxation pressure on the company considering the current competition environment.
- To collect opinions about the implications of the fiscal regulations on the process of providing financial – accounting services.
- Setting the influence of taxation on the corporate behavior.

To reach these objectives we carried out a qualitative research as individual semi-structured in-depth interview (Lefter 2004). We interviewed 10 managers of accounting audit companies. They were chosen from the list of the accounting audit companies registered in the Chart of Romanian Charted Accountants and Certified Accountants – Brasov Branch. The sample is made up of 6 companies pertaining to the class of micro-enterprises and 4 companies from the class of small enterprises.

The number and the structure of the accounting audit companies of Brasov city, of which we made up the aforementioned sample is presented in table 1.

Table 1. The number of accounting audit companies of Brasov city, per classes of size

Number of employees	Type of company	Number of companies
Companies with up to 10 employees	Micro enterprise	200
Companies having between 10 - 49 employees	Small enterprise	4
Companies having between 50 - 249 employees	Middle enterprise	0
TOTAL		**204**

Data source: www.ceccarbv.ro

In order to put in practice the semi-structured interviews, the sample members have been selected using a selection questionnaire. This one was designed to select companies with various characteristics, respectively managers of the companies that provide financial-accounting services in the category of the micro-enterprises and of the small enterprises.

The interviews have been conducted based on an interview guide, which contain a list of the themes and sub themes that must be approached within the semi-directive in depth interview. The main discussion themes are:

- opinions regarding the financial-accounting services market;
- restrictive factors in the contractual relationships with the beneficiaries of financial – accounting services;
- opinions of the managers concerning the expected relationships in the process of providing financial – accounting services.

4. Research outcomes

The semi-directive in depth interviews were recorded on audio tape and the analysis of the gathered information was based on the content analysis – specific method of qualitative data analysis (Constantin, Tecau 2013). The results of this analysis are concluded on two major directions:

- *The horizontal analysis*, which reflects the manner in which each theme and sub-theme is approached by all the respondents. This analysis is significant as it represents the base of the qualitative study.
- *The vertical analysis*, by approaching within the same interview the manner in which each respondent approached the themes and the sub-themes of the in depth interview.

The primary information recorded in the synthesis table led to the following findings:

A. The horizontal analysis

The attention given by the managers of the financial–accounting service providers to the topics discussed in the interview can be highlighted on the grounds of a quantitative determination, which takes into consideration the number of intervention for every theme of discussion. The figure below presents the ratio of each theme in the total interventions of the managers.

Ratio in the total interventions (%)

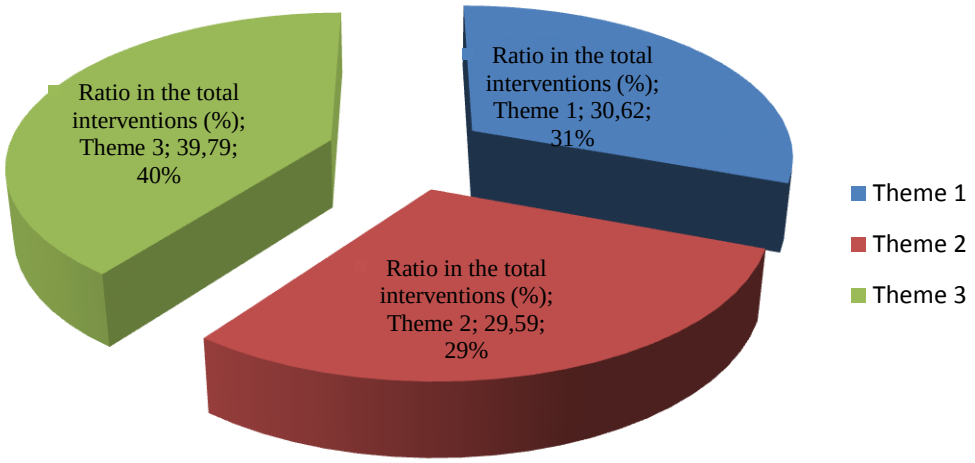


Figure 1. The structure of managers' interventions on every discussion theme

The structure presented in Figure 1 reveals a higher attention given by the interviewees to the Theme 3, which is related to the expected relationships in the process of providing financial – accounting services. This result stresses the importance of these relationships for the managers of financial service companies. The percentages of the other two themes are quite close to each other.

A synthesis of the research results on every discussion theme is presented below:

1. Related to the *market of the financial – accounting services*, there is a total dissatisfaction of the managers whose opinions are that:

- The market of the financial – accounting services of Brasov is unstructured, saturated and unpredictable;
- The potential beneficiaries of the services offered by the financial–accounting services providers are mostly represented by micro, small and middle enterprises;
- The market is featured by unfair competition developed by the "covered" companies owned by public clerks, which practice dumping prices and "tacitly" provide protection against the tax controls;
- The demand is also influenced by the high rate of taxation that determined a doubtful behaviour of the service beneficiaries as the financial–accounting information has to provide an image of the reality of their business.

2. The theme related to the *restrictive factors in the contractual relationships* reflects the managers' dissatisfaction concerning the attitude of the services' beneficiary that are not interested in this activity because:

- The financial – accounting services are useful only for the taxation authority and they do not represent an instrument in business analysis and coordination;
- The financial – accounting services generate costs and they are a "burden" for the company;
- The financial – accounting services are associated to taxation and therefore they are materialized into "bad news" on the taxes and duties payable to the state.

- The financial – accounting services are nowadays 90% taxation; they are limited and suffocated by these one and most of the accounting information is directed first of all to the state institutions and then to the satisfaction of the client' needs;

There are more and more complex accounting and fiscal regulations for the micro, small and middle enterprises, which lead to the development of a complicated, stressful and time consuming bureaucratic system.

The most of managers underline that there is an image offered by the accounting information for the tax office and for the other beneficiaries, as result of processing the accounting documents and another image shown by "the personal records of the company rigorously maintained and exclusively used by this one".

3. The opinions of the managers *concerning the expected relationships* in the process of providing financial – accounting services reflect the following aspects:

- The accounting professional must transfer the clients confidence in the well-organized service, provide counseling, provide solutions to its problems, be a business diagnostician, an architect of low sizing the taxes and duties and not just a data processor ;
- The provider and the beneficiary must have a long term relationship, based on mutual respect, understanding, empathy, permanent communication, patience, correctness and seriousness;

In the parties' relationship there must be initiative of offering the best solutions for the client, business management at the lowest price.

The provider-beneficiary relationship is influenced by several legal restrictions generating undesired evolution in providing financial–accounting services. The opinions of the managers reveal a very excessive regulation of the accounting profession, a strong focus of the accounting services on the taxation and a strong involvement of politics in the activity of professional organizations.

The accounting profession is an activity full of responsibility and requires the undertaking of risks that may arise out of the law interpretation; the wrongful sizing of taxes and duties may have serious effects on the client and may entail the responsibility of the professional.

In conclusion, the carried out research reveals the influence of taxation on the accounting, the state being the main user of the accounting information.

B. The vertical analysis

The vertical analysis of the semi-directive in depth interviews reflects the opinions of every manager on the collaboration between the provider and the beneficiary of financial-accounting services, considering the taxation implications on the corporate behavior.

On the grounds of the synthesis table we made some determinations regarding the interviewees' interventions on every discussion theme. These determinations reveal the importance given by managers to every theme.

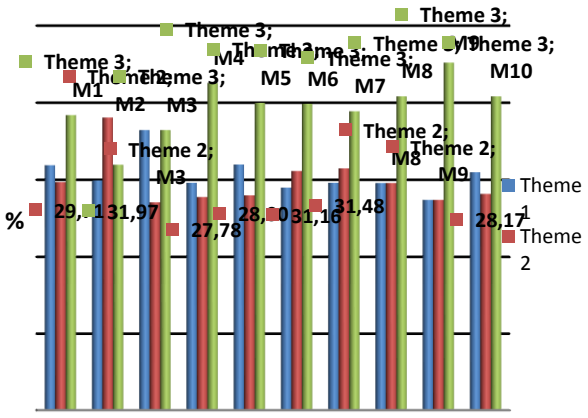


Figure 2. The % of managers' interventions on every theme

On the grounds of the graphic above, we can notice that almost all managers paid a higher attention to the theme 3, regarding the relationships between the financial service providers and their clients.

The analysis of each interview regarding the information given for all the discussed themes outlines the following:

- *Subject 1* particularly emphasized the restrictive factors, such as the fiscal regulations, which influence the contractual relationships with the beneficiaries of financial–accounting services; this one especially analyzed the relationship between ethics and the quality of these services as a sine-qua-non condition of the provider – client relationship.
- *Subject 2* emphasized few improvement ideas for the financial – accounting services mainly with respect to the harmonization of the accounting – taxation relationship.
- The intervention of *subject 3* expresses the idea that the information produced under the taxation pressure determines a distorted image of the company's business, this one being interested in the lowest possible sizing of the taxes and duties.
- *Subject 4* stressed the importance of a mutually beneficial relationship, considering the best taxation for the financial services' beneficiary.
- *Subject 5* mostly approaches the issue of producing quality accounting information, without constraints in determining tax charges.
- *Subjects 6 and 7* outline the idea of a high level of mutual respect and the appreciation of the responsible work of the accounting professional within the contract relationships with the clients.
- *Subject 8* is in a way sympathetic with the public clerks who, in their turn, are suffocated by the excessive tax legal changes.
- *Subject 9* is interested in a long term contract relationship, based on a mutual understanding and close collaboration.
- *Subject 10* is rather pragmatic, concisely, attaining the essential points. He particularly insists on the corporate behavior of the service beneficiary, which are permanently interested in a collaboration leading to finding answers and solutions to the encountered problems.

The vertical analysis outlines some differences between managers' opinions concerning the issues related to their requirements and expectations from a contractual relationship. The comparing analysis of their interventions on the themes and sub-themes approached in the interviews highlight various particularities such as:

- from the point of view of the mentioned themes, the opinions of the managers of the small enterprises are closed, due to the complexity of the businesses they do, the large number of clients they collaborate with, the various and multiple issues they have to solve. Even if the information of each manager is different in quantity, from the quality point of view they lead to similar conclusions.
- an important remark that can be iterated related to the information provided by most of the interviewees is that the contractual relationships between the accounting services provider and their beneficiary should reach a high level of professional performance.

Conclusions

The research outcomes lead to a general conclusion that due to the increased taxation the clients consider the accounting services as an obligation required by law, which decreases their important role in the management, sizing and assessment of the company's business. Among the legal restrictions generating undesired development of the financial accounting business we can find the excessive taxation.

This one tends to gain the upper hand of the financial accounting services, determining the client to become very discreet about his/her business. In certain cases we notice a slight lack of interest of the client in the information provided by the business analysis and forecast and increased interest in obtaining profits as high as possible based on the low taxes paid to the state (Anton 2011). Such an attitude requires the need to elaborate tax optimization structures leading

to a balance between accounting and taxation. For this reason, the balance between accounting and taxation is the key issue of the relationship between the two components, influencing also the contractual relationships between the providers of financial–accounting services and their clients. This requires detailed knowledge of the tax laws and of the company management by each company. Permanent monitoring of the fiscal norms and principles and understanding the consequences of the inobservance of the tax laws (fines, increases, penalties, imprisonment etc) lead to a better collaboration of the contract partners for the execution of the financial – accounting services.

Considering that taxation is mandatory, it must be understood as a component of the business management. The role of the accounting professional is to look for solutions to the benefit of the client, and for this reason a strong collaboration with the services provider is needed. The accounting professional must provide to his/her client the experience gathered with other partners or the state institutions, contributing in this way to the creation of a collaboration climate between the partners, aiming at business development. The beneficiary of financial services must see the tax as a factor that helps the stimulation of a more efficient economy by using all the fiscal facilities provided by law (Ristea 1998).

On another hand, the financial service providers should help the clients to develop their business not only to prepare good reports for taxation purposes. Some companies need to consider the reengineering of their activities in order to maintain or increase their competitiveness. Such a process needs efficient solution of redesign the enterprise's processes and activities (Stefanescu *et al*. 2008). Thus, the financial service provider could support managers to take the best decisions based on reliable financial information, which includes also the risk analysis.

Taking into account the above mentioned, in the relationship with their clients the financial-accounting services companies could offer additional credibility to the financial statements but also professional support in the diagnosis of the financial health of a company and in its decisions for future development.

References

[1] Anton, C.E. (2011). Consideration Related to the Taxation - Accounting Connection, Reflected in the Collaboration between the Romanian Companies Providing Financial Accounting Services and their Clients, in Proceedings of INTED 2011 Conference, Valencia, Spain, pp. 1330-1339.

[2] Baba, M. C. 2011. *Rapoarte financiar-contabile utilizate în analiza şi deciziile manageriale, (Financial – Accounting Reports in the Managerial Analyses and Reports)*, Transilvania University of Braşov Publishing House, *in Romanian.*

[3] Cetină, I., Brandabur, R. E., Constantinescu, M. (2006). *Marketingul serviciilor. Teorie şi aplicaţii, (Services Marketing, Theory and Applications)*, Uranus Publishing House, Bucharest, *in Romanian.*

[4] Chitu, I.B., Tecau, A.S. (2012). Consultancy services in marketing and management -growth factor of competitiveness for small and medium enterprises, *Journal of Applied Economic Sciences*, 22: 373-379.

[5] Constantin, C., Tecau, A. (2013). *Introducere in cercetarea de marketing (Introduction to the Marketing Research)*, University Publishing House, Bucharest, *in Romanian*.

[6] Cuzdriorean, D.D., Matiş, D. (2012). The relationship between accounting and taxation insight the European Union: the influence of the international accounting regulation, *Annales Universitatis Apulensis Series Oeconomica*, 14(1): 28-43.

[7] Kolarova, E., Otrusinova, M. (2012). Management of receivables, the case of the Czech Republic, advances in finance and accounting, in Proceedings of the first WSEAS International Conference on Finance, Accounting and Auditing, Czech Republic, pp. 44-49.

[8] Lefter, C. (2004). *Cercetarea de marketing Teorie şi aplicaţii (Marketing Research Theory and Applications)*, Infomarket Publishing House, Braşov, *in Romanian.*

[9] Olteanu, V. (2005). *Marketingul serviciilor- o abordare managerială (Services Marketing – A Managerial Approach)*, Ecomar Publishing House, Bucharest, *in Romanian*.

[10] Ristea, M. (1998). *Contabilitatea între fiscal şi gestionar (Accounting between Taxation and Management)* Tribuna Economică Publishing House, Bucharest, *in Romanian.*

[11] Stefănescu L., Ungureanu L., Matei I.V. (2008). Reengineering as Efficient Solution to Redesign Activities and Processes of an Enterprise, *Journal of Applied Economic Sciences*, III (2(4)):161-170.

[12] Teodorescu, N. (2003). *Comportament al consumatorului in Marketing-Dicţionar explicativ (Consumer Behaviour – in Marketing – Explanatory Dictionary)*, Florescu, C., Mâlcomete, P., Pop, N. Al., coord, Economic Publishing House, Bucharest, *in Romanian*.

APPLICATION OF ECONOMETRIC MODEL IN THE STUDIES OF FACTORS AFFECTING THE INCOME TAX OF LEGAL ENTITY IN THE SLOVAK REPUBLIC

Anna BÁNOCIOVÁ
Ľudmila PAVLIKOVÁ[1]
Faculty of Economics, Technical University of Košice, **Slovakia**
anna.banociova@tuke.sk
ludmila.pavlikova@tuke.sk

Abstract:
Econometric models are used to analyze the development for the period for which the data are available (ex post analysis), and also for predicting the future values of endogenous variables (ex ante analysis). Econometric modeling is one of the most common ways of macroeconomic forecasting. This paper describes the econometric model created by using the software "R", which in the view of statistically significant factors, estimated the possible development of tax incomes of the Slovak Republic based on the data analyzed for the period 1993-2011.

Keywords: tax incomes, inflation, GDP, number of legal entities, tax rate, econometrics, modeling.

JEL Classification: C51, H29

1. Introduction

This paper is focused on the analysis of the factors which affect the income tax of legal entity and their consecutive effect on the State Budget. There are more factors that affect the ITLE in different ways. We will concentrate on those, which substantially change the ITLE. The main objective is to define the factor that is statistically most influencing the amount of the ITLE (Šoltés and Gavurová, 2013).

First we will analyze the mutual relations between the tax incomes and factors effecting these incomes and then we will test them through statistical and econometrical methods and by econometric software "R", which will show which factors are, or not, significant in our case (Gavurová and Glova, 2012). As the econometric software "R" can evaluate only numeric data and then select the factor which has a statistically significant effect in the monitored period, we trace following factors: the number of legal entities, gross profit of legal entities, legislative changes – tax rate, tax reliefs, inflation and GDP.

The paper is divided into several parts. In the first part we will describe and summarize the share of taxable and non-taxable incomes on the total incomes of the State Budget of the SR and also the share of the income tax of legal entities on the total incomes. The second part is dedicated to the factors affecting the income tax of legal entities and to the selection of five specific factors. Based on the selected factors, in the third part of this paper, we will describe the creation of econometric model for determining the effect of statistically significant factors for the amount of tax incomes in the conditions of the Slovak Republic tax incomes. In the conclusion we will show some of the results of created model, as well as the forecast of tax incomes for the next year and we will summarize the info and formulate the results (Szabo *et al*., 2013).

2. Incomes and the state budget

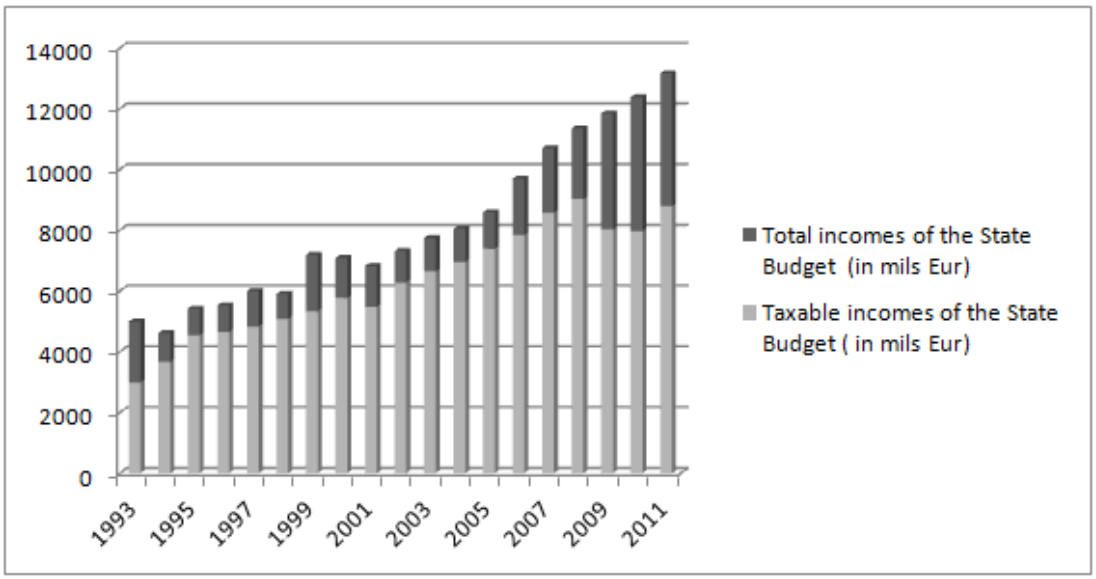
The income part of the State Budget is necessary to secure the expenditure part. The taxable incomes represent the biggest portion of the income part of the State Budget. We studied the taxable incomes for the period from 1993 until 2011 from the view of:

- share of taxable and non-taxable incomes on the incomes of the State Budget;
- share of the income tax of legal entities on the total taxable incomes;
- factors effecting the income tax of legal entities (Schultzová, 2004).

[1] Corresponding author, Department of Banking and Investment, Faculty of Economics, Technical University of Košice, Němcovej 32, 040 01 Košice, Slovakia.

2.1 Mutual relation between taxable incomes and the State Budget

The share of the taxable incomes on the total incomes of the State Budget of the SR ranged around 80% throughout the entire period from 1993 until 2011 (as shown on the Figure 1). Despite the percentage swings, on the absolute base they still had a growing trend.

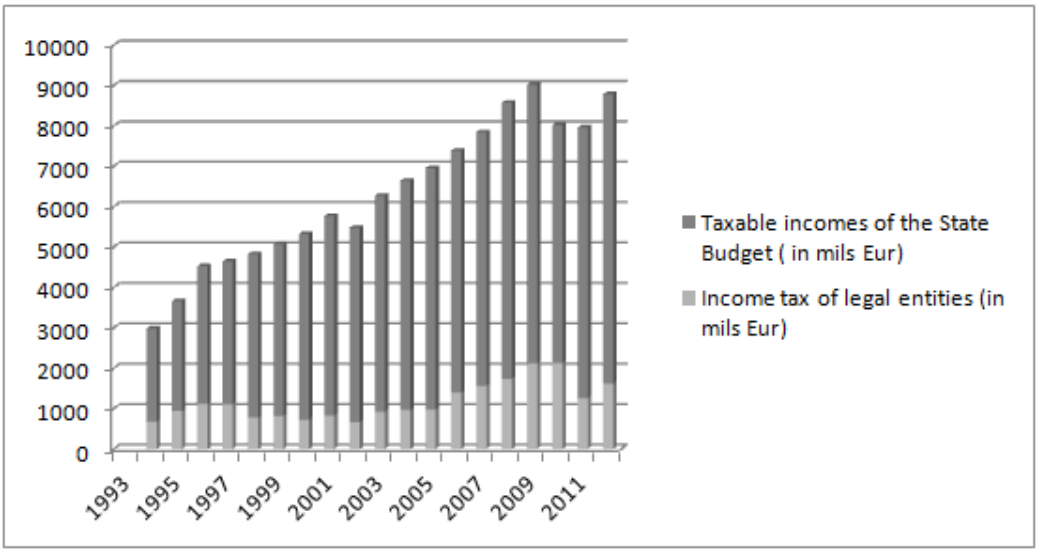


Source: Custom processing based on the data provided by Ministry of Finance of the SR, 2012

Figure 1: Share of taxable incomes on the total incomes of the State Budget in mils EUR

Share of the income tax of legal entities on the taxable incomes of the State Budget of the SR

Figure 2 shows the share of the income tax of legal entities on the taxable incomes of the State Budget of the SR. The income tax of legal entities represented almost one third of the taxable incomes of the State Budget in the period from 1993 until 1996.



Source: Custom processing based on the data provided by Ministry of Finance of the SR, 2012

Figure 2: Share of the income tax of legal entities on the total taxable incomes of the State Budget of the Slovak Republic

There was a significant decrease in 1997, when the share of the ITLE dropped from almost 24% down to 16%. This drop was caused by the unstable situation of businesses and

also by the tax reliefs that were provided to the foreign investors for the period of 5 years. The share of the ITLE had a declining trend until 2001. Starting in 2002, the share of the ITLE on the taxable incomes of the State Budget of the SR has grown, which was influenced by the change of the tax rate from 40% down to 29% and subsequently to 19%. Reduced rate was motivational to the legal entities. After booking the results of the ITLE for 2004, the income of the State Budget was 42% higher than in the previous year.

3. Factors affecting the income tax of legal entities

Out of the factors influencing the amount of the income tax of legal entities, we have chosen following:

- number of legal entities,
- gross profit of legal entities,
- legislative changes – tax rate and tax reliefs,
- inflation,
- GDP.

These factors will be further analyzed for the monitored period.

3.1 Number of legal entities which submitted the tax reports – „living payers"

Table 1: Number of legal entities which submitted the tax reports, i.e. „living payers"

Year	Number of legal entities	Year	Number of legal entities
1993	6480	2003	83431
1994	33765	2004	90367
1995	40140	2005	107116
1996	47000	2006	118509
1997	53456	2007	127670
1998	61157	2008	143776
1999	65500	2009	163539
2000	69785	2010	170058
2001	74075	2011	184922
2002	77846		

Source: [Ministry of Finance of the SR, 2012]

In the Table 1 we show the development of the number of „living payers" in the SR, i.e. those who submitted their tax reports. The number of legal entities has a growing trend, which does not necessarily mean increased incomes into the State Budget. It is not a rule that increasing number of legal entities causes increased income into the State Budget.

3.2 Amount of gross profits of legal entities

The amount of gross profits should be the decisive indicator of the taxable incomes of the State Budget (Andrejovská and Buleca, 2012). By comparing Table 1 and Table 2 we can notice that even the number of legal entities increased in 1994 vs. 1993 by five times, the gross profit grew only by less than 17%. The opposite situation was in 1995 when the number of legal entities grew by less than 19%, but the amount of gross profits increased by 24% (Bajus and Gál, 2008).

Although there were a higher number of submitted tax reports in 1998 and 2004, the gross profits of legal entities dropped.

We can draw a conclusion, based on comparing the data in the Table 1 and Table 2, that both factors have a growing trend and we can determine which of them has a bigger impact on the income tax of legal entities, only by using the econometric model.

Table 2: Profit before tax – gross profit of legal entity

Year	Gross profit of legal entities *(mils Euro)*	Year	Gross profit of legal entities *(mils Euro)*
1993	1925,21	2003	6405,76
1994	2249,98	2004	7091,88
1995	2765,19	2005	10644,33
1996	2490,64	2006	11950,91
1997	2422,79	2007	12945,99
1998	2198,7	2008	12375,06
1999	2157,41	2009	12778,00
2000	3305,62	2010	7542,00
2001	4308,40	2011	1614,00
2002	4502,19		

Source: [Ministry of Finance of the SR, 2012]

3.3 Legislative changes – tax rate and tax reliefs

A decrease in the tax rate from 45 % to recent 19 % can also be the significant factor which provides for the increased income tax of legal entities in the State Budget. The lower tax rate should be in some extent a "motivational" factor for reporting all of the taxable incomes. On the other hand, the tax rate of 45 % could encourage legal entities to avoid taxing of all of their incomes. Tax reliefs are motivational element, unfortunately only for the foreign investors (Jakubíková and Šoltés, 2008). Domestic businesses have no opportunity to receive any tax reliefs.

Table 3: Tax reliefs provided in the period from 1993 until 2011

Year	Tax reliefs *(mils Euro)*	Year	Tax reliefs *(mils Euro)*
1993	94,78	2003	221,21
1994	79,09	2004	200,16
1995	45,09	2005	93,66
1996	53,49	2006	140,93
1997	68,33	2007	139,13
1998	91,27	2008	53,97
1999	89,52	2009	63,01
2000	92,82	2010	67,08
2001	139,17	2011	65,24
2002	151,84		

Source: [Ministry of Finance of the SR, 2012]

The Table 3 shows that the tax reliefs had a decreasing trend from 1993. There is an opposite effect from 1996, when the tax reliefs started to grow until 2003. After 2004 the tax reliefs significantly declined. The lowest level of tax reliefs is substantial for the incomes of the State Budget, even though the tax reliefs are motivational factor for the foreign investors. We can notice a decrease in tax reliefs in 2008, which was caused by the expiration of the five year period for which the tax reliefs were applied. The Slovak government adopted "a package of measures" in 2009, to mitigate the effects of the global crisis. The goal of these measures was to contribute to the mitigation of global economic development delay of the national economy. The government adopted the measures in the macroeconomic area, as well as in the area of business environment. The most significant areas of the business environment from the tax prospective can be considered: Decreased number of fixed assets depreciation groups (from five to four groups) and at the same time increased limit of entry price of fixed assets. The

component depreciation has been introduced, also regrouping of some types of assets to the lower depreciation group. The mentioned actions repeatedly activated tax reliefs, which in this case had the positive effect also on the Slovak businesses.

3.4 Inflation

Inflation is a macroeconomic problem which is indicated by the increased prices of goods and services, causes reduction of the purchasing power and influences the price level as a whole. The consequences of the inflation affect all areas of the economic life, they are linked to the production and the economic growth. On one side, the increased prices of goods bring higher incomes to the sellers and therefore also higher taxes paid to the State Budget. From this point of view, we could see inflation as a positive factor, which impacts the amount of incomes of the State Budget.

On the other side, the inflation[2] can cause the weakening of the purchasing power, as a result of high prices, which lowers the incomes of the producers, i.e. also, decreases the amount of taxes paid into the State Budget.

Next table shows the development of the inflation throughout the monitored period. Various inflation rates are caused by economic and political circumstances, which took place in individual time periods.

Table 4: Inflation development in %

Year	Inflation (%)	Year	Inflation (%)
1993	25,1	2003	9,3
1994	11,7	2004	5,9
1995	7,2	2005	3,7
1996	5,4	2006	4,2
1997	6,4	2007	3,4
1998	5,6	2008	4,4
1999	14,2	2009	1,6
2000	8,4	2010	1,0
2001	6,5	2011	3,9
2002	3,4		

Source: [Ministry of Finance of the SR, 2012]

3.5 Gross domestic product

Gross domestic product (GDP) represents the volume of the final production, which was produced by the production factors in the area of a given state. To determine the GDP growth, we need to formulate it in the constant prices, where we set the prices of a certain year as a base (in our case the base will be represented by the prices of 1995) and then by these prices we evaluate the production of the following and the previous years (Mirdala and Siničáková, 2008). We have chosen GDP as one of the factors which influences the income tax of legal entities and ultimately also has an impact on the State Budget. We can assume that the higher GDP means bigger volume of produced production, higher incomes of producers, who therefor pay higher taxes, and that increases the income of the State Budget. Based on this assumption, the growth of GDP has a positive impact on the income tax of legal entities and therefor also on the State Budget. This is also valid in the opposite case, when GDP declines, the producers have lower incomes, they pay lower taxes and generally this causes lower incomes of the State Budget. The same like with all other factors, we tested also GDP through the econometric model[3].

[2]We will determine the magnitude of inflation effect on the tax of legal entities for the monitored period by using the econometric model.

[3]We were testing the impact of GDP on the income tax of legal entities and generally on the State Budget during the monitored period.

Table 5 shows the development of GDP and the value of ITLE as a percentage of GDP. GDP grew throughout the entire monitored period from 1993 until 2011. But the ITLE, determined as a percentage from GDP did not have always a growing trend. In the period from 1993 until 2004, the values of ITLE were alternately increasing and decreasing. Starting in 2004, this irregularity changed to a growing trend and in 2008 the ITLE achieved 4.16 % of the GDP value.

Table 5: Gross Domestic Product development

Year	GDP *(mils Euro)*	ITLE as % from GDP	Year	GDP *(mils Euro)*	ITLE as % from GDP
1993	17021,84	4,01%	2003	35331,61	2,62%
1994	18080,73	5,22%	2004	37172,54	2,60%
1995	26110,34	4,28%	2005	39612,96	2,48%
1996	28204,87	3,95%	2006	42994,42	3,25%
1997	29393,22	2,66%	2007	47452,37	3,31%
1998	30697,74	2,67%	2008	50417,51	3,45%
1999	30704,37	2,38%	2009	62895,50	3,37%
2000	31135,90	2,68%	2010	65887,40	3,23%
2001	32191,46	2,08%	2011	69058,20	1,82%
2002	33751,58	2,74%			

Source: [Ministry of Finance of the SR, 2012]

4. Testing of the factors' impact on the ITLE using the „R" software

The econometric modeling is one of the most extended ways of the macroeconomic forecasts creation (Doval, 2010). Correctly specified econometric model, through its variables, mathematical and analytical form of the tested reliance and stochastic assumptions on probability distribution of random failures, allows quantifying the intensity and the direction of the mutual relations of economic variables of the model, based on the model's parameters, if the adequate statistical data are available.

We quantified the impact of individual factors on the ITLE using the econometric software „R". The main objective is to determine, which of the monitored factors are statistically significant in our case. We created a linear model in which we track the impact of factors NLE, GPLE, TR, TF and GDP on the monitored development of the ITLE change. This linear model must meet the following assumptions:

Random failures have a zero mean value in all observations:

$$E(u_i) = 0 \qquad i = 0,1,2,3.....,n$$

The compliance with this assumption leads to a result that variants have their mean at a zero value.

Variance of random failures is constant in all observations:

$$var(u_i 2) = \sigma 2 \qquad i = 0,1,2,3.....,n$$

This assumption is referred to as an assumption of heteroscedasticity, based on which the random failures in all observations have the variance, which we do not know. Random failures are not correlated with each other, i.e. their covariance equals to zero:

$$cov(u_i u_j) = 0 \qquad i=0,1,2,3.....,n \quad i \neq j$$

Explanatory variables are linearly independent, i.e. matrix X is at the value which equals to the number of columns:

$$h(X)=k+1\leq n.$$

Explanatory variables are non-random, i.e. elements X_{ij} of the matrix X are the same in repeated selections and variances of their values are nonzero.

Random failures u_i have a normal distribution:

$$u \sim N(0, \sigma 2I)$$

Fulfillment of these assumptions safeguards that the linear model has good characteristics. In case that the assumptions are not met, then the parameters loose some of these good characteristics.

Our single-equation model has following form:

$$ITLE = \beta_0 + \beta_1 * NLE + \beta_2 * GPLE + \beta_3 * TR + \beta_4 * TF + \beta_5 * GDP + \beta_6 * INF$$

β_0 - absolute element, resp. the constant at the level;
$\beta_1 - \beta_6$ - regression coefficient, expresses the impact of tracked factors on ITLE;
NLE - number of legal entities;
GPLE - gross profit of legal entities;
TR - tax rate;
TF - tax reliefs;
GDP - gross domestic product;
INF - inflation.

The objective of our testing was to determine which of the tracked factors has a statistically significant impact on the ITLE. The first step is testing of the regression coefficients' significance by using the function summary (). Following data from the Table 6 represents the result.

Table 6: Testing of the significance of regression coefficients 1

	β	p-value		B	p-value
Intercept	1,394e+10	0,54954	TF	-2,692e+04	0,06460
NLE	-1,444e+05	0,67462	GDP	1,54e+04	0,651
GPLE	1,136e-01	0,00684 **	Inflation	-1,027e+08	0,81863
TR	1,610e+08	0,76208			

Source: Common processing through „R" software

p- value – value based on which we decide on the significance of the individual factors.

The testing shows that not all of the factors are significant. Software R marked with stars, resp. dots the significant factors and we used these factors in further testing. In elimination of insignificant factors we started with the highest p-value and proceeded to the lowest value. The highest p-value was shown for inflation; therefore we eliminated this factor as the first one. The reason could be that the changes in inflation do not have a direct impact on the change of the ITLE[4].

We repeated the process after the elimination of inflation with 5 remaining tracked factors.

[4] The stable and low inflation is a proof of a good situation in a business environment, which can be motivational element for foreign investors and for the economic expansion and then consequently it is shown in the amount of the ITLE.

Table 7: Testing of the significance of regression coefficients 2

	β	p-value		B	p-value
Intercept	1,433e+10	0,51491	TR	8,410e+07	0,82962
NLE	-1,911e+05	0,46969	TF	-2,843e+00	0,02233 *
GPLE	1,124e-01	0,00431 **	GDP	2,083e+04	0,37844

Source: Common processing through „R“ software

As a result of eliminating the insignificant factor – inflation, the p-values have changed. Subsequently we removed another insignificant factor – TR, because its p-value is the highest.

The business environment in the Slovak Republic was in the early stages of the Slovak Republic unhealthy due to a high tax rate. The development of the tax amount and the number of legal entities was contradictory[5]. We had 4 remaining factors after elimination of TR factor.

Table 8: Testing of the significance of regression coefficients 3

	β	p-value		β	p-value
Intercept	1,857e+10	0,05527	TF	-2,999e+00	0,00202 **
NLE	-2,095e+05	0,38131	GDP	2,1236e+04	0,31453
GPLE	1,107e-01	0,00246**			

Source: Common processing through „R“ software

Table 9: Testing of the significance of regression coefficients 4

	β	p-value		B	p-value
Intercept	3,394e+10	0,002549**	TF	-3,122e+00	0,001063 **
GPLE	9,221e-02	0,000524***	GDP	3,509e+03	0,697149

Source: Common processing through „R“ software

NLE is another insignificant factor, which we have eliminated similarly like in the previous cases. Indicator NLE does not directly express the amount of incomes of legal entity[6]. Subsequently we tested the significance of remaining factors. The last insignificant factor that we tracked was GDP. The high production of individual businesses does not necessarily need to bring high profits, as it depends on the amount of costs. After eliminating the last insignificant indicator, we have only significant factors remaining and those are the gross profits of legal entities and the tax reliefs.

Table 10: Testing of the significance of regression coefficients 5

	β	p-value
Intercept	2,622+10	1,49e-07***
GPLE	9,915e-02	4,58e-08***
TF	3,106e+00	0,000701**

Source: Common processing through „R“ software

After elimination of all insignificant factors we created an equation for the optimal model in the following form:

ITLE = 2.622e+10 + 9.915e-02 *GPLE + -3.106e+00 *TF

[5] In the following years the tax rate was decreased and the number of legal entities grew, so the tax base grew as well. And this growth could lead to the fact that the decrease of the tax rate did not necessarily had to be the reason of decreased income tax of legal entities in the State Budget.

[6] The number of legal entities and the amount of total incomes of legal entities does not need to have a direct correlation. It may happen that the income of one legal entity is higher than the income of e.g. another five legal entities.

After all we have tested the model by using selected tests for compliance with the assumptions of the linear model. When the model is entered, its testing for the presence of unfavourable effects is an obligatory step.

1. Testing of residues' normality

The base assumption is that the residues have a normal distribution, which we test by applying Jarque – Bera test. This test is performed by using the function *jbTest(resid())* and by establishing the hypotheses:

H_0: residues are from a normal distribution

H_1: residues are not from a normal distribution

P-value is a criterion for decision on the test result. If p-value is higher than α=0,05, then the hypotheses H_0 – residues are from a normal distribution, is not rejected. In our case, the test of model was higher than α (Table 11), which means that we can assume that the residues are from a normal distribution.

Table 11: Result of residues' normality testing

	p-value
Model1	0,66

Source: Common processing through „R" software

2. Testing of random components' autocorrelation

This type of model assumes that the random components are not correlated with each other. If this assumption is not valid, then we say that there is an autocorrelation in the model. We test the presence of autocorrelation through Durbin-Watson test, in which we establish the following hypotheses:

H_0: autocorrelation is not present

H_1: autocorrelation is present

This test is represented in the econometric software „R" by the order *dwtest()*. Unlike the previous *jbTest*, where we tested p-value first, based on which we formulated the conclusion on hypotheses validity, in this step we will concentrate on DW statistics[7].

In our case, the DW statistic does not belong to any of the intervals, which means that it falls into the grey area and we will decide on the presence of autocorrelation based on the p-value, which is 0.09382. Based on this value we can conclude that the model does not contain the autocorrelation of the random components.

Table12: Result of random components autocorrelation testing

	DW statistic	p-value
Model1	1,21	0.09382

Source: Common processing through „R" software

3. Testing of heteroscedasticity

It is necessary to perform a test of heteroscedasticity, to make sure that the model, that we have chosen and adjusted, has a sufficient reporting ability. The problem of heteroscedasticity rises, when the variance – covariance matrix of random components does not

[7] If the value of DW statistic ranges in the interval <1, 8; 2, 2>, there is no autocorrelation in the model. If the DW values are close to 0, resp. 4, the random components are positive, resp. they are negatively correlated. If the value of DW statistic is not from the mentioned intervals, then it is in a grey area and we can decide on the presence of autocorrelation the same way as in the previous test, based only on the p-value.

have a constant value of the variance on the main diagonal. The presence of heteroscedasticity is tested through Breusch-Pagan test, which is represented in the „R“ software by the order *bptest()*, based on established hypotheses:

H_0: heteroscedasticity is not present

H_1: heteroscedasticity is present

The presence of the heteroscedasticity is decided again based on the p-value, which we compare with $\alpha = 0.05$. In our case the $p = 0.4777$, so H0 is not rejected and we can draw a conclusion that the heteroscedasticity is not present in this model.

4. Testing of multicollinearity

Another significant assumption of correctly defined linear model is the independence of rows and columns in the matrix of random components. In our case, we tested the multicollinearity through the correlation matrix *cor( )* and by establishing the hypotheses:

H0: multicollinearity is present

H1: multicollinearity is not present

Based on the Table 13, there is no multicollinearity in the model and the reason for that is that the value in the matrix is not higher than 0.8.

Table 13: Correlation matric of the explanatory variables

	GPLE	TF
GPLE	1	0,2886756
TF	0,2886756	1

Source: Common processing through „R“ software

5. Testing of the correct model specification

At the end of testing it is necessary to test if the final model is correctly specified. We applied the order *resettest()* and established the following hypotheses to perform this control:

H0: model is correctly specified

H1: model is not correctly specified

Again we compare the p-value with the value $\alpha = 0.05$. If the p-value is higher than α, then we do not reject the hypotheses that the model is correctly specified, which has been confirmed also in our case, because the p-value of our model1 is 0.1332.

The main objective of this testing through the econometric software „R“ was to determine, which of the tracked factors (number of legal entities, gross profit of legal entities, tax rate, tax reliefs, GDP and inflation) had the strongest impact on the ITLE and at the end also impact on the State Budget. By using the software, we have identified that the tax rate, GDP and inflation have the insignificant effect on the ITLE. In contrary, the tax reliefs and the amount of gross profits of legal entities represent a high impact. The final model ITLE = 2.622e+10 + 9.915e-02 *GPLE + -3.106e+00 *TF, which we got, we can draw the conclusion:

- If the gross profit of legal entity grows by 1 unit, then the ITLE grows by 9,915 *10-2 units, which is logical, because the increase of profits is the source of higher ITLE and consequently also of higher incomes into the State Budget.
- If the tax reliefs grow by 1 unit, then the ITLE falls by 3,106 units. When it comes to the tax reliefs, there is a place for discussion, because on one hand the decrease of incomes is the source for the tax base decrease, but on the other hand, it is motivational and attractive element for the new foreign investors.

Forecast of the ITLE development in 2012

The econometric model „R" allows us, except for the determination of significant and insignificant variables, also to predict the trend of the monitored value, in our case of the ITLE. We have eliminated three explanatory variables from the original model and those were inflation, GDP and tax rate. The result of the testing is the model with two variables, the tax reliefs and the gross profit of legal entities, which have a strong impact on the ITLE.

Table 14: Development of the explained variable – ITLE

Year	Real values *(mils Euro)*	Balanced values *(mils Euro)*	Lower limit of interval *(mils Euro)*	Upper limit of interval *(mils Euro)*
1993	681,9	766,8	460,3	1073,3
1994	943,2	847,8	541,2	1154,3
1995	1117,5	1004,4	689,9	1319,0
1996	1113,1	951,1	639,2	1263,1
1997	783,0	898,3	590,3	1206,3
1998	819,9	804,9	499,2	1110,4
1999	730,9	806,2	500,3	1112,0
2000	834,0	909,8	607,5	1212,0
2001	670,9	865,2	560,8	1169,7
2002	926,4	951,8	537,2	1152,9
2003	966,4	818,4	476,4	1160,3
2004	984,3	951,8	624,8	1278,8
2005	1396,8	1634,8	1317,7	1952,0
2006	1569,1	1617,5	1296,6	1938,5
2007	1740,8	1721,8	1394,1	2049,5
2008	2122,1	1929,7	1584,0	2275,5
2009	2130,0	1941,8	1589,4	2294,2
2010	1257,7	1580,0	1058,0	1935,0
2011	1620,5	1730,0	1318,0	2056,0
2012	1733,0	1810,0	1371,0	2124,0

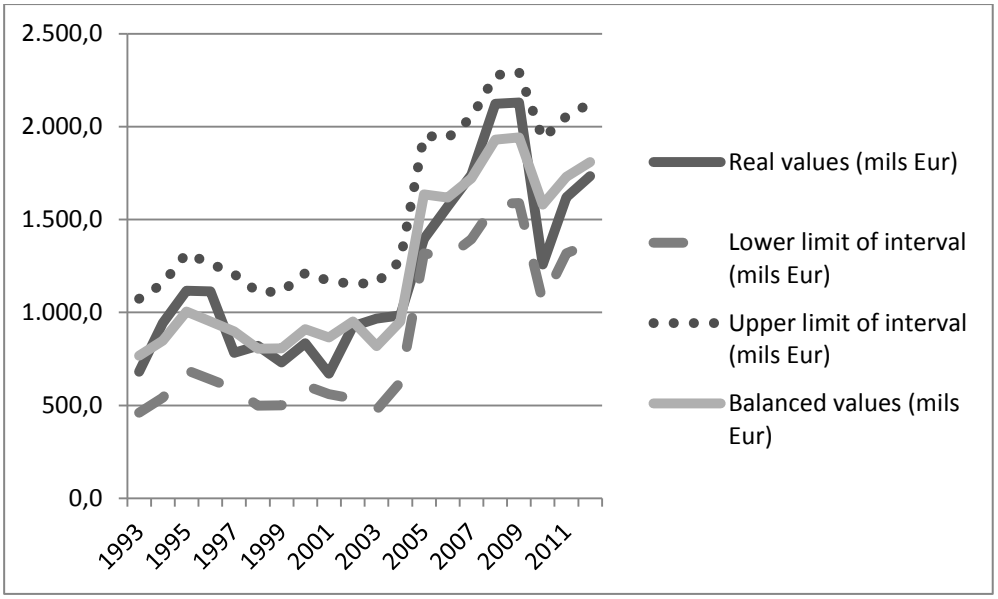
Source: Common processing through „R" software

We have chosen year 2012[8] for the forecasting of the ITLE value. We compared the obtained result with the real value of the income tax of legal entities from 2012.

The econometric model has determined the forecasted interval of the expected income tax of legal entities development and also the mean value, around which the value of the tax should oscillate. For forecasting we have used the function *predict()* and the real data from 1993 until 2011. The output data are shown in the Table 14.

The following Figure 3 represents a graphical view of the income tax of legal entities development, based on the forecasted trend of the significant factors. The real value of the income tax of legal entities should range in the interval with the lower limit of approximately 1 371 mils EUR and the upper limit around 2 124 mils EUR.

[8] We have assumed, based on the monitored development of used factors, that there should be an increase of the gross profits of legal entities in 2012 and therefor also the increase of the income tax of legal entities (Raisová, 2012).



Source: Graphical processing of the data from the Table 14

Figure 3: Income tax of legal entities development and forecast for 2012

The applied econometric model can be used at the theoretical level. It has been proved, by our case, which it is also applicable at the practical level – at forecasting of the income tax of legal entities. However, it is not guaranteed that the tax development will always follow the trend calculated by the econometric model, as there are other factors influencing the income tax of legal entities, which cannot be expressed in the monetary units and still have a significant impact on the value of the income tax of legal entities. It was not possible to use these factors as they do not have to have the monetary value.

Conclusion

The tax system was introduced at the time of the Slovak Republic establishment and the system has undergone several changes and tax reforms since. The changes were applied mainly in the area of tax rates, depreciation and reliefs. Those are the factors that affected the State Budget in a significant manner. The impact and the significance of these factors on the income tax of legal entities was tested by the created econometric model, where the statistically major impact was proved for the indicators as gross profit of legal entities and tax reliefs. The values forecasted through this model were compared to the real values and as the result was the confirmation that the values were from the interval, which was forecasted by the econometric model.

References

[1] Andrejovská, A., Buleca, J. (2012). Impact of revenues on the profit of production business. National and Regional Economics 9, Textbook from the International Conference: 26th-27th September, Herľany, Slovakia, Košice: TU, 2012 p. 1-7. - ISBN 978-80-553-1215-6.

[2] Bajus, R., Gál, M. (2008). *Taxes of business entities practice book.* 1st Edition. Košice: Elfa. 83 p., ISBN 978-808086-069-1.

[3] Doval, E. (2010). A model of planning process by using scenarios in strategic management, *Journal of Applied Economic Sciences*, 4: 317-323.

[4] Fekete, I. (1995). *Act on Income Tax*. Bratislava: Eurounion, spol. s r.o., 1995. 382 p., ISBN 80-85568-44-6.

[5] Gavurová, B., Glova, J. (2012). Application of value-at-risk methods for measuring of the financial risk - a comparison. *Transactions of the Universities of Košice*, 2: 35-43.

[6] Harumová, A. (2002). *Taxes in theory and practice*. Bratislava: Forma, 240 p., ISBN 80-

89047-39-4.

[7] Jakubíková, E., Šoltés V. (2008). *Taxation and public finance in the Slovak Republic*. Taxation and Public Finance in Transition and Developing Economies. New York: Springer Verlag, 603-608, ISBN 978 038 7257112.

[8] Kubátová, K. (1998). Harmonization of taxes in the EU, *Taxes*, 7-8/1998.

[9] Mirdala, R., Siničáková, M. (2008). Analysis of selected areas of fiscal policy in the context of EMU accession on the examples of the Czech Republic and the Slovak Republic, *E + M. Economy and management*, 11(4): 21-33.

[10] Pauličková, A. (2000). *Income taxes since 1.1.2000*, Bratislava, Eurounion, ISBN 80-88984-14-9.

[11] Raisová, M. (2012). *Fiscal impulse under Conditions of the Slovak Republic*. Curentul Juridic, 15(4): 54-63.

[12] Schultzová, A. (2004). *Taxing in the Slovak Republic*. Bratislava: Súvaha, spol. s r.o., 331 p. ISBN 80-88727-77-4.

[13] Szabo, K.Z., Šoltés, M., Herman, E. (2013). Innovative Capacity & Performance of Transition Economies: Comparative Study at the Level of Enterprises, *E+M Ekonomics and Management*, 16(1): 52-69.

[14] Široký, J. (2008). *Tax theories with the practical application*. Prague: C.H. Beck, 301 p. ISBN 978-80-7400-005-8.

[15] Šoltés, V., Gavurová, B. (2013). Application of the cross impact matrix method in problematic phases of the Balanced Scorecard system in private and public sector, *Journal of Applied Economic Sciences*. 8(1): 99-119. Available: http://www.cesmaa.eu/journals/jaes/jaes_issues.php.

*** Econometrics: [online]. Available from <http://issuu.com/dexterka/docs/prednaska3-em-konvertovana>.

*** Information on impacts of tax rate on the income tax of legal entities and comparison of taxable income for the period from 1999 until 2001: Ministry of Finances of the SR. [online].Available from http://www.finance.gov.sk/Default.aspx?CatID=84&NewsID=19>.

*** Incomes of the State Budget: Ministry of Finances of the SR. [online]. Available from <http://www.finance.gov.sk/Default.aspx?CatID=4110&id=117>.

*** Public finances in the Slovak Republic: Peter Goliáš. [online]. Available from <www.ineko.sk/file_download/455>.

*** Selected economic indicators: National Bank of Slovakia. [online]. Available from <http://www.nbs.sk/sk/statisticke-udaje/vybrane-makroekonomicke-ukazovatele>.

*** Act No. 595/2003 Corpus Iuris on Income Tax

*** www.drsr.sk/statistiky/

TECHNICAL EFFICIENCY OF THAILAND SMALL AND MEDIUM ENTERPRISES: THE APPLICATION OF DATA ENVELOPMENT ANALYSIS

Nongnit CHANCHARAT[9]
Surachai CHANCHARAT[10]
Faculty of Management Science
Khon Kaen University, Khon Kaen, Thailand
mnongn@kku.ac.th

Abstract:

This study focuses on examining the level of technical efficiency and the efficiency changes in SMEs in Thailand from 2008 to 2010 using Data Envelopment Analysis (DEA) approach. The sample consists of 1,411 SMEs with completed data are obtained from the Ministry of Commerce's database. The results found that Thai SMEs have quite low technical efficiency score about 20-24% during 2008 to 2010. In addition, SMEs in manufacturing sector is the most efficient SMEs with the efficiency score of 63% 54.60% and 47.50 % in 2008, 2009 and 2010, respectively. Furthermore, we also found that small scale SMEs is the most efficient SMEs compare to medium and large scale SMEs. Small SMEs have the efficiency score of 54.30%, 64.80% and 59.30% in 2008, 2009 and 2010, respectively. Using Malmquist Productivity Index for investigating the efficiency changes, the study found that, from 2008 to 2010, the technical efficiency of SMEs have decreased.

However, Thai SMEs have invested more in high technology to support the business operation, consequently, the Total Factor Productivity of SMEs from 2008 to 2010 have improved. The results imply that Thai SMEs have plenty of room for improving their efficiency. These SMEs could have the same level of output by decreasing approximately 80% of the input used at the current level. The entrepreneurs and policy makers could adopt the research results for benchmarking the performance of SMEs in Thailand and improving their efficiency level.

Keywords: technical efficiency, efficiency change, Data Envelopment Analysis, SMEs.

JEL Classification: *D24, M21*

1. Introduction

Small and medium enterprises (SMEs) play an important role in a nation's economy. They make substantial contributions to employment and comprise the majority of businesses in the nation (Bushong, 1995; Burns and Dewhurst, 1996; Holmes *et al.*, 2003). The recent literature emphasizes the role SMEs play in nurturing entrepreneurship and generating new products and processes (Taymaz, 2005).

In developing countries, small-scale businesses are the most important source of new employment opportunities. Governments throughout the world attempt to promote economic progress by focusing on small-scale enterprises (Harper and Soon, 1979). National governments and international lending institutions have supported SMEs in several developing countries with credit and technical assistance for decades (Mini and Rodriguez, 2000).

The rationale behind supporting SMEs is that the development of SMEs could link to achieve higher employment, income equality and a more geographically dispersed distribution of wealth. However, does achieving those goals through SME support come at a hidden price due to the possibility that SMEs are less technically efficient than larger firms? (Mini and Rodriguez, 2000). As a result, the efficiency of SMEs is central to debates about the role of small-scale industries in economic development.

---

[9] Corresponding author: Assistant Professor in Finance, Faculty of Management Science, Khon Kaen University, Khon Kaen, Thailand. Email: mnongn@kku.ac.th.

[10]Assistant Professor in Economics, Faculty of Management Science, Khon Kaen University, Khon Kaen, Thailand. We would like to thanks you to Thailand Research Fund, Commission on Higher Education and Khon Kaen University for financial support. Project no. MRG5380144.

Although various SME-support programs have been adopted all around the world, the empirical evidence strongly indicates that there are substantial productivity differences between small and large enterprises independent of sector- and country-specific factors. The productivity differential narrows down by economic development but it's does not vanish completely even in the developed countries (Snodgrass and Biggs, 1996).

An efficient SME uses inputs at optimum levels and hence, reduce the usage of unnecessary inputs to attain the level of a given output or the SME would maximize output at a given input level. Hence, revenue and profits would be maximized. Conversely, an inefficient SME will incur unnecessary cost and wastage resulting in low returns on invested capital. Generally, SMEs are poorly managed due to the lack of management skills among owners or managers. They lack awareness of the importance of adopting business best practices and quality management systems, such as financial management and customer focused activities, in order to enhance the firms' productivity and profitability. Inefficiency is a result of using excessive inputs at a given output level or poor output at a given input level. Inefficiency increases cost of production which affects price, sales and revenue. As a result, inefficient SMEs are unable to compete effectively in the market impacting the entire small and medium enterprise (SMEs) sector performance (Radam, Abu and Abdullah, 2008).

Given the fact that SMEs are the dominant source of employment in low- and middle-income countries (Taymaz, 2005) and there exist various SME-support programs have been adopted around the world, therefore, 'Do SMEs use their resources efficiently?' become the important research question especially for developing country. This study focuses on this question by examining the efficiency of SMEs in developing country context, Thailand.

The nature and definitions of SMEs differ among countries, in Thailand, SMEs are classified into three major categories include: 1) production sector including agricultural processing, manufacturing and mining, 2) service sector and 3) trading sector consists of wholesale and retail. The definition of SMEs adopted in Thailand based on either the number of employees or the total values of fixed assets depend on the business sector.

According to Office of Small and Medium Enterprises Promotion (2011b), the contribution to GDP by SMEs was 3,746,967 million baht in 2010 or 37.1% of the overall GDP with an annual expansion rate of 7.9%, an increase from a contraction of 2.4 in 2009. Considering employment by SMEs in 2010, the number of people employed by enterprises of all sizes totaled 13,496,173. Of this number, large enterprises employed 2,988,581 people and SMEs employed 10,507,507 people, or 77.86% of overall employment. Small enterprises employed the greatest proportion of all enterprises overall at 66.72% as well as among SMEs at 85.70 % (Office of Small and Medium Enterprises Promotion, 2011a).

Although the concept of efficiency plays an important role in understanding firm dynamics and the fact that SMEs plays the important role in economic development, there are a limited number of studies focused on SMEs productivity or efficiency in Thailand. Those studies included Wiboonchutikula (2002), Meingchom (2007) and Charoenrat and Harvie (2012a; 2012b). These studies focus on particular sector namely, manufacturing sector, rather than examining SMEs from the whole sector.

The research aims to examine the level of technical efficiency of SMEs in Thailand from all sectors using DEA approach. Specifically, this study examines how efficient Thailand's SMEs used the resources in the production of their output by measuring the technical efficiency and efficiency changes during 2008-2010 using Data Envelopment Analysis (DEA) approach.

To the author's best knowledge, this is the first study attempt to examine the level and efficiency change of Thai SMEs from the whole sectors. By examining technical efficiency of SMEs in Thailand, this study will add the contribution regarding the efficiency measurement of SMEs. Particularly, its usefulness to benchmarking is adapted in this research to provide an analytical, quantitative tool for measuring relative efficiency among SMEs. The entrepreneurs and policy makers could adopt the research results for benchmarking the performance of SMEs in Thailand and improving their efficiency level.

The remainder of this paper is organized as follows. Section 2 presents the literature review about SMEs efficiency studies. Section 3 provides research methodology. Specifically,

Data Envelopment Analysis approach, the data and sample are discussed. The empirical results are shown in Section 4. Finally, conclusions and discussion are provided in Section 5.

2. Literature review

Some studies found that SMEs were more efficient than large firms in some industrial sectors while other studies found them were less efficient overall. These mixed evidences about how efficient SMEs are relative to larger firms are discussed in Little, Mazumdar, & Page (1989); Cortes, Berry, & Ishaq (1987); and Liedholm & Mead (1987).

There exist several studies have been examined the efficiency of SMEs using varieties of techniques in various study context. For example, Philippines (Mini and Rodriguez, 2000), Malaysia (Zahid and Mokhtar, 2007) and (Radam, Abu and Abdullah, 2008) and Iran (Gholami, Moshiri and Lee, 2004)

In Thailand, there are a limited number of studies examining the efficiency of SMEs despite the fact that SMEs has been playing a crucial role in Thai economy in terms of employment and its contribution to National Domestic Product. To the best of knowledge, these studies include Wiboonchutikula (2002), Meingchom (2007) and Charoenrat and Harvie (2012a)

This study will use DEA in measuring the level of technical efficiency of SMEs in Thailand. The DEA approach is chosen because the approach has some advantages include DEA focuses solely on productive efficiency and does not require the explicit specification of the form of the underlying production relationship. Furthermore, the method has proven to be valuable tool for strategic, policy and operational problems (Coelli *et al.*, 2005).

3. Research methodology

This study focuses on examining technical efficiency and efficiency changes of SMEs in Thailand using DEA approach. The following sections will describe the concept of technical efficiency and DEA approach.

The concept and measurement of technical efficiency was made operational by (Farrell, 1957) who discussed in detail the factors that lead to inefficiency in production. Technical efficiency is defined as the ability of a firm to use a minimal amount of inputs to produce an optimum output. Technical efficiency only provides a measure of the efficiency of firms relative to the best-practice firms in the sample (Coelli *et al.*, 2005).

This research uses DEA model in examining technical efficiency of SMEs in Thailand. The DEA approach is based on a mathematical model originally developed by Charnes, Cooper, & Rhodes (1978). Several different mathematical programming DEA models have been proposed in the literature (Charnes *et al.*, 1994). According to Barr, Killgo, Siems, & Zimmel (2002), each of these models seeks to establish how the *n* DMUs determine the envelopment surface (the best practice efficiency frontier). The geometry of this envelopment surface depends on the specific DEA model adopted. In order to make detailed analysis of inefficient units and take corrective actions to improve their performance, both the constant returns to scale (CRS) assumption and the variable returns to scale (VRS) assumptions are allowed.

This study uses DEA-Solver-LV 1.0 Program for computing efficiency score and the efficiency change analysis. There are 2 models in DEA approach include input-oriented model and output-oriented model. The first model focuses on minimizing the input for the same level of output and the second model focuses on maximizing output given the same amount of input. This study applies input-oriented model because the cost of goods sold and operating expenses which are uses as input variables in this study are the important variables that the management team want to understand. Furthermore, the model would suggest that SMEs will minimize input in order to produce the same level of output.

Two assumptions are relevant to DEA: Constant Return to Scales (CRS) and Constant Return to Scales (VRS) assumption. CRS assumption or CCR model is named after Charnes, Cooper and Rhodes who introduced the model in 1978. The model is appropriate if the production units are operating at optimal scale, otherwise, VRS assumption is more suitable.

The VRS assumption or BCC model is named after Banker, Charnes and Cooper who introduced the model in 1984. This study applies VRS assumption because of there is imperfect competitive market in the industry and result that SMEs is not operating at the optimal scale.

DEA approach will produce the efficiency score of each SME which is Decision Making Units (DMUs). SME with efficiency score equal to 1 is the best practice enterprise, then, efficiency score are assigned to other SMEs by comparing them to the best practice enterprises.

For CCR-Input Oriented, the model is as follows.

$$\text{Min} \quad \sum_{i=1}^{m} \omega_i x_{ik} \tag{1.1}$$

$$\text{Subject to} \sum_{j=1}^{n} \mu_r y_{rk} = 1 \tag{1.2}$$

$$\sum_{i=1}^{m} \omega_i x_{ik} - \sum_{j=1}^{n} \mu_r y_{rk} \leq 0 \tag{1.3}$$

when μ_r , $\omega_i > 0$

x_{ik} = The amount of input i of DMU k

y_{rk} = The amount of output r of DMU k

μ_r = The weights of output r

ω_i = The weights of input i

r = The number of output; r = 1, 2,…, s

i = The number of input; i = 1, 2,…, m

j = The number of DMU; j = 1, 2,,k,..., n

Equation 1.1 focuses on minimizing input given the same level of output of DMU whereas the equation 1.2 and 1.3 are the constraints of the model that limit the maximum of efficiency score is not greater than 1 and the weights of input and output for all DMUs are greater than 0.

In addition, the model could be written as multiplier model of linear programming with Constant Return to Scale assumption using dual problem as following:

$$\text{Min} \quad \theta_k$$

$$\text{Subject to} -\sum_{i=1}^{m} x_{ij}\lambda_j + \theta_k x_{ik} \geq 0$$

$$\sum_{r=1}^{s} y_{rj}\lambda_j \geq y_{rk}$$

$$\lambda_j \geq 0 \tag{2}$$

when:

θ_k = Technical efficiency score of DMU k

x_{ik} = The amount of input i of DMU k

y_{rk} = The amount of output r of DMU k

λ_j = The weights of efficiency of DMU j

Banker, Charnes and Cooper (1984) have been modified CCR model by adding the constraint $\sum \lambda_j = 1$ which is Convexity Condition in equation (2) to allow variable the return to scale for DMUs. The model is called VRS or BCC Model, the details as follows:

$$\text{Min} \quad \theta_k$$

$$\text{Subject to} \quad -\sum_{i=1}^{m} x_{ij}\lambda_j + \theta_k X_{ik} \geq 0$$

$$\sum_{r=1}^{s} y_{rj}\lambda_j \geq y_{rk}$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

$$\lambda_j \geq 0 \qquad (3)$$

4. Data and sample

This study employs sales as output variable and we use cost of goods sold, total assets and operating expenses as input variables. SMEs data are obtained from Ministry of Commerce's database. The financial statements of SMEs from 2008 to 2010 are downloaded from the database. The SMEs which completed data are included in the analysis. After cleaning the data, we got 1,411 SMEs from various business types. The most of SMEs sample is in wholesale, retail trade and repair of motor vehicles at 54% or approximately 760 SMEs from 1,411 of SMES sample. Follow by SMEs in manufacturing with the proportion about 19% and SMEs in fishing is the least proportion at only 0.21%. This study further classifies SMEs used in the study by sector. We found that approximately 54% of the SMEs sample is in the trade and maintenance sector. SMEs in manufacturing sector and service sector are about 25% and 21%, respectively.

The descriptive statistics of input and output used in the study classified by sector are presented in Table 1.

Table 1: Descriptive Statistics of input and output used in the study classified by sector

Unit: Baht

Variables		2551		
Manufacturing	Mean	SD	Min	Max
Sales	71,580,667.22	113,959,007.81	180,869.76	774,665,547.64
COGS	64,186,832.97	106,879,564.26	149,692.00	765,260,276.89
TA	43,995,355.08	51,737,282.25	67,709.73	286,671,271.21
OpEx	6,682,410.74	9,518,114.56	5,982.25	70,062,637.00
Trade and maintenance				
Sales	67,687,237.49	114,454,035.15	127,500.00	932,460,586.86
COGS	62,867,750.46	109,337,212.71	40,286.07	845,193,921.50
TA	22,964,366.22	33,321,259.27	81,883.86	237,707,743.29
OpEx	5,263,407.30	9,667,320.16	4,000.00	88,237,689.90
Service				
Sales	26,532,387.78	42,900,559.58	34,838.87	281,626,223.64
COGS	17,598,503.77	30,416,565.38	22,464.00	210,864,803.97
TA	49,736,335.07	81,367,701.37	26,467.89	1,029,437,333.03
OpEx	5,685,378.99	10,113,407.25	25,932.70	80,107,213.66
				2552
Manufacturing	Mean	SD	Min	Max
Sales	72,626,292.97	112,485,433.43	181,264.47	1,042,957,234.97
COGS	64,482,278.27	104,150,712.76	153,516.00	926,175,204.93
TA	35,220,087.99	44,632,203.03	16,500.00	198,038,448.31
OpEx	12,974,586.80	9,731,111.61	3,132.21	67,654,194.00
Trade and maintenance				

Sales	66,481,161.27	123,832,984.79	35,240.00	1,583,853,308.31
COGS	61,013,743.87	117,562,541.33	13,800.00	1,476,055,658.27
TA	23,254,183.74	35,068,181.95	156,614.44	263,101,134.80
OpEx	5,373,076.91	9,757,443.17	8,788.56	103,146,246.29
Service				
Sales	24,621,021.92	38,756,341.58	76,155.00	217,390,657.34
COGS	16,608,900.86	27,949,558.01	47,930.29	183,241,014.22
TA	32,707,925.16	45,478,619.75	80,656.30	294,165,165.10
OpEx	5,426,578.26	9,888,830.16	8,713.83	96,058,737.51
				2553
Manufacturing	Mean	SD	Min	Max
Sales	76,886,503.69	112,796,894.57	155,552.16	764,338,836.00
COGS	68,485,925.14	105,001,012.61	75,189.46	648,336,042.00
TA	37,121,366.43	47,272,779.86	9,500.00	199,643,064.00
OpEx	6,820,000.97	11,975,349.39	5,134.82	142,267,822.63
Trade and maintenance				
Sales	77,000,134.03	143,542,870.86	10,660.00	1,634,438,294.81
COGS	71,028,475.43	136,630,924.93	1,200.00	1,521,515,949.89
TA	24,467,607.96	35,499,121.76	57,005.76	199,723,178.97
OpEx	5,663,164.85	10,345,422.77	22,795.71	108,289,939.60
Service				
Sales	26,455,654.02	40,175,310.83	170,000.00	268,816,483.36
COGS	18,019,280.61	29,063,471.49	55,377.21	185,717,359.61
TA	31,863,503.83	42,986,126.48	71,009.70	199,983,446.73
OpEx	5,956,915.00	12,662,638.01	36,974.15	147,274,171.81

Source: Computed from Ministry of Commerce (2011).

Table 1 shows the descriptive statistics of the data. Sample mean, standard deviations, minimum and maximum are presented. We found that, in 2008-2009, manufacturing sector had the highest sales volume about 72-73 million baht which is higher than trade and maintenance and service sector. In 2010, trade and maintenance sector had the highest sales about 77million baht which is higher than sales in manufacturing and service sector. Focusing on service sector, the volume of sales in the sector is lowest compare to other sectors. The sales figure is approximately 24-27 billion baht in 2008-2010.

Considering cost of goods sold (COGS) variable, we also found the same pattern as sales variable. Specifically, in 2008 and 2009, COGS of manufacturing sector is about 64 million baht which is higher than trade and maintenance and service sector. In 2010, trade and maintenance sector had highest COGS at 71 billion baht. Furthermore, we found that service sector had lowest COGS about 16-18 million baht compare to other sectors.

For assets item, the results show that, in 2008, the service sector had the highest assets approximately 50 million baht whereas, in 2009 -2010, manufacturing sector had the highest assets of 35 - 37 million baht.

In addition, manufacturing sector had the highest operating expenses in 2008-2010. Specifically, in 2008 and 2010, the operating expenses were about 7 million baht while in 2010 the expenses were around 13 million baht.

5. Empirical results

The data envelopment analysis is used to examine the level of relative efficiency of SMEs in Thailand and to measure the efficiency changes of SMEs in Thailand during 2008-2010. The empirical results are demonstrated in Table 2 and 3, respectively.

Table 2: Technical efficiency of SMEs from 2008-2010

Unit: Percent except 'n'

Categories	n	Technical Efficiency (VRS)			Note
		2008	2009	2010	
Overall	1,411	20.10	23.90	21.70	
Business Type					
A	16	88.90	91.30	96.70	Agriculture, hunting, forestry
B	3	100.00	100.00	100.00	Fishing
C	15	84.60	91.50	86.20	Mining and quarrying
D	264	67.00	58.40	51.40	Manufacturing
E	10	94.00	94.00	93.30	Electricity, gas, and water supply
F	47	83.80	65.40	69.20	Construction
G	760	31.30	33.00	28.10	Wholesale, retail trade, repair of motor vehicles
H	124	57.20	41.50	46.30	Hotels and restaurants
I	17	89.50	86.10	88.20	Transport and storage
J	7	79.90	92.00	87.00	Financial intermediation
K	88	37.80	58.50	52.50	Real estate activities
M	11	89.50	87.90	89.70	Education
N	16	81.20	81.90	91.10	Health and social work
O	33	75.00	87.40	65.10	Other community, social and personal service activities
Business Sector					
Manufacturing	354	63.00	54.60	47.50	
Trade and maintenance	760	31.30	33.00	28.10	
Service	297	26.90	36.90	36.40	
Region					
West	139	49.60	47.70	41.20	
East	186	58.90	50.50	57.30	
South	321	41.90	40.20	37.50	
North	197	25.70	51.80	51.90	
North eastern	214	26.40	35.70	41.10	
Central	354	43.90	54.20	35.50	
Size					
S	85	54.30	64.80	59.30	Small Scale
M	299	39.70	39.30	40.50	Medium Scale
L	1027	18.80	29.60	28.10	Large Scale

Source: Author's calculation.

According to Table 2, the empirical results show that Thai SMEs had quite low technical efficiency level in 2008-2010. The average technical efficiency score is approximately 20 percent which means Thai SMEs has plenty of room for improving their technical efficiency. In other words, an average Thai SMEs could have used 80 percent fewer input (which is measured by COGS, total assets and operating expenses) to produce the same amount of output(which is measured by sales).

In 2008-2010, SMEs had the low technical efficiency score which is only about 20 percent 24 percent and 22 percent, respectively. The results imply that there is the chance for

Thai inefficiency SMEs for improving the efficiency to the same level of the frontier SMEs by reducing input level at about 76-80 percent.

Comparing technical efficiency score by business type, we found that in, 2008-2010, SMEs in Fishing business had full efficiency with the technical efficiency score equal to 1. The results imply that these SMEs operate at most productive scale size. Furthermore, we found that, in 2008-2009, the technical efficiency score of SMEs in electricity, gas and water supply rank in the second place with the score about 96.7 percent in both years.

Focusing on business sector, the empirical results point that the manufacturing sector is the most efficiency SMEs with the highest efficiency score 63%, 54.6% and 47.5 % from 2008 to 2010, respectively.

In addition, we found that SMEs in different regions had different efficiency score. In 2008 and 2010, SMEs in east region had the highest technical efficiency score with 60% while SMEs in central region is the highest efficient SMEs in 2009. The efficiency score of central SMEs is approximately 54.2% in 2009. The second rank is SMEs in east region which had the score about 50.5%. The reasons for SMEs in east region is relatively high efficient organization could be the excellent location that provide the convenience of shipping.

This research further classify SMEs by size include small (S) medium (M) and large (L) scale follow the S M L definition of Department of Business Development, Ministry of Commerce. The detail of the definition is shown as follows. The SME is classified as small scale if total assets of the SME is less than or equal to 1 million baht. If the total assets is greater than 1 million baht but less than or equal to 5 million baht then that SME is classified as medium scale. Finally, if SME's total asset is greater than 5 million baht then it is classified as large scale.

Consequently, we apply DEA to SMEs data classified by SML scales. The results show that small SMEs had the highest technical efficiency score compare to medium and large SMEs. Specifically, in 2008-2010, the efficiency scores of small SMEs are 54-65 percent while medium and large SMEs had lower scores, respectively. The possible explanation for this finding could be small SMEs tend to have flexible organization structure compare to medium and large SMEs, therefore, the small SMEs could have quick and efficient coordination within the organization.

The second objective of this research is to measure the efficiency changes of SMEs during 2008-2010. The empirical results are demonstrated in Table 3.

Table 3: Efficiency Change of SMEs from 2008-2010

Categories	N	Technical efficiency change	Technological change	Total factor productivity (TFP) change	Note
Overall	1,411	0.845	1.658	1.401	
Business Type					
A	16	1.002	1.071	1.073	Agriculture, hunting, forestry
B	3	0.993	0.984	0.977	Fishing
C	15	1.116	0.873	0.974	Mining and quarrying
D	264	0.728	1.450	1.056	Manufacturing
E	10	0.995	0.907	0.902	Electricity, gas, and water supply
F	47	0.680	0.617	0.420	Construction
G	760	1.025	1.346	1.380	Wholesale, retail trade, repair of motor vehicles
H	124	0.619	1.553	0.961	Hotels and restaurants
I	17	1.225	0.884	1.083	Transport and storage
J	7	0.920	7.588	6.981	Financial intermediation
K	88	2.251	2.431	5.472	Real estate activities
M	11	0.931	1.115	1.038	Education

Categories	N	Technical efficiency change	Technological change	Total factor productivity (TFP) change	Note
N	16	1.234	1.170	1.444	Health and social work
O	33	0.845	1.248	1.055	Other community, social and personal service activities
Business Sector					
Manufacturing	354	0.684	1.760	1.204	
Trade and maintenance	760	1.025	1.254	1.285	
Service	297	1.232	1.312	1.616	
Region					
West	139	0.418	0.884	0.370	
East	186	1.252	2.102	2.632	
South	321	1.160	1.257	1.458	
North	197	2.752	2.005	5.518	
North eastern	214	1.251	1.340	1.676	
Central	354	0.682	2.543	1.734	
Size					
S	85	1.006	1.207	1.214	Small Scale
M	299	1.049	1.312	1.376	Medium Scale
L	1027	1.225	1.509	1.849	Large Scale

Source: Author's calculation.

The efficiency changes are reported in Table 3 using Malmquist Productivity Index. The table shows efficiency changes in 3 categories include 1) Technical efficiency change 2) Technological change and 3) Total Factor Productivity (TFP) change. If the figure of changes is greater than 1 then the changes have been in the better way otherwise the SMEs have not changes in the better way. If the figure equal to 1 that means there is no changes in efficiency.

As shown in the table, SMEs in overall have lower technical efficient level while those have higher technological change and TFP change level in 2010 compare to 2008. The results imply that although Thai SMEs have lower technical efficient level but the SMEs had the better technology adaptation in operating the business which is lead to better overall TFP changes.

Considering the efficiency changes of SMEs by business type, we found that SMEs in financial intermediation business have the highest score of technological and TFP changes. The possible reason could be SMEs in this business type for example the securities broker often seek to use the high technology in business transaction for providing the customer's convenience and for competing in the financial services business which need real time transactions. However, the SMEs in this business type had lower technical efficiency level.

In addition, the results point that the efficiency changes of SMEs in various business sectors are different. We found that SMEs in manufacturing sector have the highest technological changes and TFP changes level. This finding implies that SMEs in manufacturing have used the modern technology equipment for supporting the production. However, these SMEs had lower technical efficiency level while the technical efficiency changes of SMEs in trade and maintenance and service sector are greater than 1.

Classifying SMEs by region, we found that SMEs in all regions except SMEs in west and central regions had better technical efficiency changes level. Specifically, SMEs in north region had the highest technical efficiency changes. Furthermore, SMEs in central region had the highest technical efficiency changes and TFP changes level. The second rank is SMEs in east region. In conclusion, the results are consistent with Table 2.

Furthermore, the empirical results reveal that SMEs in different scale include small, medium and large scale all have the better technical efficiency changes and technological changes. These results lead SMEs to have a better TFP changes.

Discussion and conclusions

This study aims to investigate the technical efficiency level and the efficiency changes of Thai SMEs using Data Envelopment Analysis (DEA) approach. The sample consists of 1,411 SMEs from various sectors: manufacturing, trade and maintenance and service sector. The data from financial statements of SMEs during 2008-2010 are obtained from Ministry of Commerce database. The output measured by sales while input variables include COGS, total assets and operating expenses.

By applying DEA input oriented model, we conclude that Thai SMEs had low technical efficiency score at only 20-24 percent during 2008-2010. The empirical results reveal that Thai SMEs could reduce the resources usages which are Cost of Goods Sold, total assets and operating expenses at about 80 percent in order to produce at the same level of output. In addition, by using Malmquist Productivity Index, we found that during 2008-2010, Thai SMEs had lower technical efficiency changes level. However, these SMEs had higher technological changes level, therefore, the TFP changes level had improved.

This study uses quantitative data only in investigating the efficiency level and changes. Further study which considering qualitative data would make significant improvement. For example, the study that makes SMEs site visit and conduct dept-interviews in order to gathering qualitative data e.g. management's ability, organization's culture, employee's attitude etc. would add value to the study. Then, ones could explore the relationship between those qualitative data with the efficiency score. The study that combines both quantitative and qualitative data in explore the efficiency level of SMEs would make substantial contributions.

References

[1] Barr, R.S., Killgo, K.A., Siems, T.F. and Zimmel, S. (2002). Evaluating the productive efficiency and performance of U.S. commercial banks, *Managerial Finance*, 28(8): 3-25.

[2] Burns, P. and Dewhurst, J. (1996). *Small business and entrepreneurship*, 2nd Edition, Macmillan Business, Basingstoke.

[3] Bushong, J.G. (1995). *Accounting and auditing of small businesses*, Garland, New York.

[4] Charnes, A., Cooper, W.W., Lewin, A.Y. and Seiford, L.M. (1994). *Data Envelopment Analysis: Theory, methodology and applications*, Kluwer Academics Publishers, Boston.

[5] Charnes, A., Cooper, W.W. and Rhodes, E. (1978). Measuring the efficiency of decision making units, *European Journal of Operational Research*, 2(6): 429-444.

[6] Charoenrat, T. and Harvie, C. (2012a). *Technical efficiency of Thai manufacturing SMEs: a comparative study of north-eastern provinces*, Working Paper Series 2012 No. WP 12-03, Working Paper, University of Wollongong.

[7] Charoenrat, T. and Harvie, C. (2012b). *Technical efficiency performance of Thai manufacturing small and medium sized enterprises*, Faculty of Commerce-Paper, University of Wollongong.

[8] Coelli, T.J., Rao, D.S.P., O'Donnell, C.J. and Battese, G.E. (2005). *An introduction to efficiency and productivity analysis*, Springer Science and Business Media, New York.

[9] Cortes, M., Berry, A. and Ishaq, A. (1987). *Success in small and medium scale enterprises: The evidence from Colombia*, New York: Oxford University Press.

[10] Farrell, M.J. (1957). The measurement of productive efficiency, *Journal of the Royal Statistical Society*. Series A (General), 120(3): 253-290.

[11] Gholami, R., Moshiri, S. and Lee, S.-Y.T. (2004). ICT and productivity of the manufacturing

industries in Iran, *The Electronic Journal on Information Systems in Developing Countries*, 19(4), 1-19.

[12] Harper, M. and Soon, T.T. (1979). *Small enterprises in developing countries: Case studies and conclusion*, Intermediate Technology Publications, London.

[13] Holmes, S., Hutchinson, P., Forsaith, D., Gibson, B. and McMahon, R. (2003). *Small enterprise finance*, John Wiley and Sons Australia, Australia.

[14] Liedholm, C. and Mead, D. (1987). *Small scale industries in developing countries: Empirical evidence and policy implications*, Working Paper, Department of Agricultural Economics, Michigan State University.

[15] Little, I.M.D., Mazumdar, D. and Page, J. (1989). *Small manufacturing enterprises in developing countries: A comparative study of India and other countries*, A World Bank Research Publication.

[16] Meingchom, N. (2007). *Efficiency measurement by DEA in SME industrial group'*, thesis, Department of Industrial Engineering and Management, Graduate School, Silpakorn University, Bangkok [in Thai].

[17] Mini, F. and Rodriguez, E. (2000). Technical efficiency indicators in a Philippine manufacturing sector, *International Review of Applied Economics*, 14(4): 461-473.

[18] Radam, A., Abu, M.L. and Abdullah, A.M. (2008). Technical efficiency of small and medium enterprise in Malaysia: A stochastic frontier production model, *International Journal of Economics and Management*, 2(2): 395-408.

[19] Snodgrass, D.R. and Biggs, T. (1996). *Industrialization and the small firm: Patterns and policies* ICS Press

[20] Taymaz, E. (2005). Are small firms really less productive?, *Small Business Economics*, 25(5): 429-445.

[21] Wiboonchutikula, P. (2002). Small and medium enterprises in Thailand: Recent trends, *Small Business Economics*, 18: 213-226.

[22] Zahid, Z. and Mokhtar, M. (2007). *Estimating technical efficiency of Malaysian manufacturing small and medium enterprises: A stochastic frontier modelling*, Proceedings of the 4th SMEs in a Global Economy Conference 2007, Shah Alam Selangor, Malaysia.

*** Office of Small and Medium Enterprises Promotion 2011a. *The white paper on Small and Medium Enterprises of Thailand in 2010 and trends 2011*.

*** Office of Small and Medium Enterprises Promotion 2011b. *White paper on SMEs 2010 and trends 2011 [in Thai]*.

THE USE OF COMMERCIAL CREDIT POLICY TO INCREASE THE COMPANY VALUE

Marius Sorin DINCĂ[11]
Transilvania University, Braşov, **Romania**
msdinca@yahoo.com
Gheorghița DINCĂ
Transilvania University, Braşov, **Romania**
msdinca@yahoo.com

Abstract:

The objective of sustainable increase in company value involves as a major component the financial management of account receivables, as it represents the main interface of the company with the most important part of the stakeholders' community. In this context, the account receivables have to be treated as a continuous short term investment the company makes in order to secure a stable and growing portfolio of customers.

In our article we are trying to set the commercial credit using an analytical framework that deals with quantity, prices, discounts, instead of using overall measures, such as sales turnover and profit. This approach allows the financial and sales managers to have a more efficient intervention upon the variables of the commercial credit policy, both in the ex-ante, setting phase of the commercial credit, as well as in the ex-post phase of analysis and correction of the results. Also, we have tried to connect the commercial credit policy with the need for a more efficient use of the existing production capacity, given the obvious cost and price advantages that a company gets when it increases the quantity of products sold.

Our paperwork is a theoretical approach that follows to offer a model for configuring the commercial credit policy by the mean of a qualitative approach that uses indexes, weights and the correlation between the evolution of quantity and the evolution of prices.

Keywords: financial management of account receivables; commercial credit policy; short term investment; variable cost margin; discount period; marginal profit.

JEL Classification: G31; G32

1. Introduction

Attaining the company's primary objective of increasing its value implies a harmonization between the interests of the company and the interests of the other stakeholders, with a special focus on its clients.

The main vectors of achieving the objective of increasing the company value are the investments. The company has to invest in its employees, in new products and technologies, in tangible and intangible assets, in its image, in the local community in order to create the necessary capacities, abilities and development framework necessary for a long-term and sustainable increase of its sales and profits. Also, essential components of these investments are its clients. Even if the account receivables are short-term investments, the company has to plan and implement a well-defined strategy of customer-oriented actions. Part of this strategy involves granting constant commercial credit to its customers, which is actually a short-term but repeated financial investment.

Two important American authors (Brigham and Houston, 2009) maintain that credit policy is important because it has a significant influence on sales, determines the investment of the company in clients and it affects the losses from bad debt. Quite often, the companies are looking to correlate their commercial credit policy with the necessity of a better use of the existing production and selling capacity. This implies that they employ the commercial credit as a mean to increase the efficiency of past production and distribution investments.

In our approach we intend to present the setting of the commercial credit using an analytical context, which involves defining variables such as the quantity of products sold on discount, the quantity of products sold on credit, the discount price and the full invoice price. This action will allow the financial and sales departments of the company to employ more precise means in the ex-ante

[11] Department of Finance, Accounting and Economic Theory, Faculty of Economic Sciences and Business Administration, Transilvania University, Braşov, Romania.

setting phase of the commercial credit, as well as an improved set of tools of ex-post adjusting the parameters of the credit policy.

2. The correlation between the commercial credit policy and the need to maximize the efficiency of existing production capacity

In an effort to increase the quantity of products sold and to maximize the efficiency of existing productive assets, companies often grant discounts from their selling prices. The purpose for this action is the reduction of the fixed cost component of the unit cost (and implicitly of the full unit cost) through the increase in the quantities sold which in turn allows for price discounts to encourage the increase in sales. The topic was addressed by various authors (Friedlob and Schleifer, 2003; Ross, Westerfield and Jaffe, 2006), however without connecting it with the commercial credit policy.

In what follows we are trying to show a way in which we can integrate the commercial credit policy with the action of maximizing the efficiency of existing production capacity.

As a result of the increased quantities ($q_1 > q_0$) we get a lower fixed unit cost component (fc_1), compared to the existing level (fc_0):

$$fc_1 = \frac{FC_1}{q_1} \qquad (1)$$
$$fc_1 < fc_0$$

where:

FC_1 – the level of total fixed costs following granting the discounts, also equal with the previous level of the total fixed costs (FC_0).

As a result of the decrease of the unit costs the company will be able to grant a discount in its selling prices, needed for the increase in sales.

If in the relation no. 1 we divide both terms by unit fixed costs from the previous period (fc_0) we get:

$$\frac{fc_1}{fc_0} = \frac{\frac{FC_1}{FC_0}}{\frac{q_1}{q_0}}$$

or

$$Index\ of\ unit\ fixed\ costs = \frac{Index\ of\ total\ fixed\ costs}{Index\ of\ quantities\ sold} = \frac{1}{Iq} \qquad (2)$$

As we are operating inside the existing production capacity, the total fixed costs will remain the same, respectively they will have an index equal to 1.

For example, if we register an increase by 10% of the quantities sold the index of the unit fixed costs will be of 0.9090, respectively they will decrease by 9.1%.

The influence upon the complete unit costs will be intermediated by the variable unit costs (*v*):

$$c_1 = fc_1 + v_1$$

If we divide by previous complete unit costs c_0 we will get:

$$\frac{c_1}{c_0} = \frac{fc_1}{c_0} + \frac{v_1}{c_0}$$

In the right term we will further divide both the numerator and the denominator with the previous unit fixed costs (fc_0), respectively by previous variable unit costs (v_0) we get:

$$Index\ of\ complete\ unit\ cost = \frac{\frac{fc_1}{fc_0}}{\frac{c_0}{fc_0}} + \frac{\frac{v_1}{v_0}}{\frac{c_0}{v_0}} = I_{fc} \cdot wf_0 + I_V \cdot wv_0$$

where:

I_{fc}– the index of unit fixed cost;

I_v – the index of unit variable cost;

wf_0 – the weight of unit fixed costs into complete unit costs previous to the action;
wv_0 – the weight of unit variable costs into complete unit costs previous to the action.

Having in mind that the index of unit fixed costs depends upon the index of quantities (Eq. 2) and that usually the unit variable cost does not change in the short term (they have an index equal to one) we get:

$$I_C = \frac{wf_0}{I_q} + wv_0 \quad (3)$$

The Equation 3 tells us that in the aftermath of granting the discount, the complete unit costs can decrease according to the increase of the quantities sold and depending upon the previous weight of the unit fixed and variable costs into the complete unit costs.

For example, if previously to modifying the commercial credit policy the company registered a weight of 30% fixed unit costs and 70% variable unit costs and the result of its action is an increase by 15% of the units sold, then the index of complete unit costs of the company should be 0.3/1.15 + 0.7, or 0.9608. This means that the result of this action should be a reduction of the complete unit costs of approximately 4%.

If the previous complete unit cost was 25 lei, then the action should determine a decrease to 24 lei of the complete unit cost, allowing the company to grant a price discount of maximum 1 leu. If the previous selling price was 32 lei, then the company can grant a discount of maximum 3% from the original price in order to promote its actions of increasing the efficiency of the productive assets.

Normally, this action should represent an integrant part of the commercial credit policy, which is intended to promote the sustainable increase of the company profits through the efficient use of the productive assets of the company and by keeping harmonious relations with the company clients.

The index of sales can be expressed as a product between the index of quantities and the index of prices:

$$Index\ of\ sales = Index\ of\ quantities \times Index\ of\ prices$$

The idea of granting the discounts in order to increase the sales assumes that the forecasted increase in quantities sold will more than compensate the decrease in prices, or $I_q \times I_P > 1$, where the index of prices (Ip) can be determined as follow:

$$I_P = \frac{\sum_{i=1}^{n} q_{i1} p_{i1}}{\sum_{i=1}^{n} q_{i1} p_{i0}}$$

The situation can be expressed as in Figure 1 below:

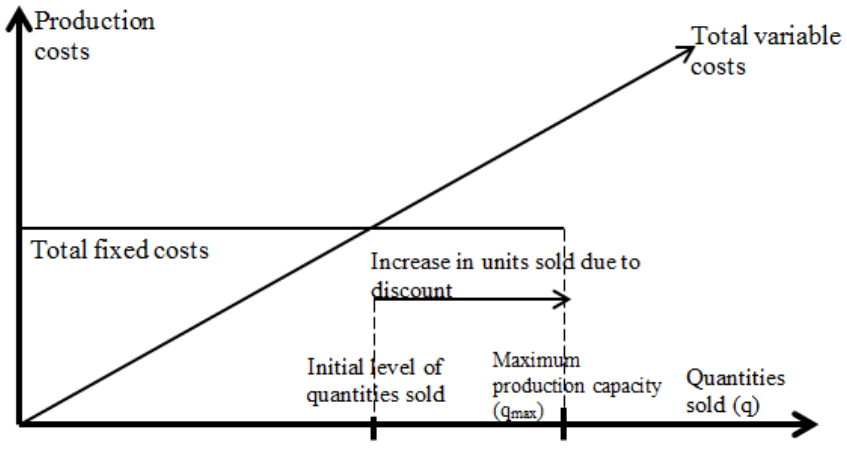


Figure 1. The correlation between quantity and prices under existing production and sales capacity

For example, a company can offer a 4% discount (a price reduced from 50 lei to 48 lei) as part of its commercial credit policy, in view of getting a 10% increase in sales. The managers rely on the

combined effect produced by the increase in the quantities sold and the decrease in prices in order to obtain the anticipated growth of sales. If after the discount the quantities sold increase by 15%, from 10,000 units to 11,500 units, they will hereby compensate the 4% discount and will generate a 10.4% increase in sales turnover (from 500,000 lei to 552,000 lei). In its turn, the evolution of the profit will be influenced by the 15% increase in quantities sold upon the unit fixed cost component.

Should a company finds itself in a situation similar to the one described in Figure 1, the increase in the quantities sold toward the maximum production capacity will determine a significant decrease in the complete unit cost (by the mean of the unit fixed cost component) which allows for the preservation or even increase of the profit margin existing from previous granting the discount.

The profit margin can even decrease, however the total operating profit will increase since the higher than one index of quantities sold will more than compensate the lower margin.

The relations could be formally expressed as follows:

- The evolution of sales turnover as a result of the discounts granted (the company wants to increase its sales turnover):

$$I_{ST} = I_q \cdot I_p > 1$$

- The relationship is governed by the rule of the complement to one, respectively a 5% decrease of the selling price (a discount granted in view of increasing the quantities sold) can be compensated only by a 5.26% increase in the quantities sold (if available).
- The evolution of operational profit as a result of the operation:

$$Index\ of\ profit = Index\ of\ quantity \cdot Index\ of\ profit\ margin > 1$$

- The profit margin is given by the difference between the price and the unit variable cost:

$$\text{profit margin} = \text{price} - \text{unit variable cost}$$

We are using the unit variable cost instead of complete unit cost, as when we operate inside the existing production capacity the overall fixed cost remain the same.

From the perspective of reaching the company's primary objective, the accounts receivable have to be considered as short-term investments, an important component of the overall investment strategy. The companies invest in their clients in order to get higher sales revenues and therefore bigger profits. But nevertheless the increase of the profit does not have to be recorded in the first trimester, semester or even in the first year. It is preferable to register a steady increase of the profits (over several years), even if the rate of increase it is not spectacular. Authors, such as Brealey and Myers (2001), Stancu (2003) and Palepu and Healy (2006), consider that we can integrate the account receivable investment into a NPV analysis, carried over several years. We have to mention that the activity of commercial credit can contribute to the increase of company profits from two sources:

- It can lead to the increase of the operating profit, because the commercial credit entails the increase of sales turnover, which leads to higher profits, if the company succeeds to maintain the variable costs margin;
- It can lead to the increase of a financial component of the operating profit of the creditor company, should the increased selling price will more than compensate the supplementary financing costs induced by instating the commercial credit.

Starting from the works of Helfert (2001), Stancu (2002), Fabozzi and Peterson (2003), Ehrhardt and Brigham (2006), Brealey and Myers (2003), Brigham and Houston (2009) we are intending to present a methodological analytical approach to the setting phase of the commercial credit, which is meant to ensure the profitability, liquidity and sustainability of the credit, as an essential component of the operating activity.

3. Setting of the commercial credit in the analytical framework

The commercial credit policy is defined by elements such as the *discount period* (in which the clients pay on spot or after several days motivated by a discount granted against the full invoice price), the *credit period* (for the clients that opt to buy on credit and pay the full invoice price), the *settlement date*, the *variable costs margin*, the *annual profitability* of the commercial credit, the *cost of the*

discount granted, the *cost of the capital invested* in clients and the *marginal profit* obtained as a result of granting/modifying the commercial credit. To present our analytical approach we shall also employ the *quantity purchased in the discount period* with the discount price as well as the *quantity purchased in the credit period* with the full invoice price.

An analytical approach in what concerns setting the commercial credit policy was presented by Ross, Westerfield and Jordan (2005). They stated that the NPV of modifying the terms of the credit policy is given by:

$$NVP = -[q_0 p + (q_1 - q_0)v] + \frac{[(q_1 - q_0)(p - v)]}{r}$$

where:

q – the quantity of product sold under previous conditions (index 0), respectively under the new credit terms (index 1);

p – the price of products sold;

v – the variable unit cost;

r – the monthly required return.

However, the fore-mentioned authors did not go further with the analysis in order to differentiate between the quantities sold on discount and the quantities sold on credit, as well as between the discount price and the full invoice price.

4. The gross profit from extending the commercial credit

In order to have a proper setting of the commercial credit, which will ensure both the profitability and liquidity targets as well as its acceptance by the clients, the company instating/modifying the commercial credit has to determine several financial components, such as: the gross profit, the supplementary costs emerged from the credit and finally the marginal profit, as compared to the previous state, when the company sold only against cash (Stancu, 2002; Fabozzi and Peterson, 2003, Brigham and Houston, 2009).

As we mentioned previously, the main objective of extending the commercial credit is represented by the increase of the profit due to higher sales (Stancu, 2002, Fabozzi and Peterson, 2003). This objective does not always concern the short term, as sometimes it can take several months or even one year until bigger sales lead to increased profits for the company extending the commercial credit.

The profit the company obtains from granting the commercial credit (Pr_1) can be expressed (Ross, Westerfield and Jordan 2009) according to the sales turnover (ST_1) and the variable costs margin (vm_1):

$$Pr_1 = ST_1 \times vm_1$$

Since the company sales are generated both from discounted sales (which use the discounted price,p_0) and from credit sales (which use a higher price,p_1), we can determine the sales turnover as follows:

$$ST_1 = q_{1d} p_0 + q_{1cr} p_1$$

where:

q_{1d} – The quantity of products sold in the discount period;

p_0 – The discount price, the same as the price charged previously when the company sold only against cash;

q_{1cr} – The quantity of products sold in the commercial credit system;

p_1 – The full invoice price charged to the clients that buy on credit.

The full invoice price, p_1, is given by:

$$p_1 = p_0(1 + rdp)$$

where:

rdp – the rate of discount for one period of credit;

$$rdp = \frac{discount}{1 - discount}$$

If we are considering a specific situation in which 25% of the quantities (1/4) are bought by the clients in the discount period and the rest of 75% (3/4) are bought through commercial credit ($q_1 = q_{1d} + q_{1cr}$) the sales can be expressed as follows:

$$ST_1 = \frac{q_1}{4}p_0 + \frac{3q_1}{4}p_0(1 + rdp) = \frac{q_1}{4}p_0(4 + 3rdp)$$

In its turn rate of return from one credit period (*rdp*) is determined as follows:

- If we replace the *rdp* formula into the previous expression we get:

$$ST_1 = \frac{q_1}{4}p_0\left(4 + 3\frac{discount}{1-discount}\right) = \frac{q_1}{4}p_0\frac{4-discount}{1-discount} = q_1p_0\frac{4-discount}{4(1-discount)};$$

- We also can express the sales according to the new full invoice price (p_1):

$$ST_1 = \frac{q_1}{4}\frac{p_1}{1+rdp}\frac{4-discount}{1-discount} = \frac{q_1}{4}\frac{p_1}{1+\frac{discount}{1-discount}}\frac{4-discount}{1-discount} = \frac{q_1}{4}p_1(4 - discount) = q_1p_1\frac{4-discount}{4};$$

- The variable costs margin (vm1) can be calculated as follows:

$$Vm_1 = \frac{Price - Variable\ cost\ per\ unit}{Price} = \frac{\overline{p_1} - v_1}{\overline{p_1}};$$

where:

$\overline{p_1}$ – the average price charged by the company after instating the commercial credit;

v_1 – the unit variable cost after instating the credit, usually equal to the previous unit variable cost, v_0

- The average price can be determined as follows:

$$\overline{p_1} = p_0\frac{q_{1d}}{q_1} + p_1\frac{q_{1cr}}{q_1};$$

After all this calculus, the gross profit from instating the commercial credit can be expressed:

$$GP_1 = ST_1 \cdot Mcv_1 = q_1 \times \overline{p_1} \cdot \frac{\overline{p_1} - v_1}{p_1} = q_1(\overline{p_1} - v_1);$$

where:

q_1 – the quantity of products sold as a result of instating the commercial credit. Normally, the quantities sold increase after extending the credit, compared to the quantities sold initially (q_0), or $q_1 > q_0$;

$\overline{p_1}$ – the average price practiced after granting the credit. Under normal conditions (in which the company does not want to diminish its operating profit as a result of granting the discount and of covering the financing costs for the credit period) this price will be higher than the previous price, that is $\overline{p_1} > p_0$;

v_1 – the variable unit cost, after granting the credit and made up usually of material costs and direct salaries. It is likely that this cost will not differ significantly from the variable unit cost registered initially (v_0), as these costs does not usually modify with the evolution of quantities sold.

We can notice that the profit obtained as a result of granting the commercial credit depends upon the quantities sold, the new full invoice price and the variable unit costs. The profit obtained in the initial conditions when the company sold its products only against cash, can also be expressed as a product between the sales turnover and the variable cost margin:

$$Pr_0 = ST_0 \times vm_0 = q_0 p_0 \times \frac{p_0 - v_0}{p_0} = q_0(p_0 - v_0)$$

In the first analysis, the profit obtained as a result of instating the commercial credit is significantly higher compared to the previous profit, as both the quantities sold and the variable cost margin are higher ($q_1 > q_0$ and $vm_1 > vm_0$) compared to the values registered before.

Nevertheless there are other elements that appear as a result of extending the commercial credit, such as the cost of granting the discount, the administration costs, and the cost of low quality receivables. All these are significantly reducing the marginal profit obtained after granting the credit compared to the profit obtained previously when the company sold only against cash.

5. The supplementary costs due to granting the commercial credit

The commercial credit carries on not only extra gains for the company but also some supplementary costs.

Firstly, once the commercial credit is extended, the company has to employ extra personnel in order to keep the evidence of each selling act and of each client, no matter if he buys in the cash and carry arrangement or via the commercial credit. Beside the supplementary costs with the personnel, there are supplementary material costs, rent, communication costs, depreciation and amortization. All these costs create the administration costs of the commercial credit.

Secondly, we have the cost of the discount granted. This is not a cost per se, but rather an unrealized profit, as the company does not earn the *rdp* upon the clients that buy against cash, granting them a discount against the full invoice price, paid by the clients that buy on credit.

The cost of the discount granted (*Cd*) is determined as follows (Fabozzi, Peterson, 2003):

$$Cd = ST_1 \times Share\ of\ clients\ buying\ on\ cash \times Value\ of\ the\ discount;$$

We can also express the cost of discount analytically (according to quantities and prices):

$$Cd = q_{1d} p_1 \times Discount = q_{1d} p_0 (1 + rdp) \times Discount = q_{1d} p_0 \left(1 + \frac{Discount}{1 - Discount}\right) Discount = q_{1d} p_0 \frac{Discount}{1 - Discount};$$

Thirdly, another supplementary cost is the *cost of the capital invested* (immobilized) in the account receivables. For the period between the end of the discount period and the final settlement day, the company remains without funding to continue its activity, as it delivers goods in which it invested money based only on the promise to pay. For that period of waiting the company has to pay its employees, suppliers, taxes as well as the interests toward the banks that finance the lack of funding as a result of the credit sales.

The cost of the capital invested (Cki) can be determined as such:

$$Cki = \frac{ST_1 \times Share\ of\ clients\ that\ buy\ on\ credit}{Number\ of\ crdit\ periods} \times Vcr \times Roc,$$

where:

- *The number of credit periods* is determined dividing 365 by the length of the credit period;
- *Vcr* stands for the variable cost rate and it expresses the share of one Leu of sales represented by the money invested by the company in order to get that Leu of sales;
- *Roc* is the rate of opportunity cost, respectively the level at which the company could otherwise employ the money it invests in the commercial credit granted to its customers. As opportunity cost rate we can use several measures, such as the RONA or ROA profitability rates.

Using the analytical approach we can express the cost of capital invested:

$$Cki = \frac{q_{1cr}p_1}{Number\ of\ credit\ peiods} \times \frac{v_1}{p_1} \times Roc = \frac{q_{1cr}p_1}{Number\ of\ credit\ peiods} \times Roc,$$

The product between the variable cost rate and the average sales from one credit cycle gives us the company investment in one credit sales cycle:

$$The\ Investment\ for\ one\ cycle = \frac{q_{1cr}v_1}{Number\ of\ credit\ peiods}.$$

Finally, if we multiply the investment with the rate of the opportunity cost we get the cost of capital invested in clients. Depending on the quality of the newly attracted clients as a result of instating the commercial credit we can register another category of costs, the cost of the low quality account receivables. This arises from the costs due to slow recovery of the receipts or from the losses coming from the defaulting customers. The cost of the low quality receivables can be expressed as a share from the supplementary sales brought on by the commercial credit or from total sales obtained after instating the commercial credit.

6. The marginal profit resulted from the setting of the commercial credit

The efficiency of extending the commercial credit can be synthetically appreciated by comparing the profit obtained after instating the credit ($Profit_1$) with the profit obtained previously ($Profit_0$), when the company sells only in the cash system:

$$\Delta Profit = Profit_1 - Profit_0 > 0,$$

The financial efficiency of the commercial credit is realized when the difference is positive or $Profit_1$ is bigger than $Profit_0$. Nevertheless the profit that will be obtained after instating the credit ($Profit_1$) has to take into account the due supplementary costs:

$Profit_1$ = Gross profit after granting the credit – (Cost of discount + Cost of capital invested in clients + Administrative costs + Cost of low-quality receivables).

We recall that gross profit from granting the credit can be determined as follows (GP_1):

$$GP_1 = ST_1 \cdot mv_1 = q_1(\overline{p_1} - v_1)$$

The difference toward the initial profit ($Profit_0$) is that the latter does not have associated costs, as the sales were done only against cash and do not imply any efforts to keep the evidence of sales or of recovering the money. After setting up the credit policy, the effective results obtained after the implementing of the commercial credit can be analyzed by the mean of various financial measures (Brealey, Meyers, 2001; Friedlob and Schleifer, 2003; Ross, Westerfield and Jaffe, 2009) and correction measures can be taken by the financial and sales managers.

Conclusions

We have shown that the commercial credit policy should be correlated with the need for a better use of the existing production and selling capacities, given the usual response of the clients (of the demand) to the initiatives of the companies offering discounts. Normally, the clients will buy more should they receive a price discount.

In such a situation, the offering company cannot, in fact, increase the full invoice price as a reflection of the advantages received by the customer which delays his payment according to the conditions of the credit policy. The company actually decreases the price, mainly for the discount period buyers, which will register an advantage (equal to the discount), should they decide to use the cash payment.

For the offering company, the discount leads to a reduction in the selling price which is made possible by the decrease of the unit fixed cost component obtained as a result of the higher volume of physical sales allocated upon the same overall fixed cost. We have determined the index of the

complete unit cost as a function of the weights of fixed and variable cost and the index of quantities sold.

Secondly, we have presented the way in which we can set the terms of the commercial credit policy taking into account the quantities, the prices, discounts and variable cost margins. The proper setting of these variables allows the managers from the financial and sales departments to configure the credit policy or to adjust it in the ex-post analysis and correction measures.

References

[1] Brealey, R.A., Myers, S.C. (2003). *Principles of Corporate Finance*, 7th Edition, *McGraw-Hill.*

[2] Brigham E. F., Houston, J.F. (2009). *Fundamentals of Financial Management*, 12th Edition, South-Western Cengage Learning.

[3] Dincă, M., Dincă, G., Botiș, S. (2006). *Finanțe, Monedă și Credit*, University Publishing House, Brașov, *in Romanian*.

[4] Ehrhardt, M. C., Brigham E. F. (2006). *Corporate Finance: A Focused Approach*, 2nd Edition, New York.

[5] Fabozzi, F.J., Peterson, P.P. (2003). Financial Management and Analysis, *John Wiley & Sons, Inc.*, Hoboken, New Jersey.

[6] Friedlob, G.T. and Schleifer, L.L.F. (2003). *Essential of Financial Analysis*, John Wiley & Sons, Inc., Hoboken, New Jersey.

[7] Helfert, E.A. (2001). *Financial Analysis Tools and Techniques, A Guide for Managers*, McGraw-Hill.

[8] Moyer, R.C., McGuigan, J.R. and Kretlow, W.J. (2006). *Contemporary Financial Management*, 10th Edition, Thomson Southwestern Publishing House.

[9] Palepu, K., Healy, P.M. (2006). *Business Analysis and Valuation*, South-Western College Publishing House.

[10] Ross, S.A., Westerfield, R.W., Jaffe, J. (2006). *Fundamentals of Corporate Finance*, 7th Edition, McGraw-Hill International.

[11] Stancu, I. (*2003). Finance*, Economica Publishing House, Bucharest, *in Romanian.*

WEATHER EFFECTS ON RETURNS AND VOLATILITY: EVIDENCE FROM MOROCCO

Mohammed MRAOUA[12]
Mohammed V University – Agdal, **Morocco**
mohammed.mraoua@hec.ca
Rachid ELLAIA
ellaia@emi.ac.ma
Abdelkhalak EL HAMI
L'Institut National des Sciences Rouen, **France**[13]
abdelkhalak.elhami@insa-rouen.fr

Abstract:
This paper seeks to examine the empirical association between weather and the Casablanca stock market returns and volatility. We choose stock indexes of three weather-sensitive sectors that account for 40% of Morocco's GDP to test the impact of weather on the Moroccan economy. We use an autoregressive linear regression model for stock returns with a GARCH(1,1) process to capture time-varying volatility. Instead of temperature, we introduced two variables, Cooling Degree Days and Heating Degree Days, which constitute the most commonly used underlying for weather derivatives. Our goal is to motivate the introduction of these financial products in Morocco. Indeed, weather derivatives might be a good hedging instrument for weather risk.

Keywords: weather derivative, weather effect, index returns, volatility, GARCH.

JEL Classification: C22, C51, G10.

1. Introduction

Weather has a significant impact on several spheres of the economic activity. The list of activities subjected to the weather risk is long and includes energy producers and consumers [Mu, (2007)], agricultural producers [Sivakumar and Motha, (2007)], supermarkets chains, industry of leisure [Bank and Wiesner, (2011); Khattabi, (2009); Tang and Jang, (2011)] and food industry. The potential market related to this kind of risk is large in magnitude. According to Pollard *et al.*, (2008), 70% of UK firms may be affected by the weather; in the USA, estimates suggest that between 25% and 42% of the US GDP is weather sensitive.

While severe weather and weather events impact all countries, they more severely impact developing countries and their economy. Just about the only sector of agriculture, the statistics are revealing. Whalley and Yuan, (2009) reported that the rural sector contributes 21% of GDP in India and 39% in Malawi, 61% and 64% of population in South Asia and sub-Saharan Africa are employed in the rural sector. In Morocco, three sectors ("agriculture, forestry and fisheries", "energy and construction", and "trade, hotels and restaurants") that are subject to weather conditions account for 40% of the Moroccan GDP [Gommes *et al.*, (2009); Requier-Desjardins, (2010); Sahay and Dorsey, (2011)].

2. Weather derivatives

To manage weather risk, companies rely on insurance. Unfortunately, few classical insurance mechanisms deal with weather risk [Gurenko, (2007); Sturm and Oh, (2010)]. Singh, (2006) supported that in agriculture, for example, traditional multi-peril crop insurance has not proven effective, particularly in the case of smallholders, and often excludes weather factors such as drought. To circumvent these difficulties, weather derivatives have emerged as new hedging products [Singh, (2006); Sturm and Oh, (2010)]. Weather derivatives are financial contracts whose payouts depend in a certain way on weather. The underlying variables can be, for example, the temperature, the rainfall,

[12] Mohammed V University – Agdal, Mohammadia School of Engineering, Laboratory of Study and Research in Applied Mathematics – LERMA, Rabat, BP. 765, Ibn Sina Avenue, Morocco.

[13] LOFIMS EA 9828 CNRS, INSA Rouen, Saint-Étienne-du-Rouvray, France

the snow or the frost, but it is the temperature which constitutes the most used underlying for weather derivatives [Dischel, (2002); Geman, (1999); Mraoua and Bari, (2007)].

Weather derivatives differ from conventional derivatives in that there is no original, negotiable underlying or price of an underlying, which normally forms the basis of any derivative. For example, financial derivatives are based on stocks, stock index, interest rates, exchange rates or currencies - all of which are themselves tradable assets, unlike the weather. The underlying of weather derivatives is based on weather conditions data, such as on the temperature or the rainfall, which influence the trading volume of some goods. Weather derivatives cannot hedge the price of the underlying, as it is impossible to put a price on the weather. Consequently, weather derivatives hedge other risks on which the weather has a big influence, such as the risk of declining sales in the energy and power sector as a result of a change in the weather and the price changes that could result from this. The idea behind a weather volume hedge is that the results of weather-sensitive sectors can be subject to great volatility - even if prices remain unchanged - due to a change in demand or volume.

There are two main motivations for this paper. First, although several studies are focused on the impact of weather on the major financial markets, very few studies have focused on the emerging markets and no study has been devoted to the Moroccan market, to the best of our knowledge [Cao and Wei, (2005); Chang *et al.*, (2008); Goodfellow *et al.*, (2010); Lee and Wang, (2011); Lu and Chou, (2012)].

Second, all previous studies have focused on the weather based on direct variables (temperature, rainfall, etc.), or through dummy14 [Chang *et al.*, (2006); Kang *et al.*, (2010); Symeonidis *et al.*, (2010); Yoon and Kang, (2009)]. No previous studies has addressed the weather variables as an underlying of a derivative and then test the effect of variation of these variables on the stock index, to our knowledge. In this context, we constructed two variables that constitute the most commonly used underlying in weather derivatives markets to motivate their introduction into the Moroccan market.

3. Data and methodology

Stock market data

We considered the daily closing prices of four Casablanca Stock Exchange (CSE) index. The MASI index is a value-weighted index of all securities coated on CSE. The three other sector index AGRI, PLGZ, LSHT are respectively, the agriculture sector index, the energy sector index and the leisure and hotels sector index. The data cover the period from January 2nd, 1992 until December 30th, 2011 for MASI, AGRI and PLGZ and from June 1st, 2006 to December 30th, 2011 for the LSHT index.

Figure 1 shows the daily evolution for our four stock indexes. Figure 2 shows their daily returns dynamics with the clustering volatility effect. For each day t, the stock index return is given by:

$$\ln(S_t/S_{t-1}) \tag{1}$$

where: - S_t is the current day stock index price;
S_{t-1} the previous day price.

[14] Other studies, from a psychological point of view, have investigated the weather effect on human behavior, particularly in the decision making process [Dowling and Lucey, (2005); Kelly and Meschke, (2010); Stracca, (2004)]. The case of an investor (or a trader) that makes decision to buy or sell stocks depending on his mood (subject to weather conditions) is a classic illustration [Daniel *et al.*, (2002)].

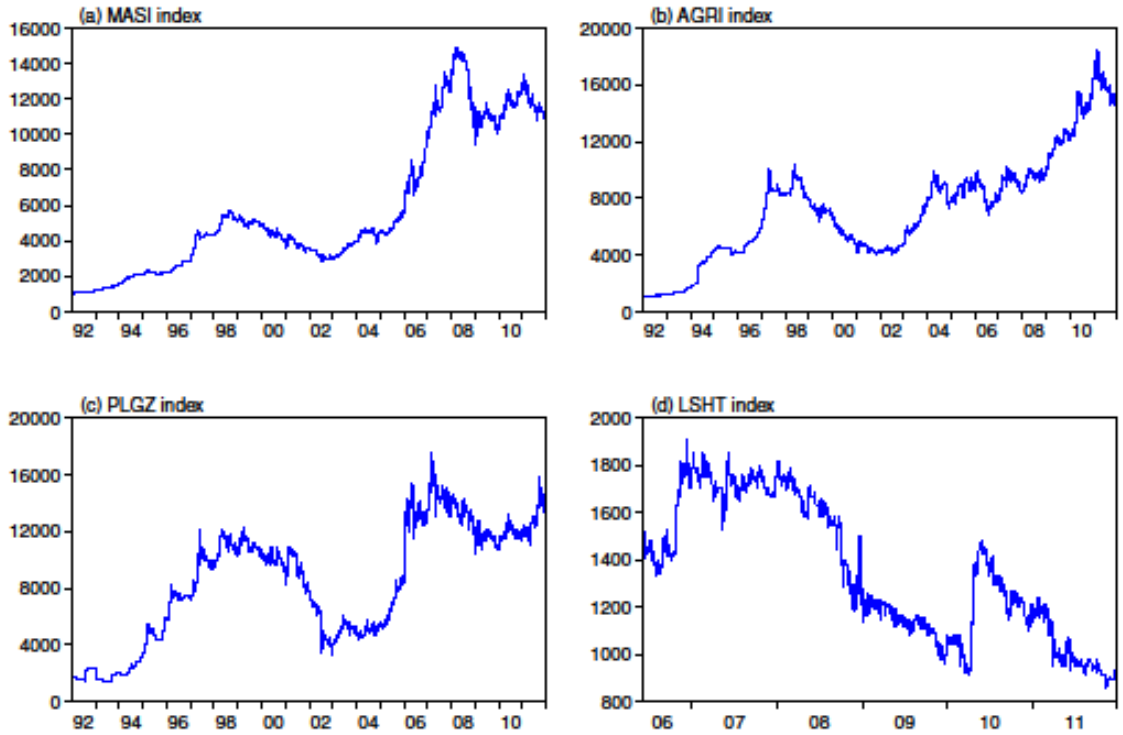


Figure 1 - Casablanca Stock Exchange daily index evolution

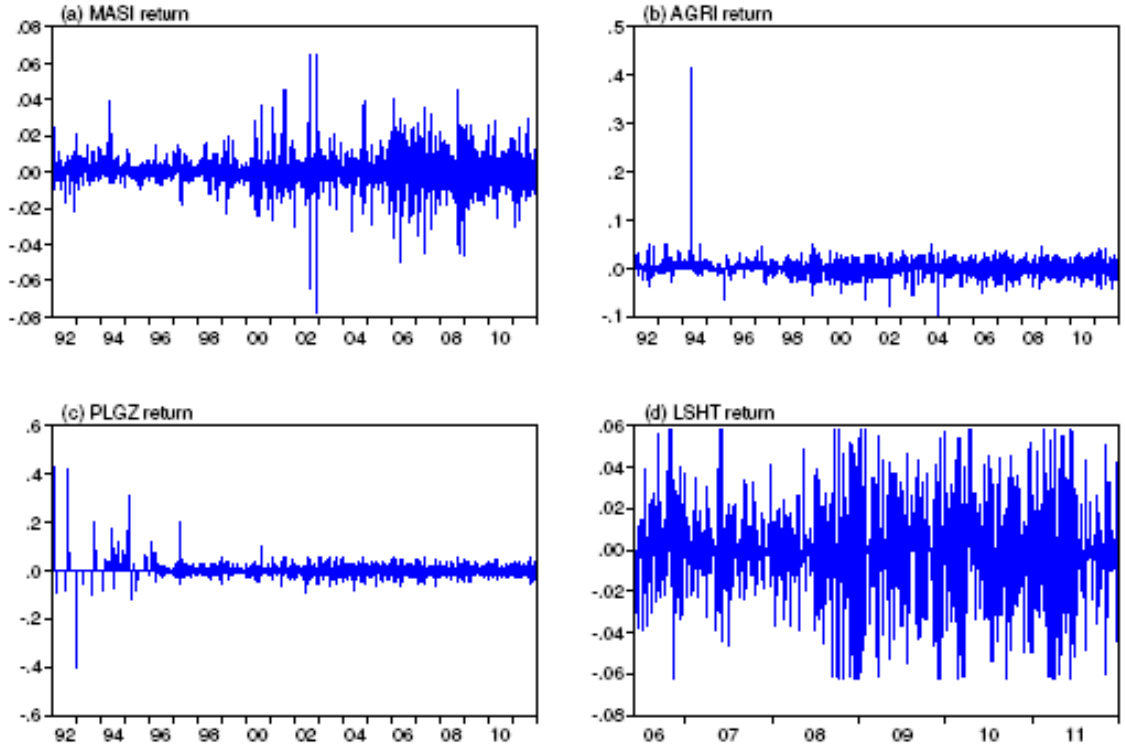


Figure 2 - Casablanca Stock Exchange daily return evolution

We calculated descriptive statistics and performed unit root tests of our stock index returns (Table 1). Panel A of Table 1 shows nonlinear character of the distribution of daily returns for the four samples as confirmed by skewness and kurtosis values and by the Jarque-Bera test.

Panel B of Table 1 gives the results of three unit root tests: the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Phillips, Schmidt and Shin (KPSS). The large negative values for the ADF and PP tests statistics allow us to reject the null hypothesis of the existence of a unit root while the KPSS test statistic does not reject the null hypothesis of stationarity at the 1% significance level. As a result, all return series are stationary processes.

Weather data

We considered the daily weather data for average temperature (TMP), rainfall (PRP), smoothed rainfall (PRC), heating degree days (HDD), cooling degree days (CDD) and total degree days (TDD) for Casablanca[15] from January 1992 to December 2011.

Table 1 - Descriptive statistics and unit root test for the four market index returns

	MASI	AGRI	PLGZ	LSHT
Panel A: Descriptive				
Number of observations	5217	5217	5217	1457
Mean (%)	0.046	0.052	0.051	-0.041
Median (%)	0.008	0.000	0.000	0.000
Maximum	0.065	0.415	0.431	0.058
Minimum	-0.077	-0.096	-0.405	-0.062
Standard deviation (%)	0.697	1.108	1.187	2.070
Skewness	-0.232	9.699	4.269	-0.107
Kurtosis	17.237	380.538	172.414	4.504
Jarque-Bera	44107*	31065*	62547*	140.05*
Panel B: Unit root tests				
ADF	-56.414*	-47.452*	-67.691*	-32.769*
PP	-57.342*	-68.780*	-67.676*	-46.614*
KPSS	0.3680	0.4789	0.3462	0.0784

Notes: The Jarque-Bera test check the null hypothesis of normality in sample return distribution. Mackinnons's 1% critical value is -3.435 for the ADF and PP tests. The critical value for the KPSS test is equal to 0.739 at the 1% significance level.

* indicates a rejection of the null hypothesis at the 1% significance level.

TMP was computed from the extreme daily temperatures. The maximum and the minimum daily temperatures for the current day t are recorded respectively, between t - 1 (yesterday) at 6 p.m. and t at 6 p.m. for the minimum, and between t at 6 a.m. and t + 1 (tomorrow) at 6 a.m. for the maximum and the average temperature (TMP) for a day t is given by:

$$T_t = (T_t^{max} + T_t^{min})/2 \quad (2)$$

where T_t^{max} and T_t^{min} are, respectively, the maximum and the minimum temperatures (in degree Celsius).

For each day t, we define HDD (measure of cold in winter) and CDD (measure of heat in summer) by:

$$HDD_t = \max(T_{ref} - T_t, 0) \quad (3)$$
$$CDD_t = \max(T_t - T_{ref}, 0) \quad (4)$$

where T_{ref} is a reference temperature. TDD is the sum of HDD and CDD.

[15] Casablanca is a city in northern Morocco. It represents the country's economic and business capital. It has a Mediterranean climate with dry hot summers and mild winters. The area within 40 km of this station is covered by oceans and seas (45%), croplands (44%), grasslands (5%), and forests (3%). The World Meteorological Organization ID of Casablanca-Anfa weather station is 60155.

The variable PRC is calculated from the PRP series by replacing each extreme value by the median of an 11-day window centered on this value and calculated over the last 30 years.

Table 2 - Descriptive statistics for the six weather variables

	T	C	H	T	PRP	PR
# of	5	52	5	52	5217	521
Mean	1	0.9	1.	2.	1.15	1.0
Median	1	0.0	0.	2.	0.00	0.0
Maximum	3	12.	1	13	177.	40.
Minimum	5	0.0	0.	0.	0.00	0.0
Standard	4	1.5	2.	1.	5.01	3.8
Skewness	0	2.5	1.	1.	12.8	5.2
Kurtosis	2	12.	3.	4.	334.	35.
Jarque-Bera	1	23	1	14	239	253

* indicates a rejection of the null hypothesis at the 1% significance level.

Methodology

To motivate the use of weather derivatives products in the Moroccan market, we examine the effect of temperature (in terms of degree days) and rainfall on the returns and the volatility of the four financial indexes. Indeed, the most commonly used underlying for these products is the temperature (degree days) and to a lesser extent the rainfall.

We start by determining the degree days. According to the report of the National Weather Office of Morocco, (2010), the reference temperature depends on seasons and it is 18^0 C for the cold season and 21^0C for the warm season. In order to compute HDD and CDD we need to determine the warm and the cold periods during the year. We use the approach presented by Mraoua and Bari, (2007). We plot on Figure 3 the monthly evolution of the monthly mean temperature over the period 1982–2011.

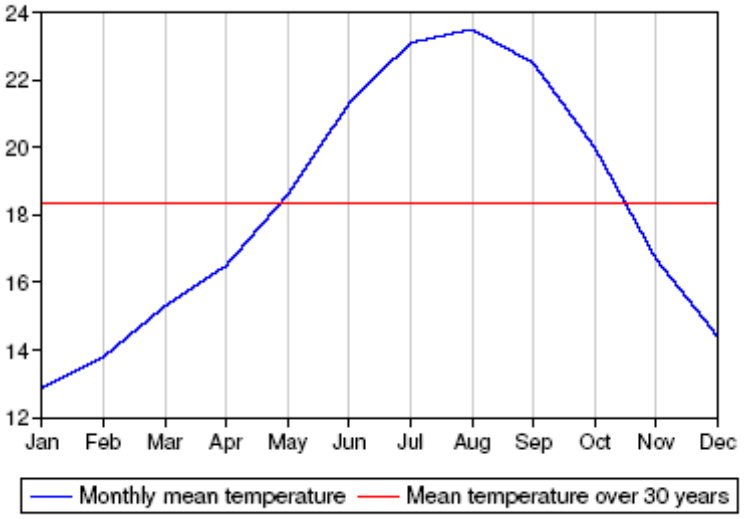


Figure 3 - Evolution of the monthly mean temperature at Casablanca (1982–2011)

We notice that the warm period begins at the end of May and ends between October and November; the other period represents the cold one. A hierarchal ascendant classification was executed to define exactly the beginning and the end of each period. According to Figure 4, we have defined these periods as: the warm period, from June to October, the cold period: from November to May.

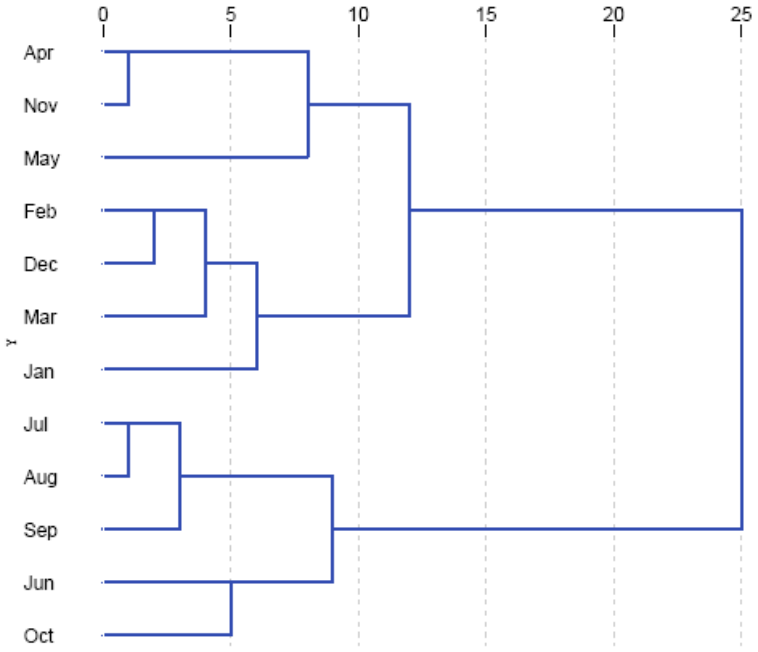


Figure 4 - Hierarchal classification of the monthly mean temperature at Casablanca

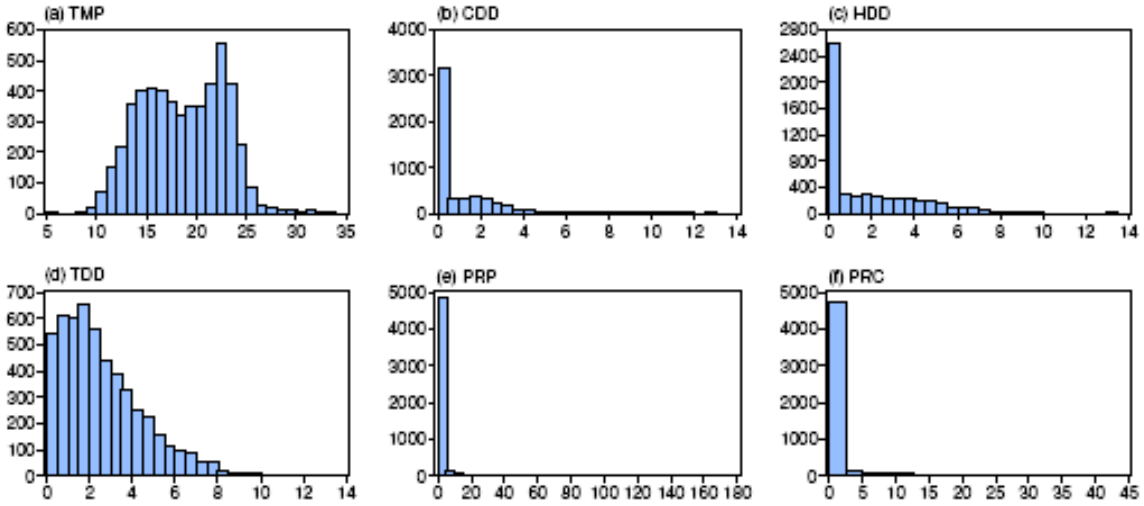


Figure 5 - Histograms for the six weather variables

Figure 5 provides histograms for the six weather variables and Table 2 reports their descriptive statistics. In order to examine the weather effect on the returns and volatility, first we use, for each stock market index, a linear regression model with an autoregressive component (Figure 6):

$$R_t = \alpha_0 + \sum_{i=1}^{k} \phi_i R_{t-i} + \alpha_1 CDD_t + \alpha_2 HDD_t + \alpha_3 PRC_t + \epsilon_t \quad (5)$$

where R_t is the daily return of the MASI, AGRI, PLGZ, and LSHT indexes at time t, CDD_t, HDD_t, and PRC_t are the selected weather variables16.

[16] The choice of the three weather variables is dictated by two considerations. First, we aim in this study to establish the existence of a relationship between the economy (represented by stock index) and the weather in order to motivate the introduction of weather derivatives into the Moroccan market. In our case, and contrary to previous studies, we took two weather variables HDD and CDD which are the main weather derivatives underlying variables. Second, we have smoothed the PRP variable to eliminate the extreme data effect (ten in total on a sample of 5217 records). Other techniques exist to deal with such phenomena, for example, Dupuis,

Then, as clearly illustrated on Figure 2 we adopt a GARCH(1,1) model to capture time-varying volatility as follows:

$$h_t = \omega + \alpha\epsilon_{t-1}^2 + \beta h_{t-1} \quad (6)$$

where ϵ_t is a normally distributed stochastic error, h_t is conditional variance ω, α and β are positive parameters and $\alpha + \beta < 1$ indicates the persistence of the shock to volatility [Francq and Zacoian, (2010)].

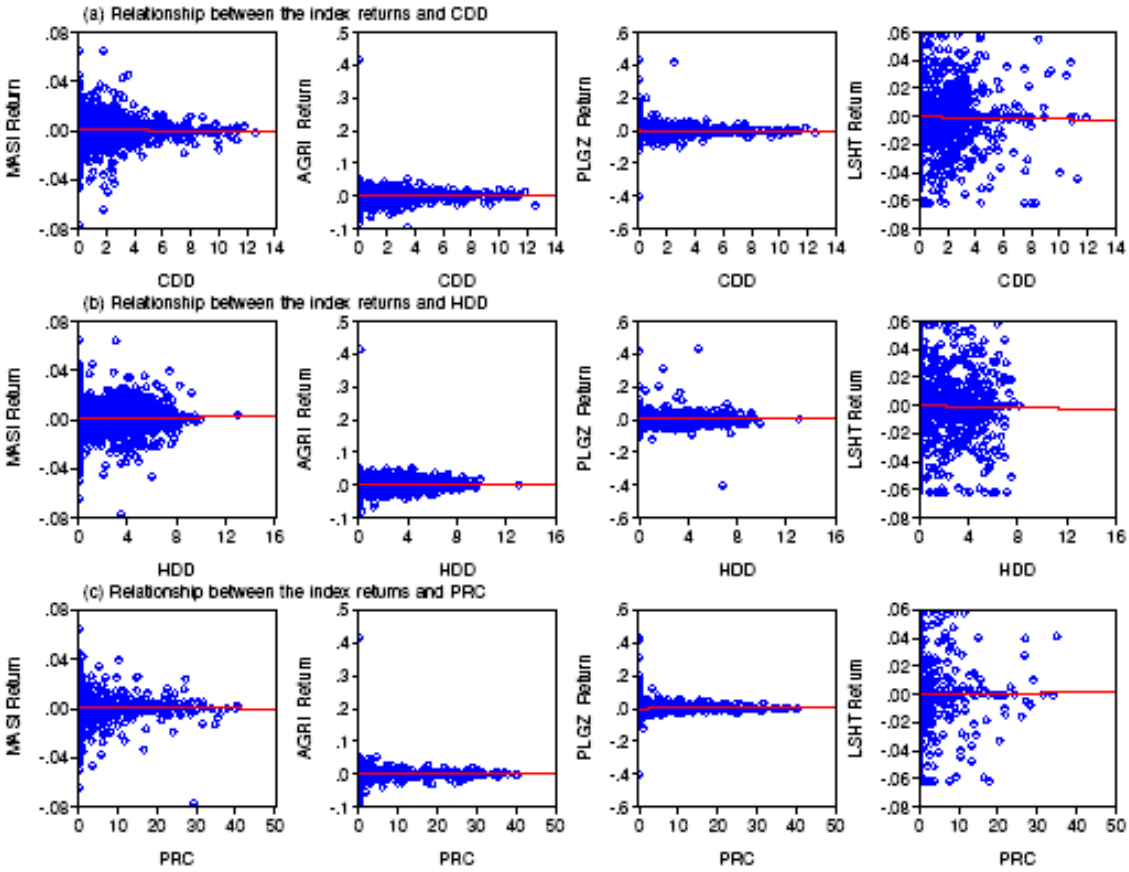


Figure 6 - Relationships between stock index returns and weather variables

4. Empirical results

To examine the effect of weather on the Moroccan stock market, we considered the most three sensitive sectors index to weather conditions. Indeed, the sectors directly affected by the studied index are "agriculture, forestry and fisheries", "energy and construction", and "trade, hotels and restaurants" witch account for 40% of Morocco's GDP [Sahay and Dorsey, (2011)].

Moreover, Morocco is located in a geographic area that has a significant climate change (longer periods of drought, periods of sudden drop in temperature cold season and increase of heat waves frequency in warm season). Thus, economic actors use more frequently insurance products to protect their profit margin against the climate hazard.

Weather effect on returns

Table 3 shows the results of the regression analysis we performed to detect the effect of weather on our four stock market index (Eq. (5)). P-values of various estimated parameters shows that they are statistically significant, implying that weather conditions influence the stock index.

(2011) showed how to apply the theory of extreme values to forecast temperature in order to price temperature derivatives.

Moreover, we noted that, globally, the impact of weather variables on our stock index returns is moderately to weakly positively significant except three situations where it is negative (impact of CDD on PLGZ and LSHT and impact of HDD on LSHT).

Table 3 - Weather effect on the stock returns

	MASI	AGRI	PLGZ	LSHT
α_0	0.0002	0.0003	0.0004	0.0004
	(0.0002)	(0.0003)	(0.0004)	(0.0009)
ϕ_1	0.2403	0.0536	0.00634	-0.1992
	$(0.0135)^{***}$	$(0.0138)^{***}$	$(0.0138)^{***}$	$(0.0257)^{***}$
α_1	0.0000	0.0000	-0.0001	-0.0004
	$(0.0001)^{*}$	$(0.0001)^{*}$	$(0.0002)^{*}$	$(0.0003)^{**}$
α_2	0.0001	0.0001	0.0001	-0.0004
	$(0.0001)^{**}$	$(0.0001)^{**}$	$(0.0001)^{*}$	$(0.0003)^{**}$
$a3$	0.0000	0.0000	0.0001	0.0001
	$(0.0000)^{**}$	$(0.0000)^{*}$	$(0.0001)^{**}$	$(0.0001)^{*}$
F-statistic	83.222	4.7502	6.1709	15.369
	$[0.0000]^{***}$	$[0.0008]^{***}$	$[0.0001]^{***}$	$[0.0000]^{***}$

Notes: The F-statistic is for the joint test for coefficients a1, a2 and a3. The null hypothesis is $H_0 : \alpha_1 = \alpha_2 = \alpha_3 = 0$. Standard errors are in parentheses and P-values are in brackets.
*, ** and *** indicate significance at the 10, 5 and 1% levels respectively.

Weather effect on volatility

After analyzing the weather effect on returns, we now examine the weather effect on volatility. Table 4 shows the results of the regression of stock index returns on weather variables using a GARCH(1,1) model to capture volatility (Eq. (6)). For each of the four index returns, we find that the values of the parameters α, β and ω are positive and that $\alpha + \beta < 1$, which confirms the non-negativity constraints of the model and the stationary of the conditional variance, respectively.

Moreover, p-values of the three estimated parameters show that they are statistically significant, implying that weather conditions influence the stock index returns volatility.

Table 4 - Weather effect on the stock volatility

	MASI	AGRI	PLGZ	LSHT
α_0	0.0000	0.0004	0.0004	-0.0002
	(0.0001)	(0.0003)	(0.0005)	(0.0008)
ϕ_1	0.2557	0.0544	0.00417	-0.2446
	$(0.0142)^{***}$	$(0.0147)^{***}$	$(0.0075)^{***}$	$(0.0274)^{***}$
α_1	0.0001	0.0000	-0.0001	-0.0003
	$(0.0000)^{*}$	$(0.0001)^{*}$	$(0.0002)^{*}$	$(0.0002)^{**}$
α_2	0.0002	0.0002	0.0000	-0.0002
	$(0.0000)^{**}$	$(0.0001)^{*}$	$(0.0001)^{*}$	$(0.0003)^{**}$
α_3	0.0000	0.0000	0.0001	0.0000
	$(0.0000)^{*}$	$(0.0001)^{*}$	$(0.0001)^{**}$	$(0.0001)^{*}$
ω	0.0000	0.0000	0.0000	0.0001
	$(0.0000)^{***}$	$(0.0000)^{***}$	$(0.0000)^{***}$	$(0.0000)^{***}$
α	0.1906	0.0006	0.0015	0.1098
	$(0.0046)^{***}$	$(0.0000)^{***}$	$(0.0001)^{***}$	$(0.0145)^{***}$
β	0.8010	0.9954	0.9501	0.8333
	$(0.0027)^{***}$	$(0.0002)^{***}$	$(0.0023)^{***}$	$(0.0188)^{***}$

Note: Standard errors are in parentheses.
*, ** and *** indicate significance at the 10, 5 and 1% levels respectively.

5. Summary and concluding comments

In this study, we attempted to explore the effect of weather on returns and volatility of the Casablanca stock market. The choice of market index and weather variables was not accidental. Indeed, the three chosen market index account for 40% of Moroccan GDP. Furthermore, selected weather variables are those most used for the evaluation of weather derivatives. By studying the effect of weather (weather derivative variables) on the economy (financial variables), our motivation was mainly to show that an emerging economy such as the Moroccan economy would benefit from the introduction and use of weather derivative products.

Our approach was structured in three stages: (1) We started by building our weather variables. In this context, we used two temperature indexes with a threshold depending on the season. An empirical analysis based on daily observations for 30 years has allowed us to determine the warm and cold seasons in the Casablanca region and thus calculate the degree-days per season. (2) We did a regression of our market index returns on weather variables to determine the effect of weather on returns. And we found that overall, the three weather variables studied impact the market index returns at different levels of significance. (3) The impact of weather on the volatility has been shown by using a GARCH(1,1) model.

Overall, the empirical results shown in this study are consistent with previous studies. Nevertheless, this study introduces variables used in weather derivatives literature to study their impacts on financial index and thus motivate their use in the Moroccan market.

Acknowledgments

The first author gratefully acknowledges the valuable comments and suggestions of Michèle Breton (HEC, Montreal) and Ali Lazrak (UBC, Vancouver). He would also like to thank Michèle Breton for her support and for giving him the opportunity to work in GERAD - HEC Montreal.

References

[1] Bank, M., Wiesner, R. (2011). Determinants of weather derivatives usage in the Austrian winter tourism industry, *Tourism Management* 32: 62–68.

[2] Cao, M., Wei, J. (2005). Stock market returns: A note on temperature anomaly, *Journal of Banking & Finance*, 29: 1559–1573.

[3] Chang, S.C., Chen, S.S., Chou, R.K., Lin, Y.H. (2008). Weather and intraday patterns in stock returns and trading activity, *Journal of Banking & Finance*, 32: 1754–1766.

[4] Chang, T., Nieh, C.C., Yang, M.J., Yang, T.Y. (2006). Are stock market returns related to the weather effects? Empirical evidence from Taiwan, *Physica A: Statistical Mechanics and its Applications*, 364: 343–354.

[5] Daniel, K., Hirshleifer, D., Teoh, S.H. (2002). Investor psychology in capital markets: evidence and policy implications, *Journal of Monetary Economics*, 49: 139–209.

[6] Dischel R.S. (Ed.). (2002). Climate Risk and the weather derivatives: Financial risk management with weather hedges, Risk Books.

[7] Dowling, M., Lucey, B.M. (2005). Weather, biorhythms, beliefs and stock returns? Some preliminary Irish evidence, *International Review of Financial Analysis*, 14: 337–355.

[8] Dupuis, D.J. (2011). Forecasting temperature to price CME temperature derivatives, *International Journal of Forecasting*, 27: 602–618.

[9] Francq, C., Zacoian, J.M. (2010). GARCH Models: Structure, statistical inference, and financial applications, Wiley.

[10] Geman, H. (Ed.). (1999). Insurance and weather derivatives: From exotic options to exotic underlying, Risk B.

[11] Gommes, R., Hairech, T.E., Rosillon, D., Balaghi, R., Kanamaru, H. (2009). Impact of climate change on agricultural yields in Morocco, Technical Report, Food and Agriculture Organization.

[12] Goodfellow, C., Schiereck, D., Verrier, T. (2010). Does screen trading weather the weather? a note on cloudy skies, liquidity, and computerized stock markets, *International Review of Financial Analysis*, 19: 77–80.

[13] Gurenko, E.N. (Ed.). (2007). Climate change and insurance: Disaster risk financing in developing countries, Earthscan.

[14] Kang, S.H., Jiang, Z., Lee, Y., Yoon, S.M. (2010). Weather effects on the returns and volatility of the shanghai stock market, *Physica A: Statistical Mechanics and its Applications*, 389: 91–99.

[15] Kelly, P.J., Meschke, F. (2010). Sentiment and stock returns: The sad anomaly revisited, *Journal of Banking & Finance*, 34: 1308–1326.

[16] Khattabi, 2009. Arab Environment: Impact of climate change on Arab countries, Technical Report, Arab Forum for Environment and Development.

[17] Lee, Y.M., Wang, K.M. (2011). The effectiveness of the sunshine effect in Taiwan's stock market before and after the 1997 financial crisis, *Economic Modeling*, 28: 710–727.

[18] Lu, J., Chou, R.K. (2012). Does the weather have impacts on returns and trading activities in order-driven stock markets? Evidence from china, *Journal of Empirical Finance*, 19: 79–93.

[19] Mraoua, M., Bari, D. (2007). Temperature stochastic modeling and weather derivatives pricing: Empirical study with Moroccan data, *Afrika Statistika*, 2: 22–43.

[20] Mu, X. (2007). Weather, storage, and natural gas price dynamics: Fundamentals and volatility, *Energy Economics*, 29: 46–63.

[21] Pollard, J. Oldfield, S. Randalls, J.E. (2008). Thornes, Firm finances, weather derivatives and geography, *Geoforum*, 39: 616–624.

[22] Requier-Desjardins, M. (2010). Impacts des changements climatiques sur l'agriculture au Maroc et en Tunisie et priorités d'adaptation, *Technical Report, International Centre for Advanced Mediterranean Agronomic Studies*.

[23] Sahay, R., Dorsey, T. (2010). IMF Country Report: Morocco, Technical Report, International Monetary Fund.

[24] Singh, S. (2006). Weather insurance and derivatives in developing countries - an alternative to agricultural insurance, The Journal of Insurance Institute of India, 32: 13–24.

[25] Sivakumar, M.V.K., Motha, R.P. (Eds.) (2007). Managing weather and climate risk in agriculture, Springer.

[26] Stracca, L. (2004). Behavioral finance and asset prices: Where do we stand?, *Journal of Economic Psychology*, 25: 373–405.

[27] Sturm, T., Oh, E. (2010). Natural disasters as the end of the insurance industry? Scalar competitive strategies, alternative risk transfers, and the economic crisis, *Geoforum*, 41: 154–163.

[28] Symeonidis, L., Daskalakis, G., Markellos, R.N. (2010). Does the weather affect stock market volatility?, *Finance Research Letters*, 7: 214–223.

[29] Tang, C.H.H., Jang, S.S. (2011). Weather risk management in ski resorts: Financial hedging and geographical diversification, *International Journal of Hospitality Management*, 30: 301–311.

[30] Whalley, J., Yuan, Y. (2009). Global financial structure and climate change, *Journal of Financial Transformation*, 25: 161–168.

[31] Yoon, S.M., Kang, S.H. (2009). Weather effects on returns: Evidence from the Korean stock market, *Physica A: Statistical Mechanics and its Applications*, 388: 682–690.

*** National Weather Office of Morocco, Zonnage climatique du Maroc, Technical Report, 2010.

EXPONENTIAL SMOOTHING TECHNIQUE IN CORRELATION STRUCTURE FORECASTING OF VISEGRAD COUNTRY INDICES

Jozef GLOVA
Technical University of Košice, Faculty of Economics, **Slovakia**
jozef.glova@tuke.sk

Abstract:

The paper provides evidence on correlation structure forecasting techniques. We use index model parameters to forecast significant parts of securities returns volatility – systematic risk and specific risk. Except of this static perspective we have suggested, improved and dynamised these techniques with exponentially weighted moving average or EWMA variance and covariance forecast, which enables us to model time-varying beta coefficient as a significant part of systematic risk That enables us to construct correlation structure of national index returns we have selected for the explanation of our methodology. As we discuss in final part of the paper some adjustment in EWMA Beta and other variables have to be done through application of Blume or Vasicek techniques. So we can forecast an appropriate correlation structure of returns which enable us to be better aware about potential exposures in market returns.

Keywords: systematic risk, exponential smoothing, country risk, Visegrad countries, time-varying beta

JEL Classification: C51, C52, G12, G32

1. Introduction

In 1952 Harry Max Markowitz (1959) published a revolutionary paper on how does one select an efficient set of risky investment or so called efficient frontier. This theory provides the first quantitative view of portfolios variance, where co-movements in securities returns are considered. So, the variance of portfolios is not a simple product of the particular investment proportion and their variances. Instead of it one has to consider covariance structure implicitly involved in multi-variate distribution of securities returns.

Some year later James Tobin, another famous economist, extended this perspective with the riskless investment involving in the model of the efficient frontier, where the first two moments of probability distributions are used. If we assume risk-free investment, the portfolio's volatility of riskless and risky assets will be linear function of risky assets variance and their weights. This result has far reaching implications, we have got a straight line in the mean-variance space and any portfolio on this efficient line is a combination of the riskless asset and the tangential (also called market) risky assets portfolio. To depicture new created efficient frontier a quadratic technique can be used. We also can consider portfolio problems with different assumptions, where short sale are or are not allowed, and where either riskless lending or borrowing is or is not possible.

According to Elton *et al.* (2006) or Šoltés *et al.* (2003), casual observation of stock prices reveals that when the market goes up, most stocks tend to increase in price and vice versa. This can suggest that there is a reason security returns might be correlated because of common response to market changes. So in 70's in the last century a number of economists were providing new models to reflect these relationships. So, the single-index or single factor models have been developed. Also very often used and applied model Capital Asset Pricing Model was developed independently by William Sharpe, John Lintner, and Jan Mossin. The model takes into account the sensitivity of capital assets to non-diversifiable component of risk (systematic risk), represented by the relative measure of risk in the form of beta (ß) coefficient, as well as the expected return and expected return n on the market theoretically defined risk-free asset, and that, based on defined assumptions.

2. The covariance structure of security returns

As we already mentioned in introduction part of the paper, the co-movements between stocks can be due to a single or multiple indices. So the correlation or covariance structure of security returns might be obtained by relating the return on a stock to the return on a stock market index or other non-market indices. Hence the return on a stock can be written using simple-index model as

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + e_{i,t} ,$$

where α_i denotes expected value of the component of security return that is independent of the market's performance, $e_{i,t}$ represent the random element of the same component, β_i represents the component of security return dependent of market return $R_{m,t}$ in the particular period of time t.

If we assume that time series data of e_i is not correlated with R_m and that e_i is independent of e_j, formally denoted $E(e_i e_j) = 0$, then we can summarize the mean return, the variance of a security's return and the covariance of returns between securities i and j. We can write formally:

$$\bar{R}_i = \alpha_i + \beta_i \bar{R}_m$$

$$\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_{ei}^2$$

$$\sigma_{ij} = \beta_i \beta_j \sigma_m^2$$

$$\beta_i = \frac{\sigma_{im}}{\sigma_m^2} = \frac{\sigma_i}{\sigma_m} \cdot \rho_{im}$$

Now decomposing the equation (3) gives two parts of the variance – systematic part of variance ($\beta_i^2 \sigma_m^2$) and specific or residual part of the variance, noted by σ_{ei}^2. The systematic part can be decomposed into two sources, i.e. the sensitivity to market factor or beta coefficient and the volatility of the market factor. In the (5) σ_i/σ_m gives the relative volatility of security return i and market returns m, and ρ_{im} is the correlation coefficient or linear dependency between security returns i and market returns m. As discusses Alexander (2010), one of the limitations of the equity beta as a risk factor is that it ignores the other two sources of risk. It says nothing about the risk of the market factor itself or about the specific risk of the portfolio. The total variance can be express as a summation of systematic and specific variance.

3. Exponential smoothing and its application for beta estimates

The previous part Beta or the beta coefficient in the single index model is the product of the market correlation and the relative volatility of the portfolio with respect to the index or benchmark. Volatility of the security return given by the factor model can be decomposed into three main sources – the sensitivity to the market factor, the volatility of the market factor and the specific risk. Taking a composite of total risk, the Beta coefficient given in (3) or (4), we can rewrite this in the following form:

$$\beta_{i,t} = \frac{\sigma_{im,t}}{\sigma_{m,t}^2} = \frac{\sigma_{i,t}}{\sigma_{m,t}} \cdot \rho_{im} ,$$

where $\frac{\sigma_{i,t}}{\sigma_{m,t}}$ gives the relative volatility of security return i and market return m, and ρ_{im} is the correlation coefficient or linear dependency between security returns i and market returns m in the time period t.

One of the limitations of the beta as a risk measure is that is ignores the other two sources of risk: it says nothing about the risk of market index itself or about the specific risk of the security returns.

We assume that the risks of return have a multivariate normal distribution or other type of the elliptical distribution as mentioned by Dempster (2002). In this case the standard correlation approach to dependency is natural and unproblematic. In other case we could model dependency using copulas.

We use the exponentially weighted moving average (EWMA), as already mentioned, as a technique for variance and covariance estimates. We can note formally:

$$\text{EWMA}(x_{t-1}, \cdots, x_1 | \lambda) = \frac{x_{t-1} + \lambda x_{t-2} + \lambda^2 x_{t-3} + \cdots + \lambda^{t-2} x_1}{1 + \lambda + \lambda^2 + \cdots + \lambda^{t-2}} ,$$

where λ is a smoothing constant, and $\lambda \in (0; 1)$. Since $\lambda^n \to 0$ as $n \to \infty$, the exponentially weighted moving average places negligible weight on observations far in the past.

$$\hat{\sigma}^2_{i,t} = (1-\lambda)\, r^2_{i,t-1} + \lambda \hat{\sigma}^2_{i,t-1} ;$$

$$\hat{\sigma}_{ij,t} = (1-\lambda)\, r_{i,t-1}\, r_{j,t-1} + \lambda \hat{\sigma}_{ij,t-1} ;$$

$$\hat{\beta}_{i,t} = \frac{\hat{\sigma}_{im,t}}{\hat{\sigma}^2_{m,t}} = \frac{\hat{\sigma}_{i,t}}{\hat{\sigma}_{m,t}} \cdot \hat{\rho}_{ij} .$$

As specified in (8), there is the EWMA model for the conditional variance, which is a restricted version of the univariate symmetric normal GARCH model, but restrictions are such that the forecast conditional volatility must be constant. Because $\alpha \equiv 1-\lambda$ and $\beta \equiv \lambda$ the restrictions are that the GARCH constant ω is 0 and the speed of mean reversion in forecasts, which is given by $1-(\alpha+\beta)$, is also 0. However the long term volatility is undefined.

The base horizon for the forecast is given by the frequency of the data – in our case the monthly returns will give the 1-month covariance matrix forecast. We can also convert a 1-month covariance matrix into an h-month forecast by multiplying each element of the 1-month EWMA covariance matrix by h.

4. Data and methodology

As described in Elton *et al.* (2006) the models for forecasting correlation/covariance structures fall in two categories – index models and averaging techniques. The most widely used technique is single-index or multiple-index model, in that it is very convenient and easy to use. But index models may be not adequate or appropriate in detail risk analysis. Market risk require monitoring on a frequent basis and the parameter estimates given by index models using Ordinary Least Square (OLS) method will not reflect current market positions. According to Alexander (2010) they represent an average value over the time period covered by the sample used in the regression model. An estimate with OLS will lead to very significant problems.

Table 1 - Descriptive statistics of monthly returns used in analysis

Statistics	CZ_PX50	HU_BUX	PL_WIG	SK_SAX	ENEXT100
Mean	0.004633	0,005734	0.007194	0.004444	-0.00276
Standard Error	0,005058	0.005182	0.004657	0.00405	0.00398
Median	0.010716	0.008608	0.01661	0	0.008651
Standard Deviation	0.061534	0.063045	0.05665	0.049266	0.048422
Sample Variance	0.003786	0.003975	0.003209	0.002427	0.002345
Kurtosis	5,449285	2.883606	2.382228	3.298831	2.818685
Skewness	-1.16472	-0.74787	-0.88858	0.590766	-1.23522
Range	0,517825	0,4606	0.386967	0.36935	0.314239
Minimum	-0.32469	-0.28441	-0.23426	-0.16298	-0.21869
Maximum	0.193137	0.176187	0.15271	0.206375	0.09555
Sum	0.685657	0.848632	1.064774	0.65764	-0.40826
Count	148	148	148	148	148

Therefore, for the purpose of mapping a portfolio risk, higher frequency data and methodology could be used to estimate a time varying portfolio beta for the model denoted in equation (2). We apply an exponentially weighted moving average (EWMA) model with an assumption, that returns are identically and independent distributed (i.i.d.). So we construct covariance and correlation matrices, each based on the exponential weighted moving average (EWMA) methodology. These matrices cover only equity market indices of Visegrad countries – Czech Republic, Hungary, Poland and Slovak Republic, and European global equity index. These matrices provided by us are each based on a history of monthly returns which have been annualized as it has been described in data description part of this paper. These are annualized monthly matrices, where a EWMA covariance matrix with λ equals to 0.97 for all elements and the multiplied by 12 has been used. As discussed by Alexander

(2010), higher values of lambda give more precise EWMA estimates and also larger effective sample of data.

We use monthly data on Visegrad countries national indices of equity market, between November 2000 and February 2013. We use Eurostat database, the Share price indices (rebased) statistics of these Visegrad countries' stock exchanges - Budapest Stock index (HU_BUX), Prague Stock Exchange 50 Index (CZ_PX50), Warsawzki Indeks Giedowy (PL_WIG), Slovak Share Index (SK_SAX). As a benchmark we use EURONEXT global index (ENEXT100) form the same database. The country equity annualized returns are depictured in Figure 1.

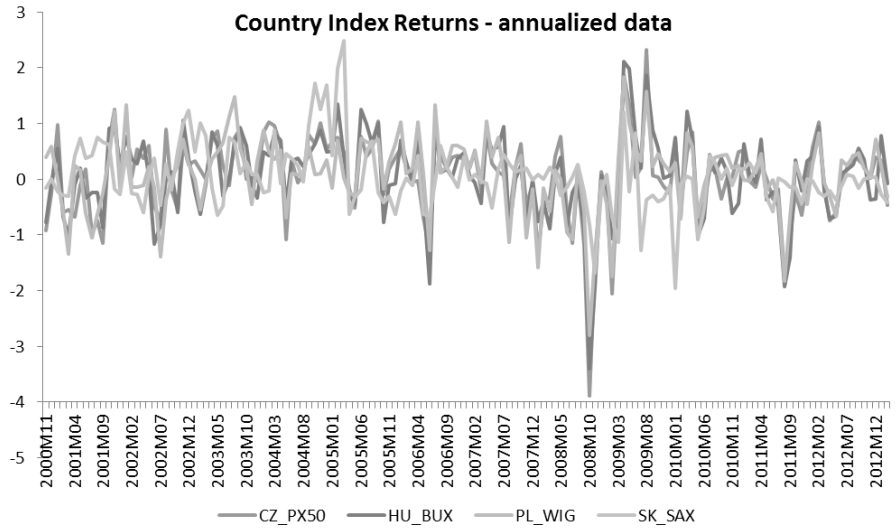


Figure 1 - Country index returns of Visegrad countries

We assume that one-period (month) log returns are generated by a stationary i.i.d. process. We compute and denote r_t the log return observed at time t, where $r_t = \ln(P_t) - \ln(P_{t-h})$ and $h = 1$. We provide all computation with monthly data except of results, where risk (total risk, systematic risk and specific risk calculations) and return parameters have been annualized. The inputs descriptive statistics are also summarized in

Table **1**.

5. EWMA results

Consider relationships of (8) up to (10) we can realize an estimate of the next value of time series data – value of variables in March 2013. The particular parameters for countries indices and global market index are depictured in Table 2. We use ENEXT 100 index as the global market index or a benchmark to provide all necessary calculations.

Table 2 - EWMA parameters forecast for March 2013 (annualized)

i	CZ_PX50	HU_BUX	PL_WIG	SK_SAX	ENEXT 100
$\hat{\beta}_{i,t}$	1.04666075	1.08092423	0.9333682	0.1982628	1
$R_{i,t}$	0.05559377	0.06880801	0.08633307	0.0533222	-0.033102
$\hat{\sigma}^2_{i,t}$	0.0398673	0.0451480	0.0320876	0.0169006	0.025033
$\hat{\sigma}_{i,t}$	0.19966805	0.21248058	0.17912999	0.13000221	0.158219

The estimates parameters provide computation inputs for the particular covariance matrices of the particular time period. So, EWMA model estimates enable us to forecast correlation structure of equity returns for the next periods. Estimates of the risk components – total risk, systematic part of risk and specific or residual part of risk are shown in Figure 2 for each of the country equity index.

The annualized values of the risk components are shown on the left-hand scales in Figure 2. Betas estimates in regard to ENEXT100 global market index are depictured on the right-hand scales.

Table 3 - Correlation Matrix Forecast for March 2013 (using adj. annualized data)

	CZ_PX50	HU_BUX	PL_WIG	SK_SAX
CZ_PX50	1	0.66755923	0.68375182	0.20012635
HU_BUX	0.66755923	1	0.66355535	0.18805878
PL_WIG	0.68375182	0.66355535	1	0.19892603
SK_SAX	0.20012635	0.19421507	0.19892603	1

In Table 3 are shown the estimates of the correlation coefficients for the next monthly period, March 2013. All of the national equity indices returns are positively dependent.

6. Discussion and possible adjustments

Consider relationships of (8) up to (10) we can realize an estimate of the next value of time series data – value of variables in March 2013. The particular parameters for countries indices and global market index are depictured in Table 2. We use ENEXT 100 index as the global market index or a benchmark to provide all necessary calculations.

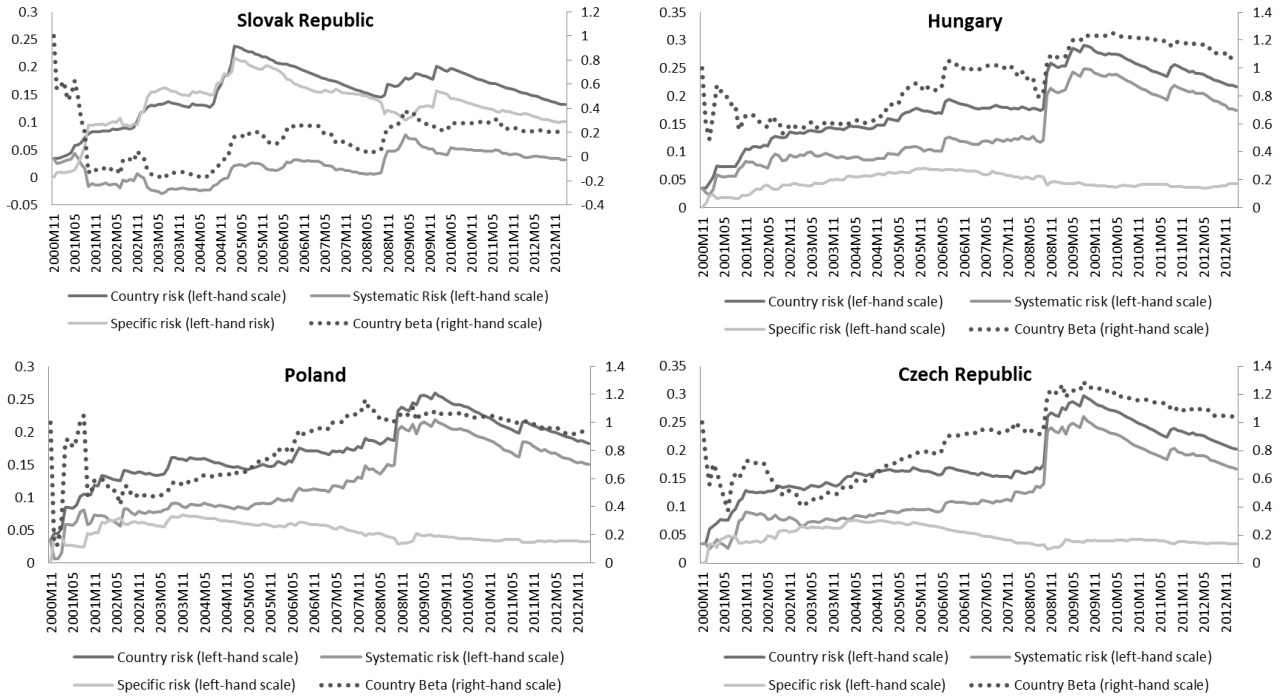


Figure 2 - Sources of market risk – total, systematic and residual risk (left-hand scales) and Betas (right-hand scales) for selected countries

The first very logical step in looking at Betas and their covariance and correlation estimates or forecasts is to see how much association there is between the Betas in the particular periods. The first author Blume (1975) has launched an extensive testing of the relationship. As a result of the testing adjusting historical estimates of Beta was proposed because of the tendency of Betas to regress toward one or toward market portfolio Beta. In Blume (1975) we can find the first scheme for capturing this tendency, where past or historical Betas are adjusted toward one. Vasicek (1973) has suggested a different scheme that incorporates the tendency, whereby the adjustment depends on the size of the uncertainty about Beta. This is quite different to the Blume model, where all stocks are adjusted with the same amount toward the average or market Beta. Klemkosky and Martin (1975) tested the ability

of these techniques to provide better forecasts for 5-year periods. In all cases both the Blume and Vasicek adjustment techniques led to more accurate forecast of future Betas that the unadjusted Betas. Elton *et al.* (1978) have also compared the ability to forecast the correlation structure between securities. They suggest the Blume adjustment technique outperformed both the unadjusted Betas and the Betas adjusted via the Vasicek technique. The difference in the techniques was statistically significant.

In the financial industry the linear or time series models of volatility and correlation became popular in the 1990 by JP Morgan RiskMetrics methodology and data. In 2006 the last update of the RiskMetrics methodology to evaluate market risks was introduced. They obtained consistency across risk horizons by building the methodology using a long memory ARCH process to compute the required forecasts as summarized by Zumbach (2007).

Table 4 - Improved Betas because of the tendency to regress toward market portfolio
Beta – Blume technique

i	CZ_PX50	HU_BUX	PL_WIG	SK_SAX	ENEXT100
$\hat{\beta}_{i,t}$	1.04666075	1.08092423	0.9333682	0.1982628	1
$adj.\ \hat{\beta}_{i,t}$	1.05158933	1.07478570	0.97489027	0.47722391	1

According to Alexander (2010) there are numerous financial application for covariance matrices, including but not limited to estimating and forecasting the volatility of a financial portfolio, estimating the value at risk (VaR) of financial portfolios, determining optimal portfolio allocations, simulating correlated returns pricing multi-asset options and hedging the risk of financial portfolios.

We use the proposed technique by Blume to the particular Betas. Adjusted values of Betas are written in Table 4. This adjustment changed the forecast of correlation structure very dramatically, especially in the case of the dependency of the Slovak equity index SAX, where we can see higher figures of Pearson correlation coefficient towards of the other indices.

Table 5 - Adjusted Correlation Matrix Forecast for March 2013 (using adj. annualized data)

	CZ_PX50	HU_BUX	PL_WIG	SK_SAX
CZ_PX50	1	0.66689377	0.71753231	0.48397783
HU_BUX	0.66689377	1	0.68913851	0.4547941
PL_WIG	0.71753231	0.68913851	1	0.50012127
SK_SAX	0.48397783	0.46482612	0.50012127	1

Recently, other attempts have been made to incorporate more data than past return information into the forecasts of Betas and so into the forecasts of correlation structure of security returns, especially in the context of time-varying country Beta modelling as proposed firstly by Harvey (1991) and recently by Gangemi *et al.* (2000), Verma *et al.* (2006) and Verbenik *et al.* (2011). This fundamental Beta approach uses a mixture of multi-index regression and time series model. But Betas estimates are quite similar to our EWMA estimates.

Conclusion

The covariance matrix of the returns on a set of assets or risk factor is the cornstone of traditional risk and return analysis. It is widely used to estimate the volatility of a portfolio, to simulate and forecast values for its particular risk factor, to allocate and diversify investments and to obtain so called efficient portfolios with optimal trade-off between risk and return. In the paper we provided evidence on selected correlation structure techniques – linear index model and time series model, but especially exponentially smoothing technique. We decomposed the total risk in the parts of systematic and specific or residual risk, whereby we could implement EWMA technique for variance and covariance estimates. So we proposed and compute forecasted correlation structure for the Visegrad countries equity indices returns. In the discussion part of paper the tendency of Beta going toward to market portfolio Beta has been considered and some adjustment in the correlation structure through

application of Blume or Vasicek techniques has been done. So we can forecast an appropriate correlation structure of returns which enable us to be better aware about potential exposures in market returns.

Acknowledgements

The work was supported by the Ministry of Education of the Slovak Republic under grant VEGA No. 1/0799/13.

References

[1] Alexander, C. (2010). *Market Risk Analysis: Practical Financial Econometrics*, John Wiley & Sons.

[2] Blume, M. (1975). Betas and their regression tendencies, *Journal of Finance*, 10(3): 785-795.

[3] Dempster, M. (2002). *Risk Management: Value at Risk and Beyond*, Cambridge University Press.

[4] Elton, E.J., Gruber, M.J., Ultrich, T. (1978). Are Betas Best? *Journal of Finance*, 13(5): 1375-1384.

[5] Elton, E.J., Gruber, M.J. (2006). Modern Portfolio Theory and Investment Analysis, John Wiley & Sons.

[6] Gangemi, M.A.M., Brooks, R. D., Faff, R. W. (2000). Modelling Australia's country risk: a country beta approach, *Journal of Economics and Business*, 52: 259-276.

[7] Harvey, C.R. (1991). The world price of covariance risk, *The Journal of Finance*, 46(1): 111-157.

[8] Klemkosky, R., Martin, J. (1975). The effect of market risk on portfolio diversification, *Journal of Finance*, 10(1): 147-153.

[9] Markowitz, H.M. (1959). *Portfolio Selection: Efficient Diversification of Investment*, Wiley.

[10] Šoltés, V., Šoltés, M. (2003). Analysis of two-asset portfolio, *Ekonomie a management*, 6: 63-65.

[11] Vasicek, O. (1973). A note on using cross-sectional information in Bayesian estimation of security betas, *Journal of Finance*, 8(5): 1233-1239.

[12] Verbenik, M., Horvath, J., Gazda, V. (2011). Country risk in the new EU member states: a country beta approach, *International Research Journal of Finance and Economics*. 80: 148-157.

[13] Verma, R., Soydemir, G. (2006). Modelling country risk in Latin America: A country beta approach, *Global Finance Journal*, 17: 192-213.

[14] Zumbach, G.O. (2007). The Riskmetrics 2006 Methodology, RiskMetrics Group. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1420185.

PROPOSAL OF A NEW GUARANTEED CERTIFICATE USING EXOTIC OPTIONS

Zuzana GORDIAKOVÁ
Abduhamid M. Ahmed YOUNIS
Faculty of Economics, Technical University of Košice, **Slovakia**
zuzana.gordiakova@tuke.sk

Abstract:
This article deals with the issue of guarantee certificate formation on the financial market. The main objective is to design a new guarantee certificate suitable for conservative investors. We found an alternative opportunity to the purchase of this certificate, i.e. investment in a bank deposit, together with a purchase of cash or nothing down and knock-out portfolio call option and a sale of cash or nothing down and knock-out portfolio put option. In our analysis we use a novel approach based on profit functions.

Keywords: guarantee certificates, exotic options, barrier options, digital options, portfolio options

JEL Classification: G15, G11

1. Introduction

A significant decline on the financial market in year 2008 has forced many investors to modify their attitude to risk. Therefore, there is an increased interest in financial tools enabling at least partial guarantee of a price drop of the underlying asset. The reaction to this situation is a research which purpose on the one side is to offer such investing tools and on the other side to analyze structured products offered to investors by issuers. Hedging against a price drop of an underlying asset by means of option strategy using vanilla options is discussed in the works (Šoltés, V. and Amaitiek 2010 a,b). Hedging against a price drop of an underlying asset by means of option strategy using barrier options is discussed in the works (Šoltés, V. and Rusnáková 2012, Rusnáková and Šoltés, V. 2012, Šoltés, V. and Rusnáková 2013). Structured products combine multiple financial products, one of them being usually financial derivative, often plain or exotic option. In the recent years, structured products have become more and more exotic. The works (Šoltés, V. and Rusnáková, 2010), (Šoltés, V. 2011) are focused on several structured products formation using vanilla or exotic options.

2. Investment certificate

Investment certificates belong to the large group of structured products including ever new ones. Today, there are a number of different investment certificate products available for investors. For example papers (Šoltés, V. and Šoltés, M. 2006), (Šoltés, M. 2010 a, b) deal with this issue.

Guarantee certificates ensure the return of the original investment. They are appropriate financial instruments for investors with risk aversion. The nature of the guaranteed certificate formation using vanilla options is discussed in the study (Šoltés, M. and Šoltés, V. 2007).

The main aim of this paper is to propose a new guaranteed certificate using exotic options. We focus on basic characteristic of the certificate, derivation of profit function and replication with other instruments, i.e. finding an alternative investment which will have the same profit profile as the purchase of this certificate. The alternative opportunity is formed to show the nature of the certificate formation using exotic options, specifically cash or nothing (digital/binary) options, barrier options and portfolio options. The returns for capital-guaranteed products with embedded cash or nothing barrier portfolio options are calculated as follows. If the prices of all assets in the basket are above the barriers specified for these assets at any time during the term of the product, a fixed percentage of the nominal value is credited to the investor. The returns of this product are paid out at maturity.

3. Exotic options

Exotic options are one of the most interesting innovations of the financial sector in the last years. For the reason of responding to the individual needs of investors, exotic options are in the continual development process. The new types of them are constantly creating respectively, modifying

existing ones. Because of this reason, there is no uniform and comprehensive classification of various kinds of them. Exotic options have some different characteristics compared to plain vanilla options, however the essential features are the same. There exists vast literature, for example (Wilmott *et al.*1995, 338), (Taleb 1997, 506), (Hull 2008, 814), (Weert2008, 204), that deals with exotic options which are dated from the late 1970s.

Probably the most popular type of exotic option is a barrier option. Barrier option is different from vanilla options because it has a second strike price called barrier. Exceeding the barrier during the option life means activation (knock-in) respectively deactivation (knock-out) of option. The barrier may be over (up) or below (down) the current price of the underlying asset at the time of closing option contracts. Barrier option is therefore associated with a condition which has to be that must be met, otherwise it will expire as worthless. In this paper we use an approach based on profit functions of exotic option in order to create proposed structured products. Analogical approach was used in works (Rusnáková and Šoltés, V. 2012) and (Šoltés, V. and Rusnáková 2012), where authors used barrier options in application to hedging against a price drop.

Buying a down and knock-out call option gives a right to buy a particular underlying asset at strike (expiration) price *X* at the time *T*, if the option is not deactivated, i.e. the price of the underlying assets does not exceed predetermined lower barrier *L* from above during the life of the option, which the following condition represents:

$$\min_{0\le t\le T}\left(S_t\right)\ge L. \tag{3.1}$$

The profit function from buying *n* down and knock-out call option is:

$$P(S)=\begin{cases} -nc & if\ \min\limits_{0\le t\le T}\left(S_t\right)<L, \\ -nc & if\ \min\limits_{0\le t\le T}\left(S_t\right)\ge L\wedge S<X, \\ n(S-X-c) & if\ \min\limits_{0\le t\le T}\left(S_t\right)\ge L\wedge S\ge X, \end{cases} \tag{3.2}$$

where: - *S* is an actual spot price of underlying asset at the expiration time *T*,

- S_t is price of underlying asset at a specified points during the time to maturity of the option *t* $\left(t\in\langle 0,T\rangle\right)$,
- *c* is premium paid for the right to buy an asset.

Selling a down and knock-out put option gives an obligation to buy particular underlying asset at the strike price *X* at the time *T*, if the option is not deactivated. The profit function from selling *n* down and knock-out put options is:

$$P(S)=\begin{cases} n(S-X+p) & if\ \min\limits_{0\le t\le T}\left(S_t\right)\ge L\wedge S<X, \\ np & if\ \min\limits_{0\le t\le T}\left(S_t\right)\ge L\wedge S\ge X, \\ np & if\ \min\limits_{0\le t\le T}\left(S_t\right)<L, \end{cases} \tag{3.3}$$

where p is premium obtained for the obligation to sell an asset.

In addition to standard barrier options, there are variations of barrier options, e.g. barrier portfolio option for what underlying asset is basket of several assets with the spot price:

$$S=\alpha\sum_{i=1}^{k}w_iK_i, \tag{3.4}$$

$$\alpha\in\langle 0,1\rangle,$$

where: K_i is the current value of the asset from specified basket at the time of closing of option contracts;

w_i is weight corresponding to individual asset.

Barrier level *L* may be defined for the entire basket of assets:

$$L = \alpha \sum_{i=1}^{k} K_{i0}, \tag{3.5}$$

where: K_{i0} is the value of the asset from specified basket at the time of option contract closing, or for each asset

$$L_1 = \alpha K_{10}, L_2 = \alpha K_{20}, L_3 = \alpha K_{30}, ... \tag{3.6}$$

where: K_{10}, K_{20}, K_{30}, … are values of the assets from specified basket at the time of contract closing.

If all assets always quote at or above their barriers during the option life of down and knock-out call/put option, then the option is not deactivated. In case the barrier is undercut by one or several asset prices during the option life, the option is deactivated. Barrier options with more barriers are known as multibarrier options.

Other type of exotic options is cash and nothing option that belongs to the group called as digital or binary options. Buying cash and nothing call option gives a right to obtain a fix cash amount if the price of underlying asset is at the maturity time higher than or equal to strike price, or nothing if the price of underlying asset is at the maturity time lower than strike price. Selling cash or nothing put option gives an obligation to pay a fix amount of cash if the price of the underlying asset at the time of expiry is less than strike price, or nothing if the price of the underlying asset at the maturity is higher than or equal to the strike price. For example (Taleb 1997, 506) and (Hull 2008, 814) deal with these issues.

In general the profit function from buying *n* cash or nothing call options is:

$$P(S) = \begin{cases} -nc & if\ S < X, \\ n(M-c) & if\ S \geq X, \end{cases} \tag{3.7}$$

and the profit function from selling *n* cash or nothing put options is:

$$P(S) = \begin{cases} n(M-p) & if\ S < X, \\ np & if\ S \geq X, \end{cases} \tag{3.8}$$

where M represents a fixed amount of the asset.

Cash or nothing portfolio barrier option presents a hybrid between digital, portfolio and barrier options. Buying cash and nothing down and knock-out portfolio call option gives a right to obtain:

- a fixed amount of the cash if the barrier is not exceeded during the life of the option and the price of the underlying asset at the of maturity option is higher than or equal to the strike price;
- nothing, if the barrier is not exceeded during the life of the option and the spot price of the underlying of asset at the time of expiry is less than or equal to a strike price;
- nothing, if the barrier is crossed over the life of the option.

The profit function from buying *n* cash or nothing down and knock-out portfolio call option with more barriers has the following form

$$P(S)=\begin{cases}-nc & if \min\limits_{0\le t\le T}(L_{1t})<L_1 \vee \min\limits_{0\le t\le T}(L_{2t})<L_2 \vee \min\limits_{0\le t\le T}(L_{3t})<L_3 \vee ..., \\ -nc & if \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge ... \wedge S<X, \\ n(A-c) & if \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge ... \wedge S\ge X, \end{cases} \quad (3.9)$$

where: - A is a fix amount of cash

- L_{1t}, L_{2t}, L_{3t},... are values of assets at specified moments during the option life,

The profit function from selling n cash or nothing down and knock-out portfolio put option with more barriers is:

$$P(S)=\begin{cases}n(B+p) & if \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge ... \wedge S<X, \\ np & if \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge ... \wedge S\ge X, \\ np & if \min\limits_{0\le t\le T}(L_{1t})<L_1 \vee \min\limits_{0\le t\le T}(L_{2t})<L_2 \vee \min\limits_{0\le t\le T}(L_{3t})<L_3 \vee ..., \end{cases} \quad (3.10)$$

where B is a fix cash amount.

4. New guarantee certificate formation

There are many guarantee certificates offered in the financial market. Almost all certificates are created by a combination of an underlying asset and appropriate combination of vanilla or exotic options. If only the value of the underlying asset at maturity is significant for the resulting profit profile, then the vanilla options are used for the formation of investment certificates. If the value of the underlying asset until maturity is significant for the resulting profit profile, then the exotic options are used. In the next section we propose a new guarantee certificate and show the nature of its formation using exotic options.

Proposed guarantee certificate is a product made up of asset basket. The product enables investors to generate an overall yield of *Y*% from the nominal value of a certificate at the end of the term, if each of the underlying assets quotes is at or above the *X*% barrier level during the observation period. The certificate is 100% capital guaranteed. It is particularly interesting at present, when uncertainty on financial markets is still high.

The principle of this guaranteed certificate is simple and is focused to limit the loss. The starting value and the barrier (L) are determined for each asset. If all assets always quote at or above their barriers (*X*% of their starting value) during the observation period, then the investor obtains 100% of the nominal value and the profit share of *Y*% from the nominal value. In case the barrier is undercut by one or several asset prices during the observation period, the opportunity to generate the *Y*% yield no longer applies, but the certificate guarantees a capital return at the maturity date.

The profit function of this guaranteed certificate is:

$$P(S)=\begin{cases}0 & if \min\limits_{0\le t\le T}(L_{1t})<L_1 \vee \min\limits_{0\le t\le T}(L_{2t})<L_2 \vee \min\limits_{0\le t\le T}(L_{3t})<L_3 \vee \min\limits_{0\le t\le T}(L_{4t})<L_4, \\ nkN & if \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge \min\limits_{0\le t\le T}(L_{4t})\ge L_4, \end{cases} \quad (4.1)$$

where: - n is number of certificates;

- k is yield participation, in our case, $k=Y/100$;
- N is nominal value of the certificate;
- L_1, L_2, L_3, L_4 are barriers for assets at initial valuation date (*X*% of the starting values of these shares);
- L_{1t}, L_{2t}, L_{3t}, L_{4t} are values of assets at specified moments during the observation period.

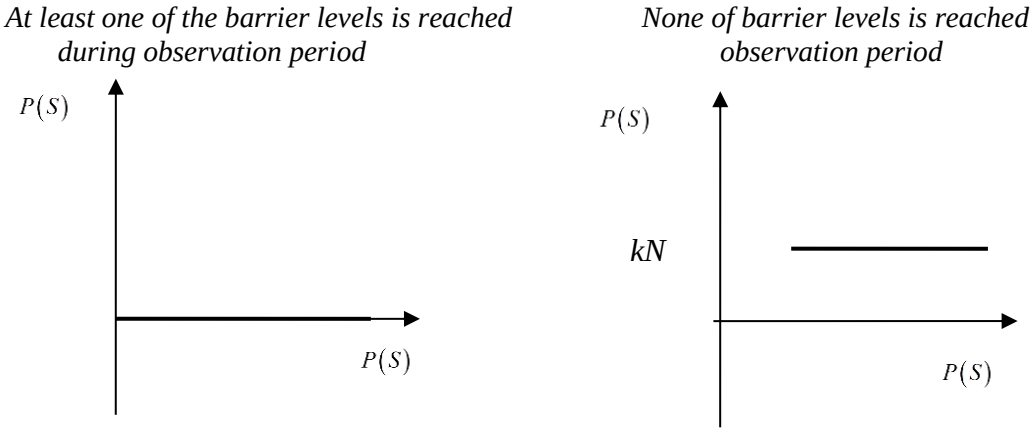


Figure 1 – Profit function of a new guarantee certificate

Figure 1 depicts the profit function of a new guaranteed certificate, i.e. function (4.1). It is evident that the investment in a guaranteed certificate never makes a loss. Guaranteed certificates are therefore suitable for conservative investors. The security is paid by a lower profit in case of a significant underlying asset price increase. The question is how the certificate was constructed? We get the answer by finding an alternative investment.

The nature of formation

Let us suppose that an investor invests nS_0 EUR to purchase n guaranteed certificates with the current price S_0 and the time to maturity of t years. One possibility of the alternative investments creation is:

- deposit in bank;
- purchase n cash or nothing down and knock-out portfolio call options;
- selling n cash or nothing down and knock-out portfolio put options.

Make a deposit in the bank at the present value of an interest rate for the year *t:*

$$\frac{nS_0}{(1+i)^t}. \tag{4.2}$$

This operation guarantees return of the initial investment at maturity date. The difference between:

$$nS_0 - \frac{nS_0}{(1+i)^t}, \tag{4.3}$$

offers a space for creating a new option strategy.

Let us buy cash and nothing and knock-out portfolio call option on the same basket of assets, strike price X, expiration time T, time to maturity t, fix amount of cash A, premium c and barriers in the form of initial asset values of assets from the basket; and at the same time, sell n cash or nothing down and knock-out portfolio put options with the same parameters and the premium p.

If the following conditions are met:

$$np - nc + n\left(nS_0 - \frac{nS_0}{(1+i)^t}\right) \geq 0, \tag{4.4}$$

A+B = C, then we can easily deduce the income function of the alternative investment as the sum of the profit function (2.9) and (2.10) modified for four-asset basket.

$$P(S)=\begin{cases}0 & \text{if } \min\limits_{0\le t\le T}(L_{1t})<L_1 \vee \min\limits_{0\le t\le T}(L_{2t})<L_2 \vee \min\limits_{0\le t\le T}(L_{3t})<L_3 \vee \min\limits_{0\le t\le T}(L_{4t})<L_4,\\ nC & \text{if } \min\limits_{0\le t\le T}(L_{1t})\ge L_1 \wedge \min\limits_{0\le t\le T}(L_{2t})\ge L_2 \wedge \min\limits_{0\le t\le T}(L_{3t})\ge L_3 \wedge \min\limits_{0\le t\le T}(L_{4t})\ge L_4,\end{cases} \quad (4.5)$$

When assuming the existence of the cash or nothing barrier portfolio options with the characteristics:

- options and certificate shall be issued on the same underlying asset, $C = kN$,

$$np - nc + n\left(nS_0 - \frac{nS_0}{(1+i)^t}\right) = 0,$$

- option and certificate have the same barriers defined by the starting value of the same basket of assets, time of purchase of options and certificate is the same, then the profit function of alternative investment opportunities (4.5) is identical with the profit function of the certificate (4.1).

Conclusion

The paper presents a proposal of the new guarantee certificate. Guarantee certificates generally guarantee 100% of the initial invested amount. Therefore they are suitable for conservative investor. A proposed guarantee certificate is appropriate for investors who do not expect a decrease under barrier level or a significant growth of underlying asset price.

In the first place the brief description of particular exotic options is introduced. This paper is focused on barrier option, mainly on their profit functions, buying a down and knock-out call options and selling a down and knock-out put options, description of portfolio barrier option and cash or nothing options as interesting types of vast group of exotic options. Following this, the exotic hybrid option - cash or nothing portfolio barrier option, its introduction, basic characteristics and profit functions from buying and selling of certain quantity were presented.

The practical part of this work demonstrates the application of exotic options in investment certificate formation. The basic features and derivation of the profit function from the purchase of this certificate were described. We found the alternative investment like an investment in a bank deposit, buying digital barrier portfolio put options and selling digital barrier portfolio call options that has the same profit profile as the certificate. Assumption of certain conditions for cash and nothing barrier portfolio options can declare that the profit function of alternative investment opportunities is equal to the profit function of proposed certificate.

References

[1] Hull, J. C. (2008). *Options, Futures, and Other Derivatives.* 7th Edition, New Jersey: Pearson Prentice Hall.

[2] Rusnáková, M., Šoltés, V. (2012). Long strangle strategy using barrier options and its application in hedging. *Actual Problems of Economics*, 134(8):452-465.

[3] Šoltés, M. (2010a). The relation between speed certificates and the inverse vertical ratio call back spread option strategy. *E+M Ekonomie a Management*, (2):119-123.

[4] Šoltés, M. (2010b). Crude oil trading using turbo certificates. *Acta Montanistica Slovaca*, 15(1): 1-4.

[5] Šoltés, M., Šoltés, V. (2000). Guarantee and airbag certificates analysis. *Biatec*, 15(1):23-24.

[6] Šoltés, V. (2011). *The Application of the Long and Short Combo Option Strategies in the Building of Structured Products.* Liberec Economic Forum 2011: September 19-20, in Liberec, Czech Republic. Liberec: Technical University of Liberec.

[7] Šoltés, V., Amaitiek, O.F. (2010a). Inverse vertical ratio put spread strategy and its application in hedging against a price drop. *Journal of Advanced Studies in Finance*. 1(1): 100-107.

[8] Šoltés, V., Amaitiek, O.F. (2010b). The short put ladder strategy and its application in trading and

hedging. *Theory, Methodology and Practice*. 6(2): 77-84.

[9] Šoltés, V., Rusnáková, M. (2010). Utilization of options in the formation of structured products. *Transactions of the Universities of Košice,* (1): 65-72.

[10] Šoltés, V., Rusnáková, M. (2012). Long Combo strategy using barrier options and its application in hedging against a price drop. *Acta Montanistica Slovaca,* 17(1): 17-32.

[11] Šoltés, V., Rusnáková, M. (2013). Hedging against a price drop using the inverse vertical ratio put spread strategy formed by barrier options. *Inzinerine Ekonomika – Engineering Economics*, 24(1): 18-27.

[12] Šoltés, V., Šoltés, M. (2006). Investing through investment certificates. *Biatec,* 14(10): 22-24.

[13] Taleb, N.N. (1997). *Dynamic Hedging: Managing Vanilla and Exotic Options.* Hardcover: Wiley & Sons.

[14] Weert, D. F. (2008). *Exotic Options Trading*. Hardcover: Wiley & Sons.

[15] Wilmott, P., Howison, S. and Dewyne, J. (1995). *The Mathematics of Financial Derivatives.* Press Syndicate of the University of Cambridge.

*** Financial Instruments Structured Products Handbook. 2004. *Vienna: Oesterreichische National Bank.* Available online at: http://www.oenb.at. (accessed November 11, 2012).

TECHNOLOGICAL BREAK-EVEN POINT AND LABOUR PRODUCTIVITY: THEORETICAL AND EMPIRICAL ASPECTS

Giulio **GUARINI**[17]
Università degli studi della Tuscia[18], **Italy**
giulioguarini@unitus.it

Abstract

The proposal of this paper is to analyze the break-even point of technological implementation from a firm, in theoretical and empirical terms. First, I have defined the Technological break-even point by building an analytical framework. The analysis points out that technological implementation is a complex activity and technological gaps among firms depend upon different dynamic of net costs and net benefits generated by new technology. Second, I have verified the significance of technological break-even point by estimating, with an econometric analysis, the labor productivity function of Sylos Labini for Italian regions in the period 1998-2003 for the manufacturing firms. As results show, the technological break-even point is significant.

Keywords*:* break-even point of technology, labor productivity.

JEL classification: O14, O33, R11

1. Introduction

In this paper, I intend to address the issue of the effects that technological implementation technology can have on a firm through a theoretical and empirical analysis. I'm going to define the technological break-even point by building a framework consisting of some important heterodox theoretical contributions in this area of research. As the economic literature draws, innovation is the main tool for competitiveness in any firm. The introduction of new technology in the production process can take place through either technology transfer or through technology development within firm.

This process involves the entire production structure in terms of organization and competencies. Sometimes the successful results of a technology may depend precisely upon the outcome of this particular step. This paper focuses on this very crucial moment in productive process, by explaining what are opportunities and difficulties caused by the implementation of a new technology within firm. To this end, I am going to start by declining costs and benefits of the implementation of a new technology. I'm going to identify the technological break-even point. This is the point beyond which benefits from the implementation of technology outweigh costs. Furthermore, I intend to support, indirectly, some main features of theoretical study with an empirical analysis on Italian regions of manufacturing sectors in the period 1998-2003. Analytical framework and empirical analysis highlight that technological implementation is a complex process. In fact it involves non-trivial net costs as well as economic net benefits after the technological break-even point.

2. Theoretical framework

First of all, I'm going to describe the main components of costs and benefits deriving from technology implementation by building a framework of technological break-even point. The main aim of this part is to identify the relevant items of cost and benefit, through a description that highlights quality features rather than quantitative elements. In fact, analysis does not go into any particular specification related to the type of firm and technology. For example in some cases costs may be *una tantum* because they will be extinguished before technology is in use; in other cases there will be costs as long as technology is used.

[17] I would like to thank Marcella Corsi, Carlo d'Ippoliti, Paolo Palazzi, Alessandro Roncaglia for helpful comments and two anonymous referees. The usual disclaimer applies.

[18] Dipartimento di Economia e Impresa, Università degli studi della Tuscia, Via del Paradiso 47, 01100 Viterbo, Italy

The introduction of new technology within a firm involves a number of costs that can be classified into fixed and variable. Fixed costs are *entry costs* (C_E), while variable costs are the costs of assimilation (C_A). I'm going to define two types of entry costs:

$$C_E = C_{AC} + C_{TR} \quad (1)$$

accumulation costs (C_{AC}) and transfer costs (C_{TR}). If the new technology is created within firm, entry costs are those of accumulation represented by investments in R&D, training, research facilities. In the case of technology transfer both costs are observed. In fact, before the acquisition of a new technology there is an accumulation step in which firm must acquire a minimum scientific infrastructure and knowledge to accommodate new technology, which may require capital expenditures for new facilities (such as laboratories and new plants) and to train workers (Perez and Soete, 1988, p. 472; Boggio Seravalli 2003). Transfer costs have three components

$$C_{TR} = (P_T + C_S)C_{OP} \quad (2).$$

The first component is the price of technology (P_T) and it is often represented by patent. Moreover, there are costs for searching the technology (C_S) that depend upon gap between the skills of buyers (such as managers and engineers) and the skills necessary both to grasp the opportunities offered by international market and to select those ones most appropriate for their needs (*competence gap*). These costs may for example correspond to the costs of external consultants (Heiner 1983, Dosi and Orsenigo 1988, Foss, 1993). Both costs are multiplied by the opportunity cost (C_{OP}) of not choosing optimal technology. This cost depends upon the probability[1] that technology may be not the most efficient (potential inefficiency) as well as the difficulty, often insurmountable, of firm to quickly change the technological choice once it have found it to be faulty (*inflexibility*) (Arthur 1988, Cowan, Gunby 1996). Transfer costs can depend upon information asymmetry between buyer and seller in the sense that the latter has obviously a greater knowledge of technology than the former. Firm may buy new technology with an overcharge (respect to real quality). Firm also has a higher probability of choosing a technology that turns out to be ineffective (with increasing opportunity cost).

According to the neoclassical approach technology is a set of techniques consisting of different combinations of capital and labor. On the contrary, in this analysis, technology is seen not only as a set of inputs, but mainly as information that must be understood and processed. In order to do this, when firm starts to use new technology, it has a number of new costs to adapt the organizational structure to new requirements. I will call these costs *assimilation costs* (C_A)

$$C_A = C_C + C_{AL} + C_L \quad (3).$$

The first component of C_A in (3) is the result of change costs (C_C). They are related to the deletion of production procedures and organizational structures of old technology that are inadequate for the new one. The second component is the algorithmisation costs (C_{AL}), which are costs brought about the codification of new information, to make the basic elements of the new information easy and approachable to all employees, and about the implementation of new routines; where routines mean standard procedures that are applied in different divisions of firm (such as production and marketing) (Zuscovitch and Willinger, 1988; Brown and Duguid 2001).

The knowledge of new technology is a process that takes time and involves costs for at least two reasons. First, technology cannot be fully understood except through its use, because there is information that can be learned only through experience, so-called *tacit knowledge*. Second, a continuous updating of skills is needed in order to maintain machinery and/or solve new problems. For these reasons, the third component of assimilation costs is represented by the costs of learning new information and generating new skills derived from direct and prolonged use of technology (*learning costs*, C_L). Figure 1 summarizes this classification.

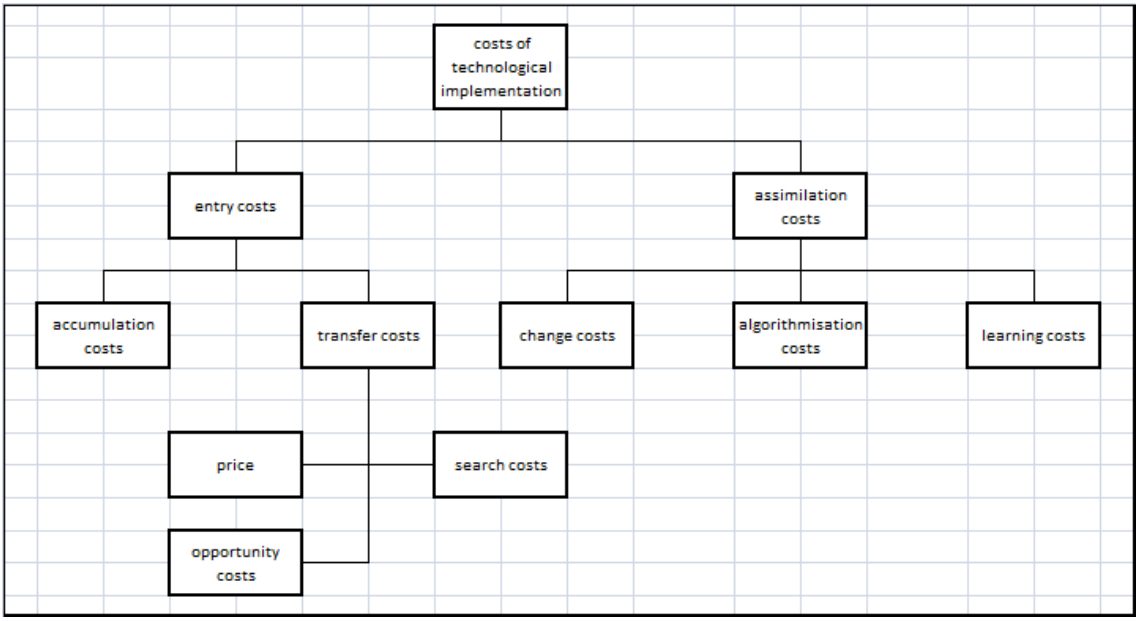


Figure 1 - The knowledge of new technology classification

Let us consider the benefits of the introduction of new technology. The benefits can derive from technology appropriability and from technological spillovers. The technological appropriability refers to a set of economic benefits obtained through new technology thanks to the sale of new products (particularly if invention relates to a technology product), and/or increased competition (particularly if invention relates to a technology process) (Malerba, Heimler and Peretto 1993, Malerba, 2004). These economic benefits are composed of higher profits, higher shares of national market (if consumers are prepared to uphold new good and/or increase their consumption at lower prices) and/or international market (if economic conditions and international policies are favorable). After carrying out an analysis of some costs and benefits of implementing a new technology, I build a graph regarding cost - benefit analysis.

The aim of this framework is to describe, in general terms, the main features of cost and benefit components without dwelling on the characteristics of firm and technology. Thus, the functions that will be shown in graph are defined in easy terms to provide a clear picture of phenomenon by highlighting only the main elements. To this end, it is assumed that the trends of costs and benefits are represented by continuous functions. The costs of technology implementation can be represented by a variable C that depends upon cumulative output *x:*

$$x = f\left(\int X_t dt\right) \tag{4}$$

where: X_t is the current production at time *t*. It may represent costs through the following function:

$$C_t = \theta_1 + x_t^{\theta_2} \tag{5}$$

where respect to the cumulative production *x*, parameter $\theta_1 > 0$ represents entry costs and $x_t^{\theta_2}$ represents assimilation costs with $0 < \theta_2 < 1$. I assume that entry costs are *una tantum* and that unit costs of assimilation are decreasing compare to cumulative output. The function of benefits is the following:

$$B_t = \phi_1 x_t - \phi_2 x_t^2 \tag{6}$$

with $\phi_1, \phi_2 > 0$.

In the graph from the Figure 2, benefits and costs are in vertical axis, while in horizontal axis is the cumulative output. Point x_0 is the level of cumulative output concerning the introduction of new technology.

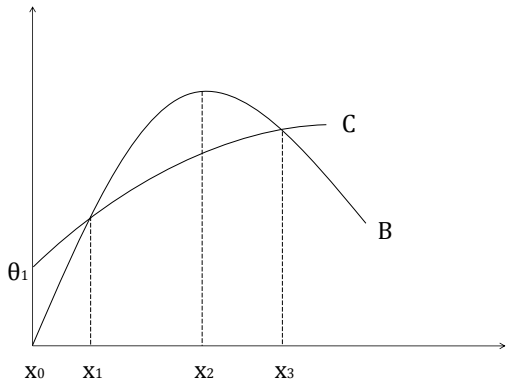


Figure 2 – New technologies

Every technology has its own life cycle; it is born, grows and dies for technological and economic reasons. Then, technical progress takes place when new technologies replace old ones that have become obsolete. This is described in the graph:

- the interval x_0 - x_1 indicates the *implementation step*, when there are positive net costs;
- x_1 represents the point of *technological break-even point* beyond which new technology finally produces positive net benefit;
- the interval x_1-x_2 is the *take-off step* in which the net benefits grow;
- x_2 indicates the situation of the *maximum competitiveness*, that is, when there is the maximum difference between benefits and costs;
- interval x_2 - x_3 indicates the *decline step*, when technology is crowded out by a new technology that enters in domestic market and/or international market and the firm that implements new technology increases its shares and profits at the expense of firms that use old technology;
- x_3 is the *saturation point* beyond which technology produces positive net costs.

According to the theoretical approach of Johnson and Lundvall (1994), in order to reduce the accumulation costs, and to move down the *C* function by reducing the parameter θ_1, the firm has to increase two components of codified knowledge (that is the knowledge that is produced and transmitted through formal channels): the first one is *know what* that indicates the codified information of the relevant facts of reality; the second one is *know why* that is a scientific knowledge of the causes of phenomena analyzed. Instead, in order to reduce the assimilation costs, firm has to increase two components of tacit knowledge (that is the knowledge that is produced and transmitted informally): the first one is *know-how*, that is knowledge of how to act and about practical skills; the second one is *know who*, that is information about who can solve specific problems in order to minimize the cost of the acquisition of new knowledge. The know - who is very useful to reduce the search costs of new technology.

There are benefits from spillover generated by new technology that can stimulate a network among firms. This network of technological knowledge can create a cumulative process of technological development within the same sector (vertical spillovers) and/or among different sectors (horizontal spillovers) thanks to technological complementarities. In that context, both interaction between public institutions (local and national) and firms, and interaction among firms themselves (such as joint ventures) are relevant in order to choose the best technologies (by reducing the cost of research and opportunity costs), to sustain and promote investments in infrastructures, to train and to disseminate new skills (by lowering accumulation costs) (Chesnais, 1988; Cimoli, Dosi, Nelson and Stiglitz, 2006). In particular, the role of government revolves around the following activities: to create effective industrial policies in order to set priorities of different technological areas; to encourage

private sector in order to follow the path of technological development; to solve structural problems; to provide the output of public research to private sector; and finally to support domestic firms in competing in international market. The externalities produced by inter-firms cooperation sustain technological development. The work of public and private institutions can improve the technological performance of firms in several ways: by reducing entry costs through structural interventions for both firms and educational system; by reducing assimilation costs, with creation and management of service facilities for firms; and finally through technological spillovers that foster business cooperation and development of productive and technological significant complementarity.

However, there may also be negative effects of interactions as free riding. In addition, the failure of coordination among firms, and between firms and institutions may prevent full dissemination of knowledge and learning (learning and knowledge-creation failure; see Cimoli, Nelson, Katz, Studart, 2003). Finally, entitlements failures may produce some difficulties in entering in technology market (Cimoli, Nelson, Katz, Studart, 2003)

Figure 2 shows an *ex ante* analysis of costs and benefits expected by a firm, due to the introduction of new technology. The firm will buy only technology that will maximize the following function:

$$\max\left[\int_{x_1}^{x_3}(B_t - C_t)dx_t\right] \qquad (7).$$

Firm cannot know in advance some of the elements of cost (such as the competence gap, information asymmetry, opportunity costs). According to this "micro" approach, in disadvantaged areas technology diffusion does not occur, or it occurs with many difficulties, because a firm can fail to take technical and economic net benefits from the introduction of new technology and it waives implementation.

According to neoclassical approach, in general, a firm chooses the best technology, and instantly uses it. This occurs in absence of externalities and uncertainty. Furthermore, learning process may not occur and if it does, it is automatic, predictable, free of charge and it is not characterized by externalities. Instead, in the theoretical framework of this paper, which incorporates several important heterodox contributions, the introduction of new technology is not something trivial and instantaneous. Moreover, learning technology is a process that takes time and involves costs, and various public and private institutions directly and/or indirectly give rise to spillovers and externalities. Finally, the outcome of implementation is uncertain: in other words, the difference between the area of costs and benefits cannot be known *a priori* in terms of both size and sign (Lall, 2001).

3. Econometric analysis

Previous theoretical analysis has identified a technological break-even point that is a point before which net costs are positive, and beyond which net benefits are positive. In this second part, I aim to study technological break-even point by an empirical point of view. I'm going to verify the significance and the sign of the effects of investments (current and past), which approximate the technology embodied in new machinery, on the growth rate of labor productivity, which can approximate net benefits.

Data are drawn from the ISTAT database "Regional Economic Accounts" which includes the 20 Italian regions. Period is six years, 1998-2003. Following the ISTAT classification, manufacturing sectors are the following nine: "Manufacture of food products, beverages and tobacco products", "Manufacture of textiles and apparel", "Manufacture of leather and leather products", "Manufacture of paper and paper products, printing and publishing", "Manufacture of coke, refined petroleum products, chemicals and pharmaceutical products", "Manufacture of non-metallic mineral products", "Manufacture of basic metals and fabricated metal products", "Manufacture of machinery and equipment, and of electrical, optical and transport equipment", "Manufacture of wood, rubber, plastics and other manufacturing industries".

The use of machinery growth rate can be a good approximation of technological implementation. In fact in 2004, in industrial firms between 10 and 49 employees (which represent the

majority of Italian firms), the share of investment spending in machinery and equipment innovation were equal to 63.3 percent of total expenditure on innovation (ISTAT, 2006). As noted by Schumpeter [Business Cycles, Vol. I, p. 93], most of the innovations - and certainly the most important - involve the construction of new facilities or new equipment" (Sylos Labini, 1967, p.96)[2]. The previous analysis has shown that the impact of new technology on production process is different in time: at first it generates positive net costs, while subsequently it causes positive net benefits. For this reason, I'm going to calculate the effect of investments on the productivity growth rate in the short term and in the medium term.

To this end, I'm going to estimate the productivity function à la Sylos Labini that has as independent variables, current and past investments. Let us illustrate in detail the composition of this function (Courses and Guarini, 2007; Guarini, 2007, 2009). According to Sylos Labini, the growth rate of labour productivity can depend upon endogenous innovations that are changes in technology driven by economic factors. These are composed of three elements: production, labor costs and investments. The first component is the growth rate of output (or income): according to the Smith, the increase of market size stimulates the division of labor with positive effects on labour productivity, thanks to static and dynamic economies of scale (*Smith effect*) (Corsi, 1991). The second component is represented by the growth rate of relative labour cost meaning the difference between wages and the price of machinery. The increase of this variable makes the job more expensive relatively to machinery, and thus the firmer is persuaded to buy new machinery. Positive effect on productivity takes place after the introduction and use of machinery. For this reason the variable regarding this effect is time lagged (*Ricardo effect*). Finally there are current and past investments. The latter have a positive effect that can be called "Schumpeter effect". Current investments, according to Sylos Labini, have a negative effect called "disturbance effect" whose explanation is as follows:

> *"This paradox can be explained by the fact that each year the majority of investments are implemented by existing firms, not by new ones, and the installation of new equipment causes several disturbances in operations concerning current production since it obstructs, even physically, certain operations and it absorbs the energies of managers and engineers, who can devote less attention to the ordinary operations of their businesses".(p.123 Sylos Labini 1984, cf. Sylos Labini 2004, pp. 43-44 and Sylos Labini 1992 p.150)*[3].

So the aim of empirical analysis is to estimate the statistical significance of the technological break-even point previously analysed in relation to technological implementation. I'm going to test econometrically the productivity function à la Sylos Labini. In this function, technology implemented generates in the short term positive net costs concerning the disturbance effect of machinery growth rate and in the medium term it shows positive net benefits represented by time lagged machinery growth rate -*Schumpeter effect*. (Corsi, Guarini 2007)

Consequently, for this type of analysis the "control variables" are the variables of Smith effect and Ricardo effect, while the "focus variables" are the variables of Schumpeter effect and disturbance effect. The productivity function considered follows the integrated approach of Sylos Labini, in the sense that macro and micro elements are integrated due to the origin of effects considered.

Many empirical studies about use regional or national data to explain Smith effect (called also "Verdoorn Law") and they stress the links between micro level and macro level caused by the complex nature of economies of scale (such as Bianchi 2002; De Stefanis 2002; Fingleton and McCombie 1998; Lau1998 Harris, 1999; León-Ledesma, 1999, 2000; McCombie and Ridder, 1983, 1984; Ofria 1997).

As far as Ricardo effect is concerned, Sylos Labini justifies the link between micro and macro levels of analysis with the interaction between productivity growth and relative labour cost. At the beginning, technical progress leads to an increase in relative labour cost. In fact if we assume that labour productivity tends systematically to increase, there will always be a positive difference between wages and prices when the distribution of income does not change dramatically (see Sylos Labini, 1991 p.295).

Successively, an increase of relative labour cost may lead to further increases in labour productivity being it in same firm or in others. To neutralize the effects of these cost increases, all firms try to reduce the coefficient of work by increasing labour productivity. In sectors in which the

increase of labour productivity exceeds the increase of wages, there will be room for further wage increases. Then there will be a process of interaction, which is perpetuated and strengthened by the belief, widespread among managers, that wages have a systematic tendency to increase. Therefore, the same producers of machinery will improve the efficiency of their products even before of wage increases (see Sylos Labini, 1989, p. 69).

From this point of view, the productivity gains are both cause and effect of wage increases. They can be the *Cause* of wage increases, since the increase in labour productivity stimulate unions to request further wage increases and it allows firms to pay them. Under certain conditions, indeed, firms voluntarily decide to grant higher wages both to attract (and keep) the more efficient workers and to ensure "social peace" in firm. They can be the *Effect* of wage increases since firm tries to offset the wage increases by labour-saving, or in absolute terms, with rationalisation of production processes, or in relative terms, with the introduction of machineries that enhance labour productivity (see Sylos Labini, 1984, pp.117-118).

As far as Schumpeter effect is concerned, the use of macro data to test micro effects is justified by the nature of innovation. In fact according to Schumpeterian concept of competition, innovation in a firm can generate both a process of imitation and diffusion of innovation for competitor firms who are able to react, and a failure for firms that are not able to innovate; in both cases innovation of a firm causes a widespread growth in labour productivity.

> *"[...] The diffusion process of innovations can be identified with the Schumpeterian competitive process […]. For Schumpeter the entrepreneur who implements an innovation obtains a particular gain - the «surplus» or «profit» -. The competitive process takes place in two stages: «First, the attractiveness of gains raises a host of imitators of innovator entrepreneurs; then the fear of loss forces several producers to introduce new methods; the firms not able of transformation and adaptation are eliminated»" (Sylos Labini, 1989, 45-46)*[4].

The competitive mechanism, depending upon the size of entry barriers, is driven by creative destruction that "is the selecting out of firms or their routines by the pressure from an innovation. The process of creative destruction is a combination of this kind of selection and the innovative activities that drives the process" (Anderson *et al.* 2006, p.6).

The above framework on the technological break-even point in a firm can be analysed, with good approximation, by using aggregated data at the regional level. According to the Schumpeterian approach of Sylos Labini, I will assume that a positive growth rate of labour productivity in a firm caused by innovation can generate direct and indirect effects of innovation, imitation and selection with an increase of the growth rate of labour productivity at the sector level. While Sylos Labini uses national data, time series and few observations, I will use panel data, about one thousand observations and regional data. Finally I will introduce the time lagged growth rate of labour productivity to make function more dynamic (absent in the Sylos Labini's regressions). The production function estimated is the following:

$$prod_{it} = A + \alpha prod_{it-1} + \beta y_{it} + \gamma cr_{it-2} + \lambda_0 k_{it} + \lambda_1 k_{it-1} + \lambda_2 k_{it-2} + \varepsilon_{it} + \mu_i \qquad (8)$$

where $prod_{it}$, $prod_{it-1}$ are the labour productivity growth rates, respectively, at the current time and at time t-1, y_{it} is the current growth rate of value added, cr_{it-2} is the growth rate of relative labour cost at time t-2, k_{it} is the current growth rate of machinery, while k_{it-1} and k_{it-2} are time lagged growth rates of machinery. The coefficients $\beta, \gamma, \lambda_2 > 0$ and $\lambda_0 < 0$ represent respectively Smith effect, Ricardo effect, Schumpeter effect and disturbance effect. Finally, ε_{ij} is the white noise variable, μ_i indicates individual effect of observations. The choice of a two-year lagged for the control variable regarding the Ricardo effect is coherent with the analysis of Sylos Labini (1984).

Regarding the machinery growth rate, while Sylos Labini (1984) considers only current and the two-year lagged values, in this paper I also include values of one-year lagged, to better study the transition from a negative effect to a positive effect of investments. This change in the sign of investments' effect can indicate technological break-even point.

The estimation procedure is the GMM difference approach (Arellano-Bond 1991). In this way I take into account the potential endogeneity of $prod_{it-1}$, cr_{it-2} and of y. This last endogeneity is due to the inverse causal relationship from the income growth rate to labour productivity growth rate. In fact, according to accounting identity, income growth rate can be decomposed into the sum of labour productivity growth rate and employment growth rate. Furthermore, several studies validate Smith effect by using different econometric techniques (Rowthorn 1975; Parikh, 1978; McCombie and de Ridder, 1983, 1984, Leon-Ledesma, 1999, 2000; McCombie, 1981; Fist 1995; Førsund 1996); Destefanis, 2002).

I verify the "disturbance effect" with one year lagged machinery growth rate (λ_S with s=1) and two years lagged machinery growth rate (λ_S with s=2). I introduce these variables to better assess their significance. According to the results, the productivity function of Sylos Labini is verified in all components and in particular the Schumpeter effect is represented by λ_1, while λ_1 is not significant. With regard to control variables, the Smith effect seems to be the most significant effect. The regression verifies indirectly the significance of technological break-even point by validating the existence of a difficulty to implement new technology. The disturbance effect has a negative sign ($\lambda_0<0$), while the Schumpeter effect is positive ($\lambda_2>0$). According to the regression, the introduction of new technology embodied in new machineries has a negative short term impact, because the whole activity of the firms is "disturbed" in order to adapt production process to new technology.

Table 1. GMM difference estimates of Italian regional labor productivity

Variable	Coefficient	P-value
$prod_{t-1}$	-0.205*	*-0.021*
y	0.921**	*0*
cr_{t-2}	0.252*	*0.041*
k	-0.086*	*0.017*
k_{t-1}	-0.019	*0.48*
k_{t-2}	0.070**	*0.04*
Test statistics		
AR(1) test	-3.27**	*0.001*
AR(2) test	-1.73	*0.083*
Hansen J test	41.09	*0.511*
Time Dummies test	18.73**	*0.002*
Observations		*890*

* p<0.05, ** p<0.001, (p = p-value. Standards errors are robust to heteroschedasticity. The reported estimates are based on the one-step version. AR(1) test is for first-order serial correlation test; AR(2) test is for second-order serial correlation test.

Conclusion

In this paper I examined the technological implementation in a firm, in terms of costs and benefits, by studying theoretical and econometric aspects. First, I built an analytical framework of theoretical contributions to identify a technological break-even point that is a point before which the net costs are positive, and beyond which the net benefits become positive. The components of costs concern economic and organizational costs, and investments in skills. The components of benefits concern technological appropriability and spill-over effects. The size of these components may also depend upon various institutional factors.

Successively, I studied technological break-even point by an empirical point of view. I verified the significance and the sign of the effects of investments (current and past), which approximate the technology embodied in new machinery, on labor productivity growth rate, which can approximate net benefits. To this end, I estimated a productivity function à la Sylos Labini of Italian regions for different manufacturing sectors. The control variables are: time lagged growth rate of labour productivity; income growth rate -Smith effect-; the growth rate of relative labor cost (the

difference between wage growth rate and machinery's price growth rate) -Ricardo effect-. Instead the variables on which I focused the study are those regarding technological break-even point. They are time lagged machinery growth rate -Schumpeter effect- and current machinery growth rate -disturbance effect-. The econometric results validate the statistical significance of all components of productivity function. In particular, technological break-even point is verified: in fact the time lagged growth rate of machinery, of two years, has a positive effect, instead the current machinery growth rate has a significant negative effect.

References

[1] Andersen E.S., Dahl M.S., Lundvall B.A. and Reichstein T. (2006). Schumpeter's process of creative destruction and the Scandinavian systems: a tale of two effects, Paper for the DRUID Conference.

[2] Arellano, M. and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence ad an application to employment equations, *Review of Economic Studies*, 58: 277-297.

[3] Arthur B. (1994). *Increasing returns and path dependence in the economy*, University of Michigan Press, Ann Arbor.

[4] Arthur B. (1988). A Competing Technologies: an Overview, in Dosi G, Freeman C., Nelson R., Silverberg G. and Soete L., *Technical Change and Economic Theory*, 590-607, London and New York, Pinter Publishers.

[5] Bianchi C. (2002). A Reappraisal of Verdoorn's Law for the Italian Economy, 1951-1997, in J. McCombie, M. Pugno and B. Soro (eds), *Productivity Growth and Economic Performance*, London, Palgrave Macmillan: 115-35.

[6] Boggio L., Seravalli G. (2003). *Lo sviluppo economico. Fatti, teorie, politiche*. Il Mulino. Bologna.

[7] Brown, J.S., Duguid P. (1999). Knowledge and Organization: A social-practice perspective, *Organization Science*, 12:198-213.

[8] Chesnais F. (1988). Multinational enterprises and the international diffusion of technology, in Dosi G, Freeman C., Nelson R., Silverberg G. and Soete L. *Technical Change and Economic Theory*, 496-527, London and New York, Pinter Publishers

[9] Cimoli M., Nelson C., Katz J. and Studart R. (2003). Institutional Requirements for Market-led Development in Latin America, CEPAL - SERIE *Informes y estudios especiales* 11:1-57.

[10] Cimoli M., Dosi G., Nelson R., Stiglitz J. (2006). Istituzioni e politiche che plasmano lo sviluppo industriale: una nota introduttiva, *Stato e mercato*, n.77, Il Mulino.

[11] Corsi M. (1991). *Division of Labour, Technical Change and Economic Growth*, Avebury, Aldershot.

[12] Corsi M., Guarini G. (2007). La fonction de productivité de Sylos Labini: aspects théoriques et empiriques, *Revue d'économie industrielle*, 118:1-24

[13] Cowan R. and Gunby P. (1996). Sprayed to Death: Path Dependence, Lock-in and Pest Control Strategies, *The Economic Journal*, 106:521-542

[14] Destefanis, S. (2002). *The Verdoorn Law: Some Evidence from Non-Parametric Frontier Analysis*, in: McCombie, J., Pugno M., Soro B. (eds), *Productivity Growth and Economic Growth:Essays on Verdoorn's Law* (Houndmills: Palgrave).

[15] Dosi G. (1988). The Nature of the Innovative Process», in in Dosi G, Freeman C., Nelson R., Silverberg G. and Soete L. (eds.), *Technical Change and Economic Theory*, 221-238. London and New York, Pinter Publishers.

[16] Dosi G., Orsenigo L. (1988). Coordination and transformation: an overview of structures, behaviors and change in evolutionary environments, in Dosi G, Freeman C., Nelson R.,

Silverberg G. and Soete L. (eds.), *Technical Change and Economic Theory*, 13-37, London and New York, Pinter Publishers.

[17] Dosi G, Freeman C., Nelson R., Silverberg G., Soete L. (1988). *Technical Change and Economic Theory*, London and New York, Pinter Publishers.

[18] Fingleton B. and McCombie J.S.L. (1998). Increasing Returns and Economics Growth: Some New Evidence from Manufacturing from the European Union Region, *Oxford Economic Paper*, 50: 89-105.

[19] Førsund, F. (1996). *Productivity of Norwegian Establishments: a Malmquist Index Approach*, in Mayes D.G. (ed.) Sources of Productivity Growth (Cambridge: Cambridge University Press).

[20] Foss, N.J. (1993). Theories of the Firm: Contractual and Competence Perspectives, *Journal of Evolutionary Economics*, 3:127-144.

[21] Guarini G. (2007). La funzione di produttività di Sylos Labini tra mercato e territorio: un'analisi econometrica per le regioni italiane, *Moneta e Credito*, 60: 173-198.

[22] Guarini G. (2009). Labour productivity and technological capability: an econometric analysis on the Italian regions in Neri Salvadori *et al.*, *Geography, Structural Change and Economic Development: Theory and Empirics*, Edward Elgar, Cheltenham, 280-305.

[23] Harris R.I.D. and Lau E. (1998). Verdoorn's Law and Increasing Returns to Scale in the UK Regions, 1968- 91: Some New Estimates Based on the Cointegration Approach", *Oxford Economic Papers*, 50: 201-219.

[24] Harris R.I.D. and Liu A. (1999). Verdoorn's Law and Increasing Returns to Scale: Country Estimates Based on the Cointegration Approach, *Applied Economic Letters*, 6: 29-34.

[25] Heiner R.A. (1983). The Origin of Predictable Behavior, *American Economic Review*, 73: 560-595.

[26] Istat, (2006). *Statistiche in breve*.

[27] Lall S. (2001). *Competitiveness, Technology and Skills*, Cheltenham: Edward Elgar.

[28] Johnson B., Lundvall B. (1994). The Learning Economy, *Journal of Industry Studies*, 1: 23-42.

[29] León-Ledesma, M. A. (1999). Verdoorn's Law and Increasing Returns: an Empirical Analysis of the Spanish Regions, *Applied Economics Letters*, 6: 373-376.

[30] León-Ledesma, M. A. (2000). Economic Growth and Verdoorn's Law in the Spanish Regions, 1962-91, *International Review of Applied Economics*, 14: 55-69.

[31] Malerba, F., Heimler, A., and Peretto, P. (1993). Sources, appropriability and directions of technological change: the case of the United States and Italy, *BNL Quarterly Review*, 185: 225-242.

[32] Malerba F. (2004). *Economia dell'Innovazione*, Carocci ed.

[33] McCombie, J.S.L. (1981). What Still Remains of Kaldor's Laws?, *Economic Journal* 91: 206-216.

[34] McCombie, J.S.L. and Ridder, J.R. (1983). Increasing Returns, Productivity, and Output Growth: the Case of the United States, *Journal of Post Keynesian Economics*, 5: 373-88.

[35] McCombie, J.S.L., and Ridder, J.R. (1984). The Verdoorn's Law Controversy: Some New Empirical Evidence using US States Data, *Oxford Economic Papers*, 36: 268-284.

[36] Parikh, A. (1978). Differences in Growth Rates and Kaldor's Laws, *Economica*, 45: 83-91.

[37] Ofria F. (1997). Una verifica empirica della legge di Verdoorn per il Centro-Nord e per il Mezzogiorno (anni 1951-92), *Rivista Economica del Mezzogiorno*, 11: 497-518.

[38] Perez C., Soete L. (1988). Catching up in technology: entry barriers and windows of opportunity

in Dosi G, Freeman C., Nelson R., Silverberg G. and Soete L. (eds.), *Technical Change and Economic Theory*, 458-479, London and New York, Pinter Publishers.

[39] Pugno M. (1995). On Competing Theories of Economic Growth, Cross-country Evidence, *International Review of Applied Economics*, 9: 249-274.

[40] Rowthorn R.E. (1975). What Remains of Kaldor's Law? , *Economic Journal*, 85:10-19.

[41] Schumpeter J.A. (1939). *Business Cycles*, McGraw-Hill, New York.

[42] Schumpeter J.A. (1942). *Capitalism, Socialism, and Democracy*. New York: Harper and Brothers. (Harper Colophon edition, 1976.)

[43] Sylos Labini P. (1967). *Oligopolio e progresso tecnico*, Einaudi.

[44] Sylos Labini P. (1984). *Le forze dello sviluppo e del declino*, Laterza, Roma-Bari.

[45] Sylos Labini P. (1989). *Nuove tecnologie e disoccupazione*. Laterza, Roma-Bari.

[46] Sylos Labini P. (1991). Il mutevole carattere del così detto ciclo economico, *Moneta e Credito*, 44: 295-321.

[47] Sylos Labini P. (1992). *Elementi di dinamica economica*. Laterza, Roma-Bari.

[48] Sylos Labini P. (2004). *Torniamo ai Classici. Produttività del lavoro, progresso tecnico e sviluppo economico*. Laterza, Roma-Bari.

[49] Willinger M., Zuscovitch E. (1988). Towards the Economics of Information-Intensive Production Systems, in Dosi, Freeman, Nelson, Silverberg and Soete (eds.), *Technical Change and Economic Theory*, 239-255. London and New York, Pinter Publishers.

APPENDIX

Table A1

Variable		Mean	Std. Dev.	Min	Max	Observations
prod	overall	-.0040309	.0978892	-.8591788	.8232005	N=1060
	between		.0297528	-.1225919	.0916104	n=178
	within		.0933733	-.7858259	.9122597	T= 5.95506
$prod_{t-1}$	overall	.0022225	.1068823	-.8591788	.8232005	N=1060
	between		.027104	-.0874142	.096037	n=178°
	within		.1034686	-.7958392	.8559617	T= 5.95506
y	overall	.0046289	.0887478	-.5273549	.4920795	N=1060
	between		.0396717	-.1401519	.1062438	n=178
	within		.0794283	-.4296359	.405098	T= 5.95506
cr_{t-2}	overall	.012519	.0826777	-.5282691	1258639	N=1060
	between		.0298287	-.0928305	.2591701	n=178
	within		.0774693	-.7698825	1017025	T= 5.95506
k	overall	.0255533	.1258508	-.4139719	.4045653	N=1060
	between		.0218079	-.0217099	.0888461	n=178
	within		.1240626	-.4772647	.3412725	T= 5.95506
k_{t-1}	overall	.0540867	.1388509	-.4139719	.6438012	N=1060
	between		.0379602	-.0065988	.1940356	n=178
	within		.1340945	-.5539208	.5038523	T= 5.95506
k_{t-2}	overall	.0601772	.1309779	-.4139719	.6438012	N=1060
	between		.029723	.0098828	.1155384	n=178
	within		.127562	-.4333475	.6244257	T= 5.95506

In this panel there are not the values of sector “Manufacture of leather and leather products” in the regions Molise and Val d’Aosta, in the period 1998-2003.

CURRENT ACCOUNT ADJUSTMENTS AND REAL EXCHANGE RATES IN EUROPEAN TRANSITION ECONOMIES

Rajmund MIRDALA
Faculty of Economics, Technical University of Košice, **Slovakia**
rajmund.mirdala@tuke.sk

Abstract

One of key outcomes of open economy macroeconomics refers to a crucial importance of an investment-saving relation affecting a current account determination. However, despite a relative diversity in exchange rate regimes in European transition economies, there is still a substantial potential to analyze price effects of real exchange rate dynamics on current account adjustments. Rigorous investigation of relative changes in real exchange rates leading paths and associated adjustments in current accounts may reveal causal relationship between real exchange rate dynamics and international competitiveness in order to observe its redistributive effects. This purpose is even more significant provided that economic crisis has intensified redistributive effects that still provide quite diverse and thus spurious effects on current account adjustments.

In the paper we analyze main aspects of current account adjustments in European transition economies. Our main objective is to observe a relationship between real exchange rate dynamics and current account adjustments (in countries with different exchange rate arrangements). From estimated VAR model we estimate responses of the current account to the real exchange rate (REER calculated on CPI and ULC base) shock. To provide more rigorous insight into the problem of the current account adjustments according to the real exchange rate dynamics we estimate the model for each particular country employing data for two subsequent periods 2000-2007 and 2000-2012.

Keywords: current account adjustments, real exchange rate dynamics, economic growth, economic crisis, vector autoregression, impulse-response function

JEL Classification: C32, F31, F32, F41

1. Introduction

Macroeconomic stability and overall performance of the European transition economies during last two decades has been significantly determined by the exchange rates development. Large diversity in exchange rate regimes employed by individual countries and subsequent policy adjustments reflected overall improvements in macroeconomic performance and accelerated convergence toward western European countries during this period.

Relative importance of the exchange rate regime choice in determining international competitiveness of transition economies seems to be a frequently discussed area (particularly for understanding a wide variety of unique features of the transition process) not only by policy-makers but also academics trying to find some supportive considerations from empirical evidence on different samples of a wide variety of countries. At the same time it is necessary to highlight key outcomes of open economy macroeconomics emphasizing a crucial importance of an investment-saving relation affecting current account adjustments (intertemporal model).

Almost immediately after the beginning of the transition process countries from the past Eastern block has become a very attractive destination for foreign investors; the fact that even emphasizes the huge demand of this investments-intensive process for internal sources of a capital. However, persisting low domestic capital base put countries from the past Eastern block into the risk of lagging recession and thus it seems to be a crucial reason of early efforts toward capital account liberalization. At the same time, associated capital account surpluses (foreign capital inflows) helped transition economies to finance current account deficits. As quickly rising net debtors, countries from the past Eastern block had to avoid significant external imbalances in order to reduce pressures on their foreign exchange reserves. Persisting current account imbalances thus represented one of the most crucial risks associated with overall sustainability of rigid exchange rate regimes (either hard or soft pegged) in most countries (despite Romania and Slovenia that employed floating exchange rate regime during the whole period since the beginning of the transition process).

At later stages of the transition process European transition economies successfully improved conditions for maintaining their overall macroeconomic stability (in all countries from the past Eastern

block the initiation of this period refers to the beginning of the 21th century). As a result, most countries with soft pegged exchange rate regimes gradually increased flexibility of employed exchange rate arrangements and thus improved overall maneuverability of the exchange rate leading path (Mirdala, 2013). It seems that associated policy adjustments helped to increase fundamental interconnections between macroeconomic performance and exchange rate dynamics. Accelerated convergence toward western European countries associated with high real output growth rates implied increased intention to reduce excessive internal (fiscal deficit) and external imbalances (the current account deficit) to maintain fast economic growth (Siničáková *et al.*, 2011).

High real output growth rates, EU membership as well as euro adoption perspectives strengthened appreciation pressures on nominal exchange rates in all European transition economies but countries with pegged exchange rate arrangements (Bulgaria, Estonia, Latvia and Lithuania) (Stavarek, 2012). Despite a relative diversity in exchange rate regimes in all ten countries there is still a substantial potential to analyze price effects of (externally (nominal) or internally (real) determined) real exchange rate dynamics on current account adjustments. Rigorous investigation of relative changes in real exchange rates leading paths and associated adjustments in current accounts may reveal causal relationship between real exchange rate and international competitiveness in order to observe its redistributive effects (Rusek, 2013). This purpose is even more significant provided that economic crisis has intensified redistributive effects that still provide quite diverse and thus spurious effects on current account adjustments. Even though the contemporary evidence on empirical validity of causal relationship between the real exchange rate and the current account seems to be limited (Arghyrou and Chortareas, 2008), we emphasize challenges addressed to the phenomenon of internal devaluation (Armingeon and Baccaro, 2012) and wide range of its direct and indirect effects in the Eurozone member countries (in general, principles and associated effects of internal devaluation may be applied in countries with rigid exchange rate arrangements too).

Despite the fact, there seems to be no real prospective alternative to euro adoption for the European transition economies, we emphasize disputable effects of sacrificing monetary sovereignty in the view of positive effects of exchange rate volatility and exchange rate based adjustments in the country experiencing sudden shifts in the business cycle. On the other hand, due to existing diversity in exchange rate arrangements in the European transition economies in the pre-ERM2 period there seems to be two big groups of countries - "peggers" (Bulgaria, Estonia, Latvia, Lithuania) and "floaters" (Czech republic, Hungary[19], Poland, Romania, Slovak republic, Slovenia). Effects of the real exchange rate dynamics on the current account adjustments in both groups of countries can be conventionally interpreted as the crucial contribution in understanding fixed versus flexible exchange rates dilemma (Mirdala, 2013). At the same time, macroeconomic effects of different exchange rate arrangements during the crisis period may provide a better insight into suitability of relative exchange rate volatility in each individual economy during sudden changes in the business cycle.

In the paper we analyze main aspects of current account adjustments in European transition economies. Our main objective is to observe a relationship between real exchange rate dynamics (in countries with different exchange rate arrangements) and current account adjustments. From estimated VAR model we estimate responses of the current account to the real exchange rate (REER calculated on CPI and ULC base) shock. To provide more rigorous insight into the problem of the current account adjustments according to the real exchange rate dynamics we estimate the model for each particular country employing data for two subsequent periods 2000-2007 (pre-crisis period) and 2000-2012 (extended period). In both models for each country we alternate both CPI and ULC based REER. We suggest that a comparison of results for models with different time period is crucial to understand redistributive effects of the economic crisis in the view of changes in real exchange rates determination capabilities in the group of ten countries from the past Eastern block.

Following the introduction, we provide brief overview of theoretical concept referring to relationship between real exchange rate dynamics and current account adjustments in the Section 2. In Section 3 we provide an overview of the current empirical evidence about current account adjustments and real exchange rates dynamics. While the area of our research seems to be well documented in current empirical literature it seems that effects of real exchange rates on current accounts are unclear

[19] Hungarian forint operated during pre-crisis period in de facto fixed peg regime, but due to substantial range for fluctuations provided by wide horizontal bands it was included in the group of countries, so called "floaters"

or even puzzled. In section 4 we observe main trends in the current account development in European transition economies and highlight some stylized facts about common implications resulted from its determination. In Section 5 we provide a brief overview of the VAR model (recursive Cholesky decomposition is employed to identify structural shocks) we employ to investigate responses of the current account to negative one standard deviation REER shocks. In section 6 we discuss main results.

2. Exchange rates dynamics and current account adjustments

Exchange rate unexpected fluctuations determine economic development of countries the way quite similar to any other type of exogenous shocks. Unpredicted volatility in exchange rate short-run path (Bratu, 2011) affects macroeconomic performance the way that may be a subject of academic as well as economic policy discussions. Overall exposure of countries to negative implications of exchange rate volatility represents one of the areas of empirical investigations related to fixed versus flexible exchange rate dilemma. Rigorous analysis of various aspects of exchange rate fluctuations in terms of macroeconomic performance causal effects is considered to be a crucial outcome of not only exchange rate determining potential but also key information for exchange rate policy or policy decisions related to exchange rate regime shifts.

Exchange rate appreciation (depreciation) may suppress economic activity in country causing foreign prices of goods to decrease in comparison with domestic prices of goods. As a result, exchange rate appreciation and subsequent decrease in foreign competitiveness of domestic goods on foreign as well as domestic markets shifts expenditures from domestic goods to goods produced abroad (Mirdala, 2012). Negative impact of exchange rate appreciation on the current account is significantly determined not only by a shift in demand preferences but also by the ability of domestic economy to shift unused production capacities to more perspective areas with growing potential.

While the traditional approaches emphasize negative effects of exchange rate appreciation on the real output in the domestic economy, alternative approaches (Mendoza, 1992) highlight the presence of some positive implications. Exchange rate appreciation causes the prices of exports to rise while it is generally expected the prices of imports are going to decrease. Considering lower exports and imports price elasticity (in short period), exchange rate appreciation causes net export to rise due to export of goods increase while import of goods tends to decrease. As a result, the real domestic income rises.

At the same time, aggregate supply chain can accelerate a positive impact of exchange rate appreciation on performance of domestic economy. In the less developed countries with inputs being mainly imported (in general production of inputs in such countries is expected to be ineffective), exchange rate appreciation reduces costs of domestic companies. As a result, positive effects of costs reduction due to exchange rate appreciation obviously oversize a negative impact of the contractionary effects related to an increase in domestic tradable goods prices.

Finally we may conclude, exchange rate appreciation causes the current account deficit (due to net export deficit) and costs of production reduction. Similarly, exchange rate depreciation causes an increase in net export and costs of production increase. Combined effects of demand and supply channels determines the overall determination potential of exchange rate volatility on real output and level of prices (Stavarek, 2013).

3. Overview of the literature

Bussiere, Fratzscher and Muller (2004) analyzed the current account determination in 33 countries employing intertemporal approach via regression analysis considering effects of fiscal stance of government as well as real exchange rate deviations. Authors suggest that current account balances of countries included in the model are close to their structural current account positions confirming a validity of the intertemporal approach. Arghyrou and Chortareas (2008) investigated the dynamics of the current account adjustments and the role of real exchange rates in the current account determination in the EMU. Despite a limited evidence of most theoretical models in explaining causal relationship between real exchange rates and the current account, authors confirmed above relationship with significant validity and subject to non-linear effects. Lee a Chinn (Lee a Chinn, 2006) analyzed implications of real exchange rate fluctuations on the current account development in 7 most developed industrial countries. Authors suggest that while the variation in the current account is

mostly determined by temporary shocks, permanent shocks seem to be much more crucial in explaining the variation in the real exchange rate. At the same time, their results confirmed validity of the intertemporal opened economy model. Sek a Chuah (Sek a Chuah, 2011) explored causality between the exchange rate changes and the current account adjustments in 6 Asian countries. Authors surprisingly conclude that the current account did not change much expected after the crisis. They suggest it is due to adjustments that authorities made in countries' financial policies to reduce the excessive exchange rates volatility. Obstfeld a Rogoff (Obstfeld a Rogoff, 2005) focused their investigation on estimation of effects of global current account imbalances reduction on exchange rates (USD, EUR and Asian currencies) equilibrium path in the model with alternative scenarios. Gruber and Kamin (2005) estimated panel regression models employing data for 61 countries to observe the current account determination. However, their results did not provide supportive evidence for large US deficits nor large Asian surpluses.

4. Overview of main trends in current account imbalances

During the first decade since the initiation of the transition process at the beginning of the 1990s European transition economies experienced periods of excessive current account deficits. In line with intertemporal approach current account deficits reflect a negative trend in investment-saving ratio. While the current account adjustments reveals crucial and generally expected implications of continuously rising international integration of European transition economies (increased indebtedness, lacking competitiveness, fiscal imbalances[20], foreign capital inflows, etc.), there seems to be still enough room to investigate partial effects of dynamic changes in key current account determinants to observe associated current account adjustments.

Figure 1 provides a brief overview in the real exchange rates and current account main trends in ten European transition economies. To provide more rigorous overview of dynamics and volatility in real exchange rates, we employed quarterly data for real effective exchange rates (REER) calculated on the CPI (consumers' price index) and ULC (unit labor costs) basis. Inclusion of REER calculated using different price deflators reveals more precise picture about changes in relative international competitiveness of countries.

Individual countries experienced current account deficits during the most of the period of intensified convergence (since the beginning of 2000s) toward western European countries. It seems that countries with tightly managed exchange rates (Bulgaria, Slovenia and Baltic countries) and lacking overall macroeconomic performance (Romania as well as Bulgaria) experienced excessive current account deficits with generally negative outlook during the most of the pre-crisis period. At the same time we have observed significant trend in CPI and ULC based REER[21] discrepancies in most countries revealing asynchronous effects of processes determining internal changes in relative competitiveness.

[20] Problems of persisting fiscal imbalances (fiscal deficits) seem to be much more frequent in countries with weak nominal anchor that is why Baltic countries and Bulgaria experienced much "healthier" fiscal stance of the general government.

[21] Times series for ULC based REER till 2008 are missing in the source of our dataset.

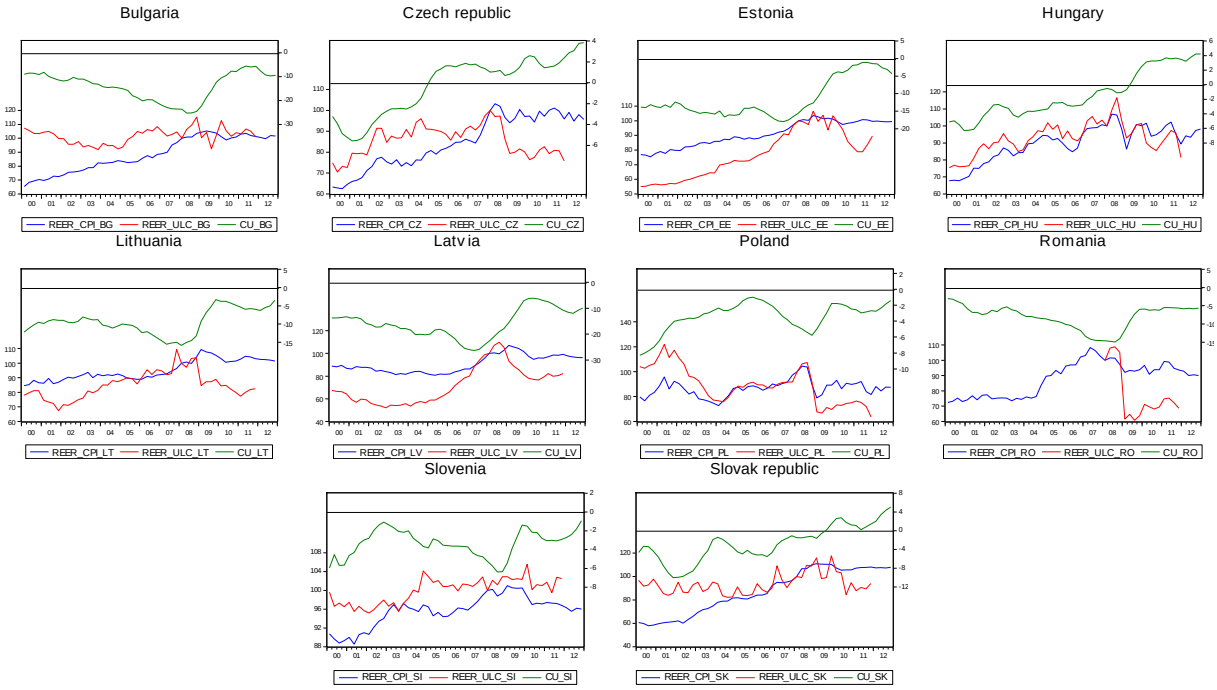
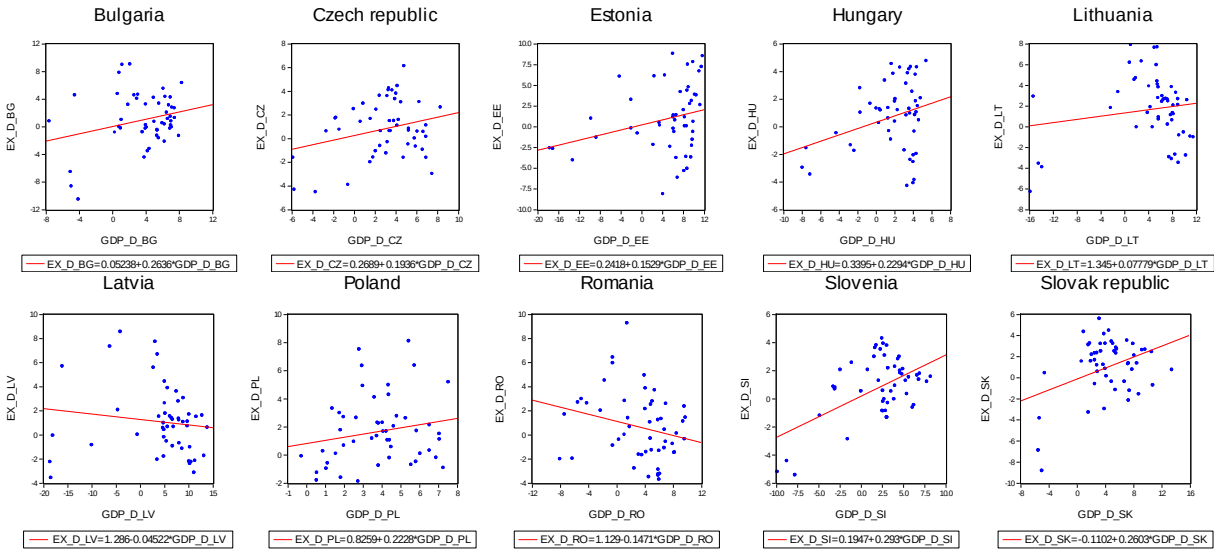


Figure 1 - Current account dynamics and real exchange rates (2000Q1-2012Q4)

Note: Endogenous variables: CPI based real effective exchange rate (REER_CPI) and ULC based real effective exchange rate (REER_ULC) are expressed as indexes (left axis in figures) (2008 = 100). Current account is expressed as percentage share in GDP (CU) (right axes in figures).

Source: Compiled by author based on data taken from IMF - International Financial Statistics (May 2013). Time series for CPI and ULC based REER we drawn from REER database ver. 29 (Darvas, Z., Nov., 2012).

Figure 2 depicts mutual relationship (simple linear regression) between real output dynamics and export performance in European transition economies. In most countries economics growth seems to have positive effect on export performance. While the size of associated multipliers revealing propensity to export differs in each individual country, overall competitiveness of export industries seems to be crucial for export to catch up with high real output growth rates especially during the pre-crisis period.



Source: Compiled by author based on data taken from IMF - International Financial Statistics (May 2013).

Figure 2 Real Output Dynamics and Export Performance (2000Q1-2012Q4)

Note: Endogenous variables: Export performance (EX_D) is expressed as the relative change in the percentage share of export of goods on GDP. Real output dynamics (GDP_D) is expressed as annual percentage change of the real output.

It seems that export performance is not necessarily associated with the overall size and total openness of particular economies (i.e. Poland doesn't seem to lag behind much smaller economies). At the same time, export performance of Baltic countries is quite low considering high growth rates of real output during the most of the pre-crisis period. Associated excessive current account deficits under rigid exchange rate arrangements thus reveal questions about effects of real exchange rates shifts (internally determined) and accompanied current account adjustments (see Section 6).

Final remark relates to revealed negative relationship between export performance and real output growth rates in two countries (Latvia and Romania). However, reason for such a misleading causality seems to be country specific. While generally considered as small open economy, Latvia's export-to-GDP ratio increased only slowly during the pre-crisis period and significantly lagged behind real output growth rates (marginal propensities to export were also significantly smaller in comparison to import ones). Romania as much bigger and less opened economy suffered from low export performance during nearly whole pre-crisis period. While lower share of external demand (in comparison with domestic components of total expenditures) in large economies is obvious, excessive current account deficits and associated distortions between relative dynamics in domestic and foreign demand reflects large potential in improving competitiveness and attractiveness of exports. Regardless of revealed mutual relationships between export performances and real output growth rates our suggestions seem to be reasonable for all countries with persisting excessive current account deficits.

Table 1 reveals detailed results of correlation relationships between export performance and real output dynamics in European transition economies. In general, we have observed strong relationships between both categories during the first sub-period (2000-2002) (Czech republic, Estonia and Poland) and at the end of pre-crisis period (Hungary, Romania and Slovenia).

At the same time, negative correlation coefficients in the second and third sub-period (2006-2008) (Czech republic, Latvia and Slovak republic) result from high real output growth rates negatively affecting export-to-GDP ratio and thus negatively affected averaged results for the whole group. Significant increase in the ratio during the third sub-period (2006-2008) is determined especially with an increased foreign demand associated with EU membership (8 of 10 countries entered EU in 2004, Bulgaria and Romania in 2007).

Table 1. Real output dynamics and export performance (2000Q1-2012Q4)

	2000-2002	2003-2005	2006-2008	2009-2012
Bulgaria	0.41	0.43	0.31	0.10
Czech republic	0.92	-0.54	0.89	0.82
Estonia	0.73	0.39	-0.27	0.35
Hungary	0.48	0.33	0.88	0.55
Lithuania	0.35	0.42	0.21	-0.09
Latvia	0.31	-0.44	-0.69	-0.75
Poland	0.87	0.52	0.37	0.82
Romania	-0.26	0.46	0.69	-0.11
Slovak republic	-0.49	-0.54	0.45	0.49
Slovenia	-0.02	0.68	0.67	0.83
AVERAGE	**0.23**	**0.10**	**0.28**	**0.30**

Source: Author's calculation.

Crisis period cooled down overall demand (both domestic and foreign). As a result, mutual relationship between export performance and real output growth rates strengthened.

Figure 3 reflects mutual relationship between current account dynamics and price level of exports and imports in European transition economies. In general, an increase in terms of trade (prices of export-to-import ratio) maybe followed by current account improvement provided low price elasticity of exports and imports. However, persisting increase in terms of trade (due to exchange rate or domestic prices shifts) is obviously followed by deterioration in international competitiveness especially with increasing lag.

Relative prices of exports and imports did not seem to follow common trend. Detailed information averaged export-to-import prices ratios reveals Table 2. Most countries (as well as the whole group of countries) experienced general improvements in term of trade over time. It seems that decreased price competitiveness of international trade was associated with drop in export performance and real output growth rates relationships during the second sub-period (2003-2005). However, steady deterioration in terms of trade did not seem to affect this relationship in the third sub-period (2006-2008).

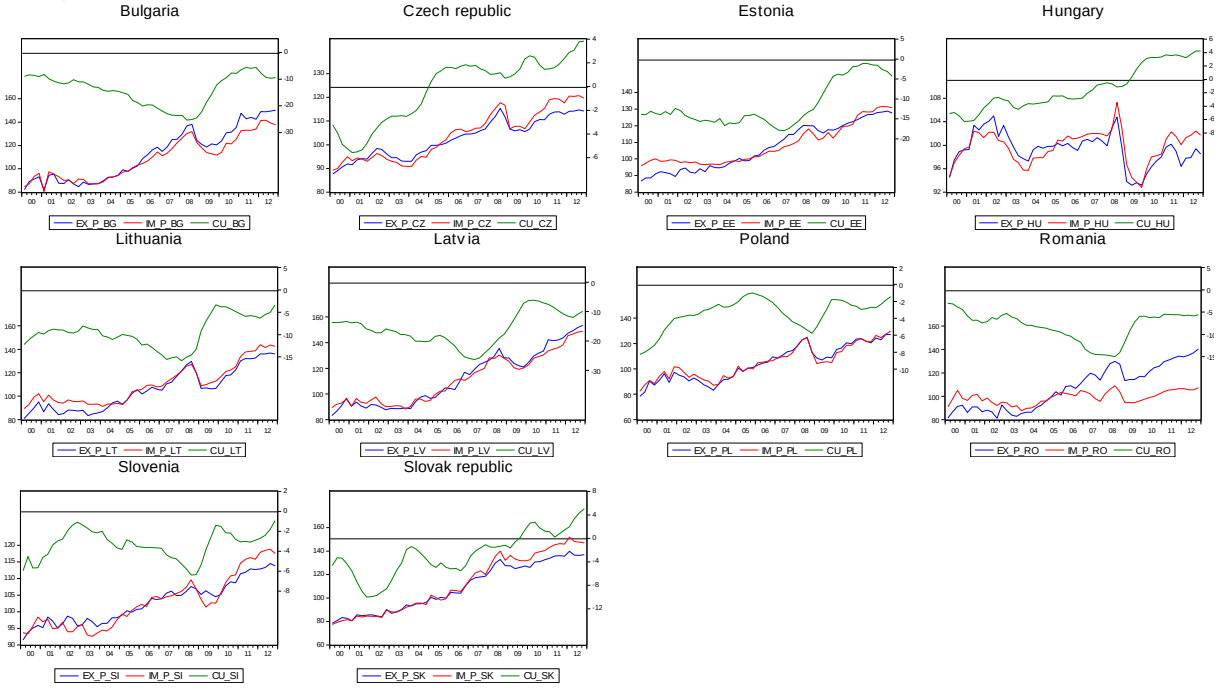


Figure 3 Export / Import prices and current account dynamics (2000Q1-2012Q4)

Note: Endogenous variables: Export prices (EX_P) and import prices (IM_P) are expressed as indexes (left axis in figures) (2005 = 100). Current account (CU) is expressed as percentage share in GDP (CU) (right axes in figures).
Source: Compiled by author based on data taken from IMF - International Financial Statistics (May 2013).

Table 2 Terms of trade (2000Q1-2012Q4)

	2000-2002	2003-2005	2006-2008	2009-2012
Bulgaria	0.98	1.00	1.04	1.08
Czech republic	1.00	1.01	0.98	0.96
Estonia	0.92	0.99	1.04	0.99
Hungary	1.01	1.01	0.99	0.98
Lithuania	0.91	0.97	0.99	0.96
Latvia	0.97	1.00	1.01	1.03
Poland	0.96	0.98	1.00	1.00
Romania	0.90	0.97	1.15	1.26
Slovak republic	1.01	1.00	0.97	0.93
Slovenia	1.00	1.02	1.00	0.97
AVERAGE	**0,97**	**0,99**	**1,02**	**1,01**

Source: Author's calculation.

Substantial decrease in demand for both foreign exports and domestic imports during the crisis period resulted in decrease in terms of trade and thus slightly improved price competitiveness of international trade in the group of countries.

Figure 4 reveals mutual relationship (simple linear regression) between export performance and CPI based REER in European transition economies. It is clear that an increase (appreciation) in REER was associated by the decrease in export performance in all countries (though with different intensity).

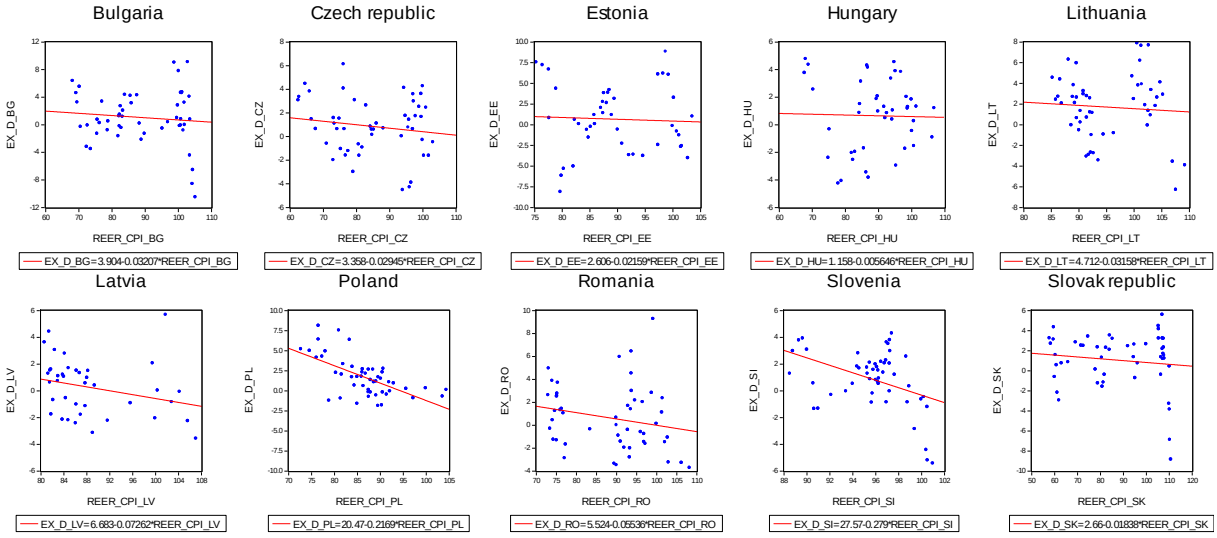


Figure 4 Export performance and real exchange rate (CPI based) dynamics (2000Q1-2012Q4)

Note: Endogenous variables: Export performance (EX_D) is expressed as the relative change in the percentage share of export of goods on GDP. CPI based real effective exchange rate (REER_CPI) is expressed as index (2008 = 100).
Source: Compiled by author based on data taken from IMF - International Financial Statistics (May 2013). Time series for CPI based REER we drawn from REER database ver. 29 (Darvas, Z., November 2012).

As a result, price elasticity of exports provides vital information to investigate the relative contribution of changes in international competitiveness to the overall attractiveness of exports on foreign markets (see Section 6 for more rigorous results for current account adjustments after CPI based REER shifts). While being identified as a generally low (but still significant), sensitivity of export performance to CPI based REER appreciation seems to be the highest in Poland and Slovenia.

Figure 5 reveals mutual relationship between export performance and ULC based REER in European transition economies. In comparison with the figure 4 we have revealed some interesting implications of internally adjusted NEER according to the average cost of labor per unit of output.

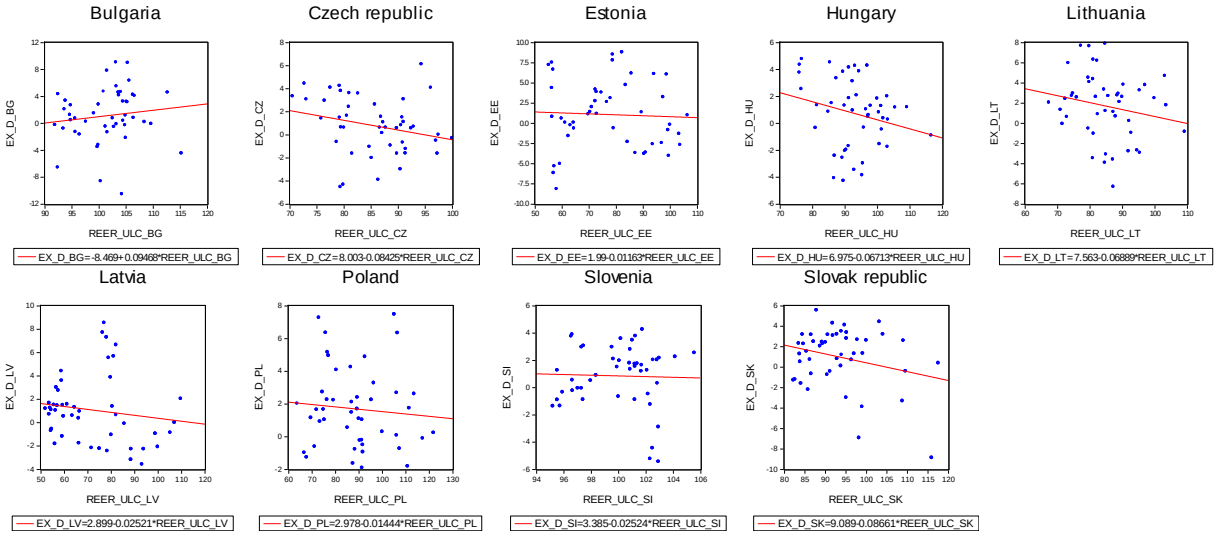


Figure 5 Export performance and real exchange rate (ULC based) dynamics (2000Q1-2012Q4)

Note: Endogenous variables: Export performance (EX_D) is expressed as a percentage share of export of goods on GDP. ULC based real effective exchange rate (REER_ULC) is expressed as index (2008 = 100).
Source: Compiled by author based on data taken from IMF - International Financial Statistics (May 2013). Time series for ULC based REER we drawn from REER database ver. 29 (Darvas, Z., November 2012).

In general, export performance of European transition economies seems to be more sensitive to competitiveness effects associated with changes in labor costs in comparison with consumer prices (excepting for Estonia, Poland and Slovenia) through the real exchange rate dynamics (see Section 6 for more rigorous results for current account adjustments after ULC based REER shifts). Moreover, we have examined a positive relationship between ULC based REER and export performance in Bulgaria. As a result, deterioration in price competitiveness due to labor costs increase did not seem to have the negative impact on export performance in Bulgaria. Because time series for the ULC based REER for Romania were not available our suggestion reflects just our finding in Bulgaria - increase in costs of labor should not be necessarily followed by the deterioration in international competitiveness associated with REER appreciation in low income countries.

5. Econometric model

VAR models represent dynamic systems of equations in which the current level of each variable depends on past movements of that variable and all other variables involved in the system. Residuals of vector ε_t represent unexplained movements in variables (effects of exogenous shocks hitting the model); however as complex functions of structural shocks effects they have no economic interpretation. Structural shocks can be still recovered using transformation of true form representation into reduced-form by imposing a number of identifying restrictions. Applied restrictions should reflect some general assumptions about the underlying structure of the economy and they are obviously derived from economic theory. There are two general (most used) approaches to identify VAR models. (a) Cholesky decomposition of innovations implies the contemporaneous interactions between the exogenous shocks and the endogenous variables are characterized by a Wald causal chain. Ordering of the endogenous variables than reflects expected particular economy structure following general economic theory assumptions. However the lack of reasonable guidance for appropriate ordering led to the development of more sophisticated and flexible identification methods - (b) structural VAR (SVAR) models. Identifying restrictions implemented in SVAR models reflects theoretical assumptions about the economy structure more precisely.

We employ a VAR methodology to analyze effects of the real exchange rate dynamics on current account adjustments in European transition economies. Cholesky decomposition of variance-covariance matrix of reduced-form VAR residuals is implemented to estimate effects of the real exchange rate dynamics on current accounts improvements.

True model is represented by the following infinite moving average representation:

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \ldots = \sum_{i=0}^{\infty} A_i\varepsilon_{t-i} = \sum_{i=0}^{\infty} A_i L^i\varepsilon_t = A(L)\varepsilon_t \qquad (1)$$

where: X_t represents n x 1 a vector including endogenous variables of the model, $A(L)$ is a n x n polynomial consisting of the matrices of coefficients to be estimated in the lag operator L representing the relationship among variables on the lagged values, ε_t is n x 1 vector of identically normally distributed, serially uncorrelated and mutually orthogonal errors (white noise disturbances that represent the unexplained movements in the variables, reflecting the influence of exogenous shocks):

$$E(\varepsilon_t) = 0, \quad E(\varepsilon_t\varepsilon_t') = \Sigma_\varepsilon = \mathrm{I}, \quad E(\varepsilon_t\varepsilon_s') = [0] \quad \forall t \neq s \qquad (2)$$

Vector X_t consists of six endogenous variables - real output $(y_{r,t})$, money supply (m_t), core inflation (p_t), short-term nominal interest rates $(ir_{n,t})$, real exchange rate $(er_{r,t})$ and current account (cu_t). In the six-variable VAR model $(X_t = [y_{r,t}, m_t, p_t, ir_{n,t}, er_{r,t}, cu_t,])$ we assume six exogenous shocks that contemporaneously affects endogenous variables - demand shock $(\varepsilon_{y,t})$, nominal shock

$(\varepsilon_{m,t})$, inflation shock $(\varepsilon_{p,t})$, monetary policy shock $(\varepsilon_{ir_n,t})$, exchange rate shock $(\varepsilon_{er_r,t})$ a current account shock $(\varepsilon_{cu_n,t})$.

The structural exogenous shocks from equation (1) are not directly observable due to the complexity of information included in true form VAR residuals. As a result structural shocks cannot by correctly identified. It is than necessary to transform true model into following reduced form

$$X_t = C(L)Y_{t-1} + e_t \tag{3}$$

where $C(L)$ is the polynomial of matrices with coefficients representing the relationship among variables on the lagged values and e_t is a n x 1 vector of normally distributed errors (shocks in reduced form) that are serially uncorrelated but not necessarily orthogonal:

$$E(e_t)=0, \quad \Sigma_u = E(e_t e_t') = A_0 E(\varepsilon_t \varepsilon_t') A_0' = A_0 A_0', \quad E(e_t e_s') = [0] \quad \forall t \neq s \tag{4}$$

Relationship between reduced-form VAR residuals (e_t) and structural shocks (ε_t) can be expressed as follows:

$$e_t = A_0 \varepsilon_t \tag{5}$$

As we have already noted at the beginning of the section we implement a Cholesky identification scheme to correctly identify structural shocks. In order to identify our model there must be exactly $n^2 - \left[\left(n^2 - n\right)/2\right]$ relationships among the endogenous variables of the model, where *n* represents a number of variables. We have to impose $\left(n^2 - n\right)/2$ restrictions on the matrix A_0 based on the Cholesky decomposition of the reduced-form VAR residual matrix that define matrix A_0 as a lower triangular matrix. The lower triangularity of A_0 (all elements above the diagonal are zero) implies a recursive scheme (structural shocks are identified through reduced-form VAR residuals) among variables (the Wald chain scheme) that has clear economic implications and has to be empirically tested as any other relationship. Identification scheme of the matrix A_0 implies that particular contemporaneous interactions between some exogenous shocks and some endogenous variables are restricted reflecting causal (distribution) chain of interaction transmission. It is clear that the Wald causal chain is incorporated via convenient ordering of the variables.

Considering lower triangularity of a matrix A_0 the equation (5) can be rewritten as follows:

$$\begin{bmatrix} e_{y_r,t} \\ e_{m,t} \\ e_{p,t} \\ e_{ir_n,t} \\ e_{er_r,t} \\ e_{cu,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{y_r,t} \\ \varepsilon_{m,t} \\ \varepsilon_{m,t} \\ \varepsilon_{p,t} \\ \varepsilon_{er_r,t} \\ \varepsilon_{cu,t} \end{bmatrix} \tag{6}$$

Correct identification of the exogenous structural shocks reflecting Cholesky ordering of variables denotes following assumptions:

- Real output doesn't contemporaneously respond to the shock from any other endogenous variable of the model;

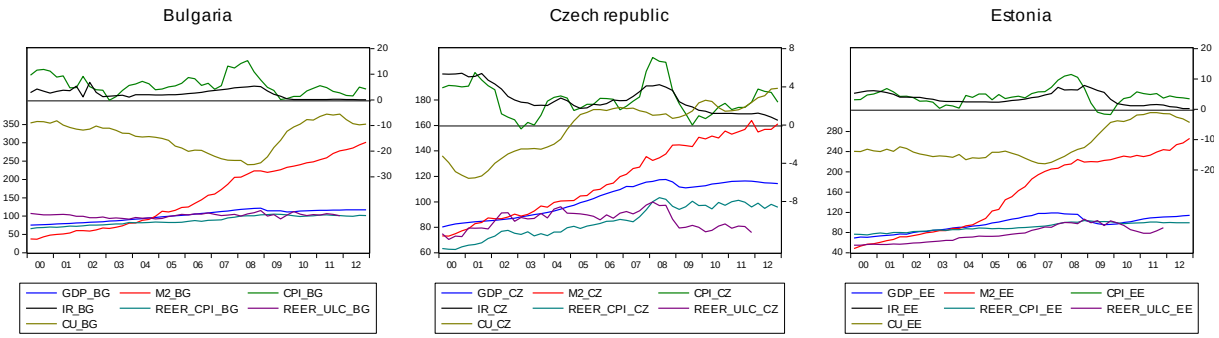
- Money supply doesn't contemporaneously respond to inflation, interest rates, exchange rate and current account shocks, while it is contemporaneously affected only by the real output shock;
- Inflation doesn't contemporaneously respond to the interest rates, exchange rate and current account shocks, while it is contemporaneously affected by the real output and money supply shocks;
- Interest rates don't contemporaneously respond to the exchange rate and current account shocks, while it is contemporaneously affected by the real output, money supply and inflation shocks;
- Exchange rate doesn't contemporaneously respond to current account shock, while it is contemporaneously affected by the real output, money supply, inflation and interest rates shocks;
- Current account is contemporaneously affected by the shocks from all of the endogenous variables of the model.

After initial period endogenous variables may interact freely without any restrictions. Estimated VAR model is used to compute impulse response functions to analyze responses of the current account to the negative one standard deviation real exchange rate shock in European transition economies. To check the robustness of empirical results we estimate the model considering different ordering of the endogenous variables in models with time series for two different periods (pre-crisis period - model A (2000Q1-2007Q4) and extended period - model B (2000Q1-2012Q4)):

- model A1, B1 $\left(X_t = \left[y_{r,t}, m_t, p_t, ir_{n,t}, er_{r,t}, cu_t\right]\right)$;
- model A2, B2 $\left(X_t = \left[y_{r,t}, er_{r,t}, m_t, ir_{n,t}, p_t, cu_t\right]\right)$;
- model A3, B3 $\left(X_t = \left[y_{r,t}, p_t, m_t, ir_{n,t}, er_{r,t}, cu_t\right]\right)$;

6. Data and results

To estimate effects of the real exchange rate dynamics on current account adjustments in European transition economies we employed quarterly data for period 2000Q1-2007Q4 (model A) consisting of 32 observations and for period 2000Q1-2012Q4 (model B) consisting of 52 observations for the following endogenous variables - real output (nominal GDP deflated by GDP deflator), money supply (monetary aggregate M2), inflation (core inflation), short-term interest rates (interbank offered rates with 3 months maturity[22]), real exchange rate (both CPI and ULC based real effective exchange rate) and balance of payment's current account (Figure 6). Estimation of two models is in line with the primary objective of the paper to reveal a relationship between real exchange rate dynamics and current account adjustments considering possible implications of the crisis period on estimated results. Time series for real output, money supply, inflation, interest rates and current account were drawn from IMF database (International Financial Statistics, May 2013). Time series for CPI and ULC based REER we drawn from REER database ver. 29 (Darvas, Z., November 2012). Time series for real output, money supply, inflation and current account were seasonally adjusted.



[22] Short-term interest rates in Estonia, Slovak republic and Slovenia we replaced by EURIBOR after euro adoption in each particular country (2007, 2009 and 2011).

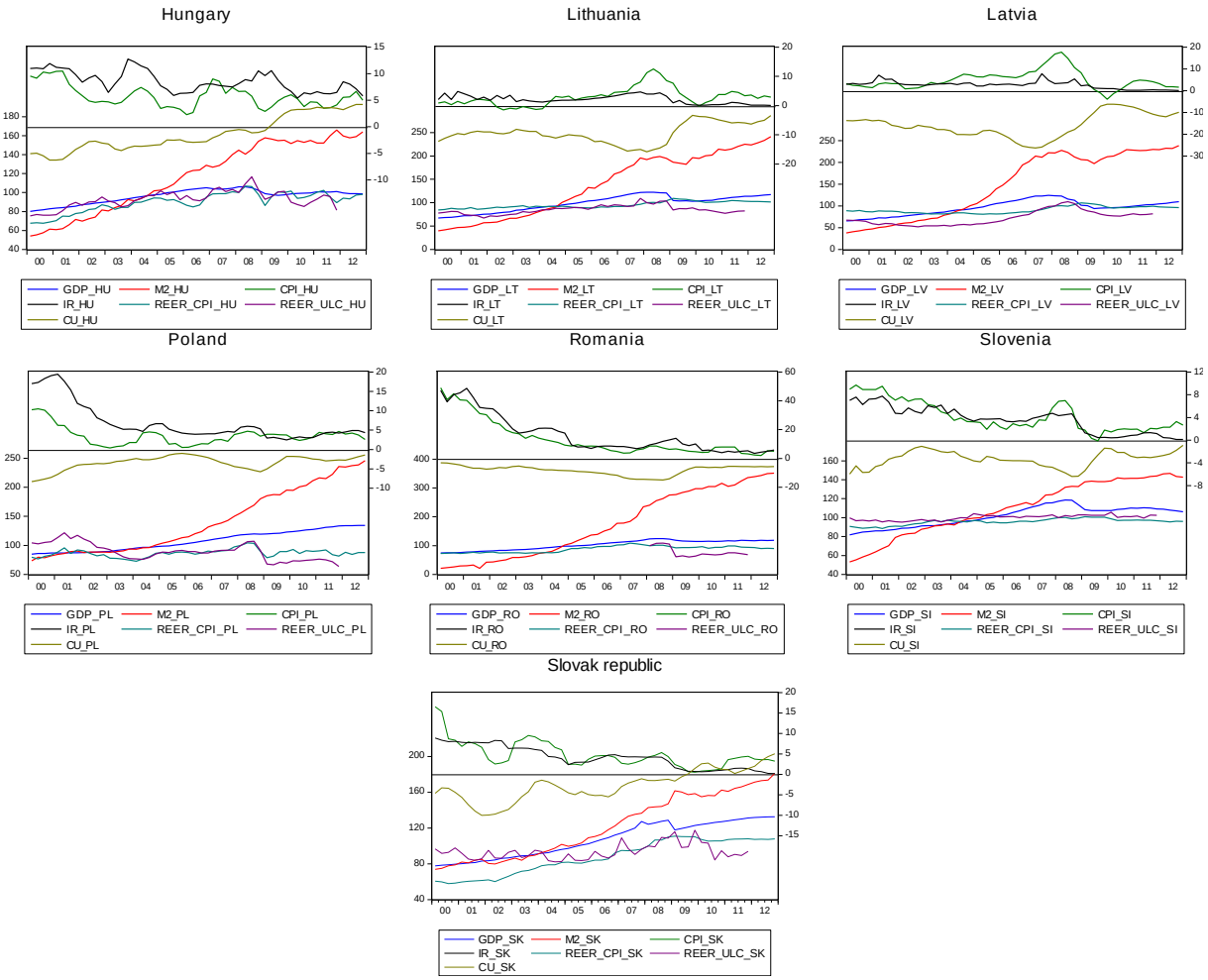


Figure 6 Real output, money supply, inflation, interest rates, real effective exchange rates (CPI and ULC based) and current account (2000Q1-2012Q4)

Note: Endogenous variables - real output (GDP), money supply (M2) and real effective exchange rate (REER) are expressed as indexes (left axis in figures) (2005 = 100). Inflation (INF) and interest rates (IR) are expressed in percentage (right axis in figures). Current account (CU) is expressed as percentage share in GDP (CU) (right axes in figures).
Source: Compiled by author based on data taken from IMF - International Financial Statistics (February 2013).

To correctly identify exogenous shocks hitting the model as well as to compute impulse-response functions it is necessary VAR model to be stationary. To check the model it is necessary to test the time series for unit roots and cointegration.

A. Testing procedures

The augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were computed to test the endogenous variables for the unit roots presence. Both ADF and PP tests indicate that most of the variables are non-stationary on the values so that the null hypothesis of a unit root cannot be rejected for any of the series. Testing variables on the first differences indicates the time series are stationary so that we conclude that the variables are I(1).

Because there are endogenous variables with a unit root on the values it is necessary to the test the time series for cointegration using the Johansen and Juselius cointegration test (we found reasonable to include variables I(0) for testing purposes following economic logic of expected results). The test for the cointegration was computed using three lags as recommended by the AIC (Akaike Information Criterion) and SIC (Schwarz Information Criterion).

The results of the Johansen cointegration tests confirmed our results of unit root tests. Both trace statistics and maximum eigenvalue statistics (both at 0.05 level) indicate that there is no cointegration among endogenous variables of the model.

To test the stability of VAR models we also employed a number of diagnostic tests. We found no evidence of serial correlation, heteroskedasticity and autoregressive conditional heteroskedasticity effect in disturbances. The model also passes the Jarque-Bera normality test, so that errors seem to be normally distributed. The VAR models seem to be stable also because inverted roots of the model for each country lie inside the unit circle. Detailed results of time series testing procedures are not reported here to save space. Like any other results, they are available upon request from the author.

Following results of the unit root and cointegration tests we estimated the model using variables in the first differences so that we can calculate impulse-response functions for all ten European transition economies. Following the main objective of the paper we focus on interpretation of responses of the current account to the negative one standard deviation real exchange rate shock. To observe effects of changes in relative competitiveness associated with REER sudden shifts on current account adjustments we estimate models with CPI and ULC based REER separately.

We also observe effects of the crisis period on the exchange rate determination potential in European transition economies by comparing results for estimated models using time series for two different periods - model A (2000Q1-2007Q4) and model B (2000Q1-2012Q4). Changed ordering of variables didn't seem to affect results of the analysis. Considering impulse-response functions are not very sensitive to the ordering of endogenous variables we present results of the models (model A1 and B1) with default ordering of endogenous variables (detailed results for models A2, A3, B2, B3 are available upon request from the author).

B. Impulse-Response Function

In order to analyze effects of the real exchange rate dynamics on current account adjustments in European transition economies we estimate responses of current account to the negative (devaluation or depreciation) one standard deviation real exchange rate shock employing quarterly data for two subsequent periods 2000-2007 (model A) and 2000-2012 (model B). Results seem to be sensitive to origins of the real exchange rate dynamics. While REER in the group of "peggers" is determined only by internal factors of international competitiveness (prices, labor costs, etc.), REER in the group of "floaters" is also determined by NEER dynamics and thus providing much more flexibility for the cross-country expenditure shifting.

In the Figure 7 we summarize results of impulse-response functions of current accounts to negative (depreciation) real exchange rate (CPI based) shocks in the model with time series for the pre-crisis period (model A1) in European transition economies.

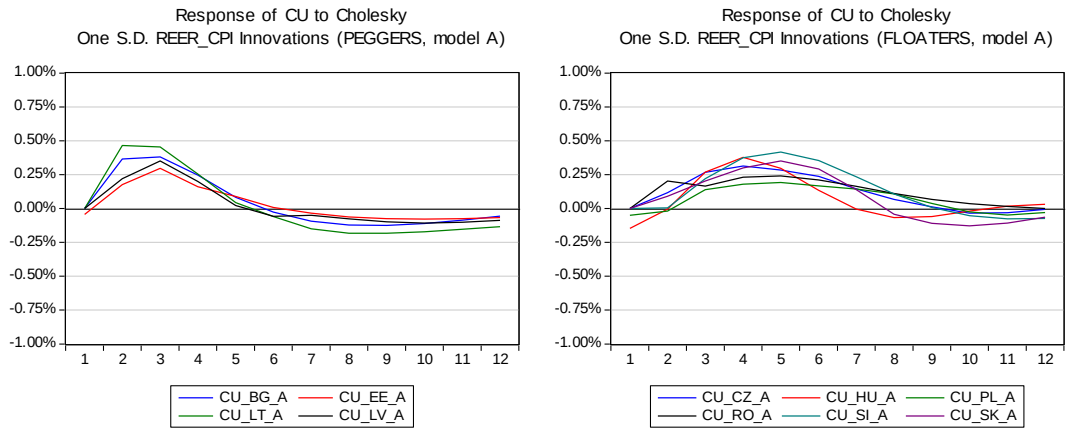


Figure 7 Responses of current account to REER (CPI based) shocks (2000Q1-2007Q4) (Model A)

Note: Curves represent responses of current account (CU) to the negative (depreciation) one standard deviation real exchange rate (CPI based) shock in each country from the group of European transition economies.
Source: Author's calculation.

Estimates of current account responsiveness to the Cholesky negative one standard deviation REER shock (depreciation or devaluation of the real exchange rate) reveals interesting implications of increased price-determined competitiveness in European transition economies during the pre-crisis

period. Unexpected shift (decrease) of REER was followed by the current account improvement in each individual country.

However, we have observed some differences in the path of the current account response in both groups of countries. In the group of "peggers" current account improved within a one quarter lag. A positive effect of the real exchange rate shock culminated between second and third quarter after the shock and subsequently steadily decreased. Its positive redistributive effect completely died out till the end of fifth quarter. Exchange rate shock seems to be neutral in the long run in determining current account adjustments.

On the other hand, responses of the current account to the negative real exchange rate shock in the group of "floaters" revealed some implications of the nominal exchange rate flexibility. Initial adjustment in the current account after the shock seems to be less dynamic. At the same time, an improvement in the current account dynamic was quite similar in its intensity but much more durable (more than one year). Positive effect of the real exchange rate decrease on the current account died out during one year since sixth quarter. Similarly, effect of the shock seems to be neutral in the long run.

In the Figure 8 we summarize results of impulse-response functions of current accounts to negative (depreciation) real exchange rate (CPI based) shocks in the model with time series for the extended period (model B1) in European transition economies.

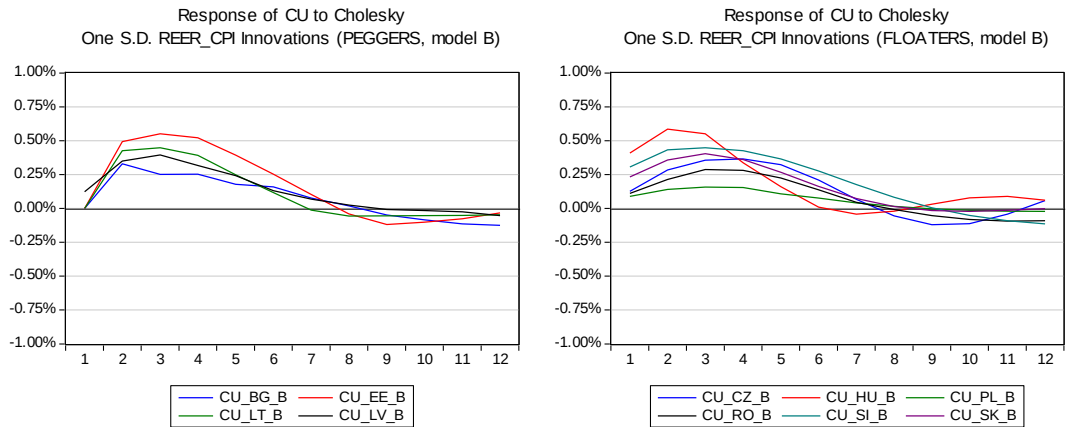


Figure 8 Responses of current account to REER (CPI based) shocks (2000Q1-2012Q4) (Model B)

Note: Curves represent responses of current account (CU) to the negative (depreciation) one standard deviation real exchange rate (CPI based) shock in each country from the group of European transition economies.
Source: Author's calculation.

Current account adjustments followed by the negative real exchange rate shock revealed generally similar effect of increased price competitiveness during the extended period (temporary improvement in the current account balance). However, current account response provides some differences in its key characteristics. Loading phase of the current account improvement seems to be reduced in both groups of countries. Positive effects of the exchange rate shock peaked during the second half of the year since the shock in the group of "peggers". At the same time, the overall durability of current account improvements slightly increased (positive effect on the current account died out till the end of the second year since the shock).

Current accounts in the group of "floaters" improved immediately after the negative exchange rate shock, though with different intensity. While the short-term positive effect (within first year after the shock) on the current account slightly increased, its durability markedly decreased. In both groups of countries the overall effect of the shock in the long run seems to be neutral in the model with time series for extended period too.

Comparison of current account adjustments followed by the CPI based REER shocks in European transition economies for both periods revealed several crucial implications. Current accounts in both groups of countries seem be vulnerable to effects associated with real exchange rates (determined by relative consumer prices) dynamics. During the pre-crisis period, current accounts in the group of "floaters" seem to be more vulnerable to unpredicted real exchange rate shocks. Despite

slightly delayed load of a positive effect (in comparison with countries from the group of "peggers") its durability was obviously higher. Our results for the extended period suggest increased short-term exposure of current accounts of both groups of countries, though markedly higher in the group of "floaters", to the exchange rate shocks but with reduced durability of effects.

In the Figure 9 we summarize results of impulse-response functions of current accounts to negative (depreciation) real exchange rate (ULC based) shocks in the model with time series for the pre-crisis period (model A1) in European transition economies.

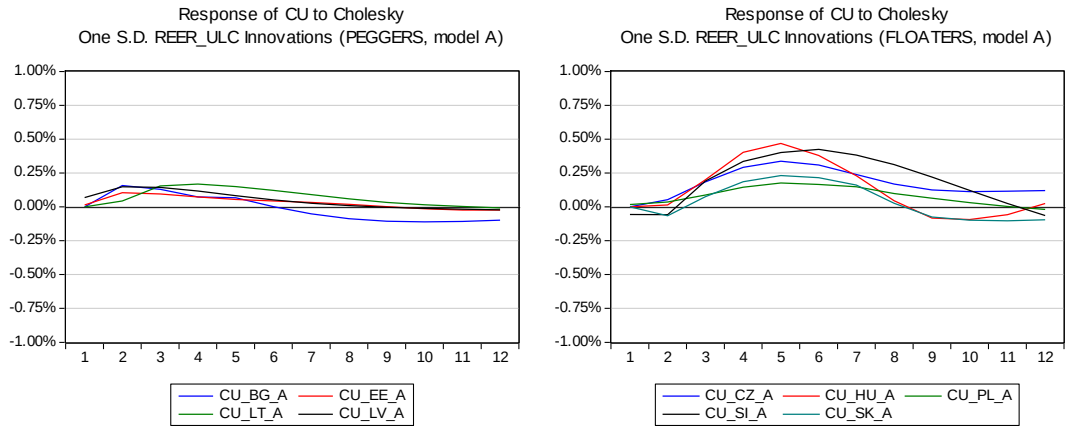


Figure 9 Responses of current account to REER (ULC based) shocks (2000Q1-2007Q4) (Model A)

Note: Curves represent responses of current account (CU) to the negative (depreciation) one standard deviation real exchange rate (ULC based) shock in each country from the group of European transition economies.
Source: Author's calculation.

Negative exchange rate shock was followed by the current account improvement in all ten European transition economies. However, our results revealed some clear differences among countries from both groups. In countries from the group of "peggers" the current account improved just for a short period of time. Intensity of the current account adjustments was significantly lower after the negative ULC based REER shock in comparison with CPI based REER shock. Beside a long-run neutrality of the exchange rate shock, its durability seems to differ in each individual country from the group (the positive effect on the current account died out within sixth and tenth quarter after the shock).

Quite different results were investigated in countries from the group of "floaters". Despite generally higher improvement in current accounts (effect of the shock culminated during the first half of the second year after the shock) we have observed slightly lagged response immediately after the shock (countries experienced the current account improvement with approximately two quarters lag). The overall durability of the positive effect was generally higher in comparison with the previous group of countries.

In the Figure 10 we summarize results of impulse-response functions of current accounts to negative (depreciation) real exchange rate (ULC based) shocks in the model with time series for the extended period (model B1) in European transition economies.

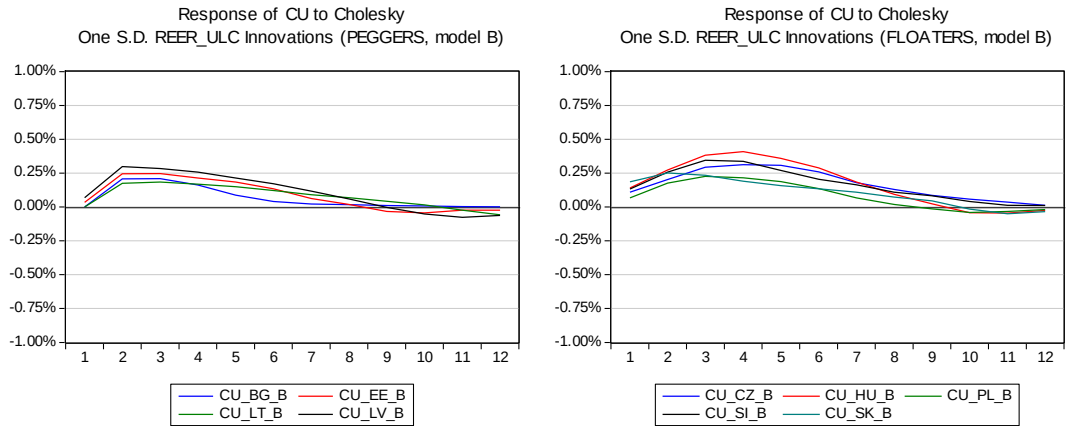


Figure 10 Responses of current account to REER (ULC based) shocks (2000Q1-2012Q4) (Model B)

Note: Curves represent responses of current account (CU) to the negative (depreciation) one standard deviation real exchange rate (ULC based) shock in each country from the group of European transition economies.
Source: Author's calculation.

Crisis period affected the pattern of current account adjustments following after the negative real exchange rate shock. In both groups of countries we have investigated a short-term improvement in current accounts. Despite identified differences between pre-crisis and extended period, our results revealed quite similar effects of the crisis period on current account adjustments initiated by both CPI and ULC based real exchange rate shocks. In countries from the group of "peggers" it seems that the short-term improvement in current accounts increased while the overall durability of the exchange rate shock did not change at all. On the other hand, the overall load time of current accounts improvement (despite a slightly reduced intensity) due to negative exchange rate shock in countries from the group of "floaters" was clearly reduced. Due to a drop in the lag it seems, that current accounts in countries with flexible exchange rate arrangements became more vulnerable to sudden exchange rate shifts during the crisis period[23].

Comparison of current account adjustments followed by the ULC based REER shocks in European transition economies for both periods revealed several crucial implications. The overall exposure of current accounts to sudden real exchange rate shocks increased in both groups of countries during the crisis period. At the same time it seems that current account improvements occurred with reduced lag in both groups of countries. On the other hand, real exchange rate shocks affected current account adjustments with generally higher intensity in countries from the group of "floaters".

Conclusion

Real exchange rates determined current accounts in all ten European transition economies in the line with economic theory (despite relatively limited empirical evidence) in both pre-crisis and extended periods. However, we have observed some specific implications of the distortionary effects caused by the unexpected real exchange rate shifts during the crisis period that may be a subject of further academic discussions focusing on wide causalities of the economic crisis. Our results also revealed possible causality between exchange rate arrangements and the way that the exchange rate shock affects current account adjustments. Thus, our investigations may be a relevant contribution to the fixed versus flexible exchange rate dilemma that seems to be a crucial part of discussions related to the wide variety of implications of sacrificing monetary sovereignty in Eurozone candidate countries.

Comparison of current account adjustments followed by the CPI based REER shocks in European transition economies for both pre-crisis and extended periods revealed several crucial implications. Current accounts in both groups of countries seem be vulnerable to effects associated

[23] Despite the euro adoption by Slovenia (2007), Slovak republic (2009) and Estonia (2011) our results for current account adjustments followed by negative CPI and ULC based REER shocks suggests that the responsiveness pattern of the current account for these three countries better suit to results observed for countries from the group of "floaters". It seems that the real exchange rate determination potential of these three new EMU member countries was not affected by its pegging to euro.

with real exchange rates (determined by relative consumer prices) dynamics. During the pre-crisis period, current accounts in the group of "floaters" seem to be more vulnerable to unpredicted real exchange rate shocks. Despite slightly delayed load of a positive effect (in comparison with countries from the group of "peggers") its durability was obviously higher. Our results for the extended period suggest increased short-term exposure of current accounts of both groups of countries, though markedly higher in the group of "floaters", to the exchange rate shocks but with reduced durability of effects.

The overall exposure of current accounts to sudden ULC based REER real exchange rate shocks increased in both groups of countries during the crisis period. At the same time it seems that current account improvements occurred with reduced lag in both groups of countries (in comparison with the pre-crisis period). On the other hand, real exchange rate (determined by unit labor costs) shocks affected current account adjustments with generally higher intensity in countries from the group of "floaters".

Improvements in current accounts followed by exchange rate shocks in European transition economies seems to be sensitive not only to the exchange rate arrangement but also to processes determining internal changes in relative competitiveness (relative dynamics in consumer prices and labor costs). As of changes in relative international competitiveness and associated cross-country expenditures shifts are more vulnerable to adjustments in consumer prices than labor costs.

Acknowledgement

This paper was written in connection with scientific project VEGA no. 1/0892/13. Financial support from this Ministry of Education's scheme is also gratefully acknowledged.

References

[1] Arghyrou, M.G., Chortareas, G. (2008). Current Account Imbalances and Real Exchange Rates in the Euro Area, *Review of International Economics*, 9(5): 747-764.

[2] Armingeon, K., Baccaro, L. (2012). Political Economy of the Sovereign Debt Crisis, *Industrial Law Journal*, 41(3): 254-275.

[3] Arratibel, O., Furceri, D., Martin, R., Zdzienicka, A. (2011). The Effect of Nominal Exchange Rate Volatility on Real Macroeconomic Performance in the CEE Countries, *Economic Systems*, 35(2): 261-277.

[4] Bartokova, L. (2012). Effects of Single Monetary Policy on the Selected Economic and Monetary Union Countries. Case of so-called "PIIGS" Countries, *Journal of Applied Economic Sciences*, 7(4): 351-360.

[5] Bratu, M. (2011). Modeling and Forecasting the Exchange Rate in Romania, *Romanian Journal of Economics*, Institutul de Economie Naţională al Academiei Române, 33(2) :56-72.

[6] Bussiere, M., Fratzscher, M., Muller, G.J. (2004). Current Account Dynamics in OECD and EU - An Intertemporal Approach, [European Central Bank, Working Paper, No. 311/2004] Frankfurt, European Central Bank, 38 p.

[7] Damian, M. (2011). The Comparative Analysis of the Monetary Policy Strategies before the Adoption of the Euro Currency and the Impact upon the Maastricht Criteria, *Journal of Applied Economic Sciences*, 6(3): 222-229.

[8] Fidrmuc, J., Horváth, R. (2007). Volatility of Exchange Rates in Selected New EU Members: Evidence from Daily Data, [CESifo, *Working Paper* No. 2107] Munich, CESifo, 31 p.

[9] Frait, J., Komárek, L. (2001). Real Exchange Rate Trends in Transitional Countries, [University of Warwick, *Economic Research Paper* No. 596] Warwick, University of Warwick, 35 p.

[10] Gruber, J.W., Kamin, S. (2005). Explaining the Global Pattern of Current Account Imbalances, Board of Governors of the Federal Reserve System, *International Finance Discussion Papers* 846, 2005.

[11] Josifidis, K., Allegret, J.P., Pucar, E.B. (2009). Monetary and Exchange Rate Regime Changes: The Case of Poland, Czech republic, Slovakia and Republic of Serbia, *Panoeconomicus*, 56(2): 199-226.

[12] Kulhánek, L. (2010). Money, Stock Prices and Economic Activity in Selected European Countries, *Journal of Advanced Studies in Finance*, 2(2): 101-115.

[13] Lee, J., Chinn, M.D. (2006). Current Account and Real Exchange Rate Dynamics in the G7 Countries, Journal of International Money and Finance, 25(2006): 257-274.

[14] Mirdala, R. (2008). Exchange Rate and Output Vulnerability in Selected CEECs (SVAR Approach), *Journal of Economics (Ekonomický časopis)*, 56(8): 745-763.

[15] Mirdala, R. (2012). Macroeconomic Aspects of Real Exchange Rate Volatility in the Central European Countries, *Journal of Applied Economic Sciences*, 7(2): 163-178.

[16] Mirdala, R. (2013). Real Output and Prices Adjustments under Different Exchange Rate Regimes, in MIRDALA, R. (ed.). Financial Aspects of Recent Trends in the Global Economy, ASERS Publishing, First Edition (published in 2 volumes),Vol. 1, Chap. 11, pp. 208-231.

[17] Obstfeld, M., Rogoff, K.S. (2005). Global Current Account Imbalances and Exchange Rate Adjustments, *Brookings Papers on Economic Activity*, 36(1): 67-123.

[18] Rusek, A. (2013). The Competitiveness Dynamics in the Eurozone, *Global Journal of Management and Business Research Finance*, 13(5): 33-38.

[19] Sek, S.K., Chuah, C.L. (2013). The Dynamic of the Current Account in Emerging East-Asian: Does Exchange Rate Matter? *International Journal of Trade, Economics and Finance*, 2(4): 293-299

[20] Siničáková, M., Šuliková, V., Horváth, J., Gazda, V., GRÓF, M. (2011). Behaviour of Inflation within V4 Countries, *International Research Journal of Finance and Economics*, 70(2011): 59-67.

[21] Stavarek, R. (2012). Exchange Market Pressure in Central European Countries from the Eurozone Membership Perspective, *South East European Journal of Economics and Business*, 3(2): 7-18.

[22] Stavarek, R. (2013). Cyclical Relationship between Exchange Rates and Macro-fundamentals in Central and Eastern Europe, *Economic Research* (*Ekonomska istraživanja*), 26(2): 83-98.

[23] Uroševic, B. (2012). Jackknife Model Averaging of the Current Account Determinants, *Panoeconomicus*, 59(3): 267-281.

DIVERSIFICATION AND DEVELOPMENT OF THE UNITED ARAB EMIRATES' ECONOMY

Daniele SCHILIRÒ
Dept. SEAM, University of Messina, **Italy**
schi.unime@katamail.com

Abstract:
This contribution examines the major features of UAE's economy, its factors of strengths, underlying also its critical aspects. Furthermore, the work focuses on the crucial factors that characterize a diversified knowledge economy and indicates the policies that the economy of the United Arab Emirates must pursue in order to improve its performance and be a competitive economy at a global level. In addition, the paper seeks to identify *new business areas for the diversification and development of the UAE's economy.*

Keywords: diversification, knowledge economy, institutions, innovation, development

JEL Classification: O11, O14, O31, O33, O38, D83, J2

1. Introduction[24]

Today the United Arab Emirates (UAE) is the second largest Arab economy and belongs to high income countries, even if the road towards this goal was different than many other countries. In fact, the UAE has not gone through the hypothetical "stages" that most developed countries seem to have experienced[25]. Massive oil revenues have enabled the UAE to short-cut the usually difficult and lengthy process of saving and capital accumulation necessary for economic development (Shihab, 2001).

From 2000 until 2012, the UAE GDP growth rate averaged 4.7 per cent, a good performance considering the severe global economic crisis of 2009. In particular, in 2012 the economy of the United Arab Emirates has witnessed a growth of about 4 per cent despite the difficulties posed by the eurozone and the global outlook negative. Although the relative contribution of the different economic sectors to GDP has shifted considerably over the years, the oil and gas sector represents the largest share in the GDP of the United Arab Emirates, since the country is endowed with vast resources of oil and gas. So the UAE's economy has still a relatively high concentration of GDP in the oil sector and in related industries, and diversification is not fully satisfactory. Such type of economic model cannot be considered inherently sustainable in the long run, because it depends heavily on the dominant sector's fortunes in the marketplace.

Historically, the UAE, as many other economies of the GCC region, particularly the Kingdom of Saudi Arabia (KSA), Kuwait, Qatar, was very sensitive to changes in the prices of oil. On the other hand, the non-oil sectors have not fully matured and still have pervasive structural weaknesses, such as inefficiencies in labor, capital, knowledge and technology.

Taking as its starting point the Vision 2021 of the Federal Government of the UAE, which aims to transform the economy into a more skill-intensive and diversified knowledge economy, this paper examines the major features of the UAE's economy, its factors of strengths, underlining also its critical aspects. In addition, the work, focusing on the key factors that characterize a diversified knowledge economy, indicates the policies that the economy of the United Arab Emirates should pursue in order to improve its performance. Lastly, the paper attempts to identify new areas of business for the diversification and development of the UAE's economy.

[24] This contribution is a revised version of the speech given at the Global Business Meeting, 8-9 December 2012, in Ras Al Khaimah, United Arab Emirates. I wish to thank Dr. Ibrahim Guizani and Bruno Sergi for reading the paper and for their stimulating comments. The author remains solely responsible for the opinion expressed and any errors in the paper.
[25] Rostow (1960).

2. The profile of the United Arab Emirates' economy

The world has been living the deepest economic crisis since generations. The economic crisis clearly slowed down the process of world-wide globalization[26], so the standstill in the globalization process is visible in all world regions[27].

In the post-global crisis, the United Arab Emirates is challenged by a weaker global demand, but also by the competition from other countries and more stringent global financial markets. One of the main lessons of the recent global economic crisis for the emerging market economies, like the United Arab Emirates, is that sustained economic growth in the future would require developing a better capacity to respond to future crises through more robust regulatory systems and a more diversified economy. However, the UAE in the last decade experienced some relative improvement in its non-oil sectors, achieving the goal of being the second largest Arab economy and, very recently, the country has been ranked as the 7th strongest Asian economy.

The UAE became an independent state in 1971, with the establishment of its formal economic, social, and political institutions. The country is a federation made up of seven Emirates: Abu Dhabi, Ajman, Al Fujairah, Dubai, Ras al Khaimah, Sharjah, and Umm al Qaiwain.

This complex process of nation building was among the causes for implementing a development policy on a interventionist-redistributive model, favored by the huge oil revenues (Yousef 2004). This development policy, thanks to the oil revenues that accrued in the country since the 1970s, permitted the creation of a vast welfare system for the population of the Emirates. Thus, UEA has enjoyed a political and social stability thanks to the distribution of its huge oil revenues in the form of social and economic infrastructure, high standards of social services (health, education) (Shihab 2001). In the UAE, like other oil exporting countries of the Gulf region, the motivation for the statism of the interventionist policies was to support the emergent private sectors. This State's strategy has stimulated massive investment by some large industrial complexes for developing the productive base of the economy and to diversify the sources of income. The industrial sector has made remarkable achievements especially in terms of the increase in the number of enterprises. Industrial activities have been facilitated by competitive low labor and energy costs, favorable tax laws and political stability (Masood and Sergi 2008).

The hydrocarbon industry is one of the most important economic sectors of the economy, and since this industry is high capital intensive, the number of workers that it employs is a small fraction of the labor force. In fact, it is well known that natural resources in general, and in the specific case oil wealth *per se*, creates few jobs directly. So this is why the non-oil private sector has to address the challenge of unemployment. The UAE has also created viable small and medium enterprises in manufacturing and services[28]. At the same time, despite efforts since the 1980s to limit hiring and downsize the public sector, state bureaucracy in the UAE maintained its dominant position in the labor market[29]. Regarding such destination of human capital in public sector employment, Pissarides (2001) already argued that in the long run the most detrimental impact of the large role of government hiring is that it traps human capital in unproductive public sector jobs, thus limiting its contribution to economic growth.

The UAE's economy, like others oil exporting countries, faced considerable oil price volatility in the 1990s[30]. However, in that decade, the UAE registered a real GDP growth averaged about 7 percent. Much of this growth was created through diversification in non-oil sectors: first, in energy-intensive, petrochemicals, fertilizers, cement and aluminum, and subsequently, tourism, trade and manufacturing (Yousef 2004, 105). So the UAE has been following a largely successful diversification strategy away from oil dependency and has been equally committed to its outward-orientated growth

[26] As in the prior year's Singapore is the country with the highest score on economic globalization.
[27] See KOF Index of Globalization 2013.
[28] Firms in the UAE produce many products including cement, aluminium, building and construction materials, fertilisers, foodstuffs, garments, furniture, plastics, fibreglass, jewelleries, pharmaceuticals, fire-fighting equipment, processed metals, etc.
[29] Government hiring typically offers more generous wages and greater employment guarantees than the private sectors.
[30] The sensitivity of UAE to changes in oil prices has manifested itself in growth volatilities across not just oil and gas, but also in different sectors that contribute to the bulk of economic output and employment.

policy. The previous vision of UAE, aimed to define the UAE's economy as a regional financial centre and international trading hub, has gradually realized. High capital productivity has filtered into high levels of gross domestic product (GDP) and the country enjoyed remarkable growth rates also in the period 2000-2005[31]. Yet, labor productivity remained relatively low in the country and total factor productivity gave a negligible contribution to economic growth[32]. Due to the lack of national high-technology sectors, UAE aimed to acquire and access foreign technology, in particular technology from the highly industrialized OECD countries, instead of generating its technology.

The labor force in the UAE is made up of more than 2.5 million employees of whom 86.5 per cent are male and 13.5 per cent are women. The labor market in UAE is based on sponsorship system or *Kafala system*. Each employee must have a sponsor or *kafeel* (Shah 2006). In the private sector, each worker must have a local sponsor who is expected to have a business for which it needs workers. Instead, for those working in the public sector, the government department employing the worker is the *kafeel*. Thus the sponsorship system is the legal channel through which expatriates obtain legal entry as guest workers in the UAE. In addition, the Emiratization process establishes a set of rules that protect the national citizens of the UAE from open competition from expatriates workers. The process sets minimum quotas of national workers for firms with 100 or more employees, enables the nationalization of particular work positions, and makes it almost impossible to fire national workers once they are employed. Emiratisation is undoubtedly important for social and political and also economic reasons. The process aims at bridging the gap between the human capital needs of the private sector and the need to employ national workers. But, at the same time, it has the potential to distort incentives in the labor market, because it forces firms to hire according to a quota system, while not necessarily motivate national employees to acquire those skills required to become competitive in the private sector economy (Dubai Economic Council 2011). Definitely, together with the effects on migrants as a result of the sponsorship system, the Emiratization process adds to the labor market distortions that lower the productivity of firms and their degree of competitiveness.

Table 1 shows rates of change in the UAE at constant prices (2007) over the period 2005-2010. The rates of change are referred to the GDP of total economy, to the Value Added of non-Oil sector and of manufacturing industries.

Table 1 - Rates of change at constant (2007) prices 2005-2010

United Arab Emirates	2005	2006	2007	2008	2009	2010
GDP Total Economy	4.9	9.8	3.2	3.2	-4.8	1.3
V.A. Non - Oil Sector	6.4	9.0	9.3	6.0	-2.9	1.4
V.A. Manufacturing Industries	6.6	7.3	1.9	10.3	-14.1	6.9

Source: UAE National Bureau of Statistics, National Accounts Division

During the years preceding the global economic crisis the UAE's economy was performing fairly well. The United Arab Emirates GDP Growth Rate reached an all-time high of 9.8 percent in 2006, while in the next two years (2007 and 2008) the pace of growth has diminished to 3.2 percent at constant prices. The Non-Oil sector recorded the highest rate of growth of 9.3 percent in 2007 and a good 6.0 percent in 2008[33].

Conversely, the global crisis has severely hit the UAE's economy, so the GDP contracted of 4.8 percent at constant prices in 2009, led by a remarkable fall in manufacturing, but also in real estate. The year of the crisis, i.e. 2009, hit more heavily the economy on the whole than the Non - Oil sector, which experienced a decrease of 2.9 percent. But the manufacturing industries have particularly suffered with a decrease of 14.1 percent. However, the economy regained confidence after the crisis.

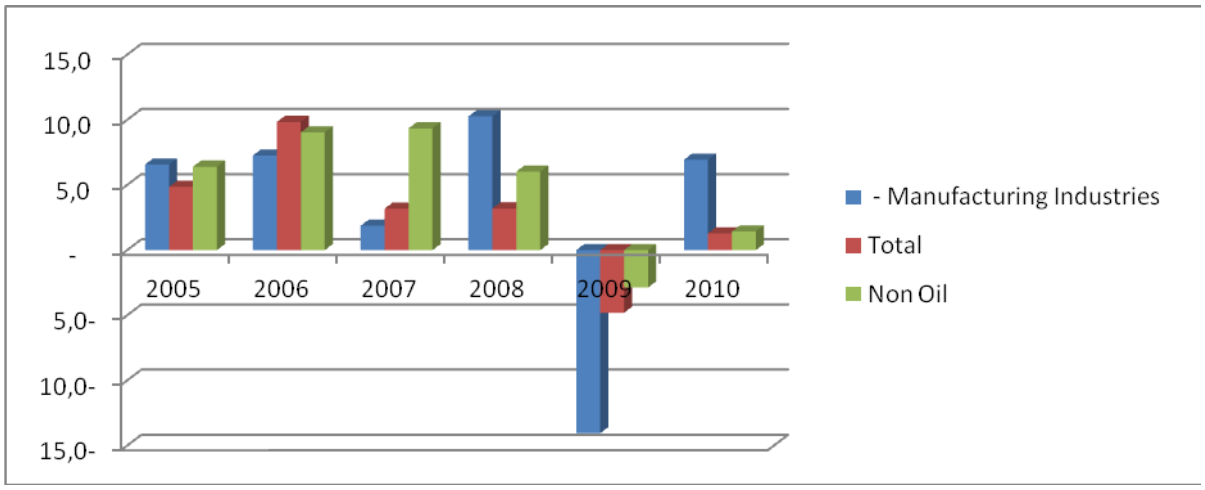
[31] Yet, Abu-Quarn and Abu-Bader (2007), for instance, showed that total factor productivity remained low and this hampered economic development in the Gulf economies and, among them, the UAE.

[32] More specifically, the oil and gas sectors achieved gains in labor and capital productivities, whereas these gains have been absent in the other sectors (Shediac *et al.*, 2008).

[33] For a quantitative analysis of the Non-Oil sector in the UAE during the period 1970-2006, see Masood and Sergi (2008).

In 2010 the growth of GDP was a respectable 1.3 percent at constant prices. Furthermore, as is documented in the Annual Economic Report 2012 of the UAE Ministry of Economy, during 2011 the GDP has grown in the UAE at a rate of 4.2 percent at constant prices, despite the political events in some Arab countries, the lower rate of growth of the global economy from 5.2 percent in 2010 to 3.8 percent to 2011, and the financial crisis at the Eurozone that determined a decline in the GDP rate of growth in the advanced economies to 1.6 percent. In addition, the public finance are in a good health. In 2011 the public debt was 16.9 percent of GDP, whereas the Government's fiscal budget was in surplus of 11.2 percent of GDP, but during 2012 it is improved further to 12 percent of GDP, due both to the counter cyclical policy implemented by the Government to avoid potential spillovers from conflict-stricken countries and to the boom of oil markets experienced in 2011.

Finally, the recovery of oil prices following the global financial crisis has been helping to maintain the commercial viability. Thus the UAE's economy has proved to be remarkably resilient to the difficulties that have characterized the world economy. After the 2009 crisis the UAE's Government has implemented some political reform and more investment in the less wealthy Emirates.



Source: Author's elaboration on data of Table 1

Figure 1 - Expresses through histograms the rates of change contained in Table 1.

The UAE's economy is continuing to rely on the hydrocarbons sector to drive growth[34], but the non-oil sector is going to become increasingly important, especially in the near future when several major industrial projects will come on stream. In fact, the large projects include the petrochemicals city, Al Gharbia Chemicals Industrial City (Chemaweyaat), which is due for completion in 2015 (a business of USD 20bln), but also the considerable expansion of Emirates Aluminium (EMAL)[35] by the end of 2014.

In the post 2009 recovery, the major drivers of the non-oil sectors have become trade[36], tourism, logistics and manufacturing. However, the road of UAE towards a diversified knowledge economy is not completed yet, so the next section examines the characteristics of a knowledge economy and the ways of achieving a knowledge economy diversified and well developed.

3. Towards a diversified knowledge economy

Diversification is important to promote economic development, to create job opportunities for a rapidly growing local workforce, but also to reduce or spread the risk of a high economic concentration, which makes an economy vulnerable to external events, such as changes in the price of the dominant commodity. An increased economic diversification can improve the performance of the

[34] The hydrocarbon economy continues to account for approximately 80 percent of total government revenues.
[35] This expansion will boost annual aluminum capacity to 1.3 mln tonnes/year.
[36] The trade balance achieved a huge surplus and it represents 23.5 percent of the GDP (UAE Ministry of Economy, 2012).

economy, minimize volatility and facilitate the path of sustainable development. More specifically, overall volatility and its ensuing spillover effects can be mitigated with the effective development and diversification of high-value-added production, but also by an increase in exports of goods and services of high quality.

It is well known that modern growth economics has focused on technological innovations and high-technology research and development as the engine factors for economic growth. In particular, endogenous growth theory has highlighted the importance of technological progress and factor productivity (Helpman, 2004). Other lines of research also emphasized the role of institutions as a fundamental cause of long-run growth (Acemoglu, Johnson and Robinson 2005). Recent development experiences suggest that an appropriate business environment is among the key ingredients of sustainable development.

The UAE 2021 vision, recently taken by the Federal Government, looks at innovation and knowledge as the key drivers of the economy[37]. Government policies, incorporated into the UAE 2021 vision of the economy based on innovation and knowledge, constitute an important step towards a diversified knowledge economy and a new growth model, but these policies should aim at creating an appropriate business environment and also an integrated set of soft and hard institutions. UAE, in fact, does not ranks well in protecting investors and on contract enforcement.

The Emirate that reached the most visible result in the diversification of the economy is Dubai. In the last decade, Dubai has become a major international service economy and has established itself as a regional center for finance, real estate development, shopping, tourism, exports and re-exports. Dubai experienced, for instance, the development of the Jebel Ali port and harbor, various "free zones" (i.e., enterprise zones) throughout the city, and extensive real estate complexes catering to the travel and tourism industry[38].

Dubai has followed an economic developmental model which is strongly pro-business, emphasizes market liberalism and economic openness, embraces globalization, while at the same time refraining from challenging the traditional neo-patrimonial leadership structure in the country. As such, the "Dubai model" has so far been distinctly different from economic models applied in the other Gulf Cooperation Council (GCC) economies[39]. Dubai is now seen as a model for the other Emirates and for the Gulf countries.

The global financial crisis has cast doubt over the traditional model of growth. The argument that improvements in knowledge are a primary source of growth has become more compelling. The idea that creating a knowledge society, based on learning and focused on absorb, adapt and produce knowledge, provides markedly different points of view on development strategies than those obtained by the traditional model, which has centered the attention on increase in capital and the efficient allocation of resources. The accumulation of knowledge is inherently associated with externalities (knowledge spillovers)[40], since knowledge is basically a public good (Foray, 2004). But the scientific and technological knowledge does not spread evenly across all sectors of the economy, thus, there are discontinuities of a different type from sector to sector (Schilirò, 2010). In this diversity with regard to the dissemination and development of knowledge between sectors of the economy of a country, the demand certainly plays an important role in driving companies to focus on those activities and products that give a higher expected return.

A country that is hydrocarbon-rich is not predestinated to economic concentration. Norway, for example, produces an amount of oil per day exceeded only by Saudi Arabia, yet it has been able to adequately distribute its GDP across a variety of productive economic sectors, and its revenues from

[37] Innovation and knowledge-based economies are characterized by a good healthcare system, a highly performing education system and proper policies and regulations. In other words, the innovation driven economies are the ones with the highest levels of prosperity. EEC (2011).

[38] Dubai Economic Council (2011).

[39] The Gulf Cooperation Council (GCC) economies are Bahrain, Kuwait, Oman, Qatar, the Kingdom of Saudi Arabia (KSA), and the United Arab Emirates. These economies are rich in hydrocarbons (oil and gas). However, recently the GCC states seem to be embracing the "Dubai model" of development making significant investments to establish economic activities with the aim of attracting foreign firms and individual investors: financial institutions, office facilities, free zones, airports, harbors, and, above all, tourism.

[40] Romer (1986).

oil and gas make up only approximately a quarter of its domestic output. Canada is another economy, rich of natural resources that have successfully diversified its economy.

Of course, diversification implies a structural change of the economy. Structural change usually refers to profound changes in the composition of employment and in the relative contribution of primary, secondary and tertiary sectors to aggregate growth (Schilirò 2012). Consequently, structural change implies agriculture transformation, industrialization, urbanization, changes in the production structure and in domestic demand, foreign trade and finance. To have a more diversified economy it is necessary to invest in productive sectors which can sustain, with their high levels of productivity, real growth in the long-term, as well as the development of new knowledge and technology. But also, it would be appropriate to foster the growth of the external sector when it promotes diversification, i.e., the export of a wide range of goods and services with high added value to a wide range of destinations.

Moreover, knowledge and skills have become the global currency of 21st century economies. With the globalization and with the related fully mobile capital, there is no reason for countries to limit themselves to patterns dictated by endowments, as conventionally defined; more important is the endowment of knowledge and entrepreneurship. A major focus of policy should be on how to enhance and shape such endowments. Therefore, it is rationale to move in the direction and to implement a new development model for the UAE, which involves a more diversified knowledge-based economy.

As it is written in the UAE Vision 2021[41], the main target of an economy that aims to compete in the global markets is to become a more skill-intensive and diversified knowledge economy. The State, however, has an important and useful role to play in promoting industrial diversification, upgrading and implementing policies to assist firms in these processes.

Knowledge economies, unlike economies that depend on finite natural resources, rely on the potentially unlimited creativity and talents of its people to generate economic value. Constructing a knowledge driven economy requires new skills, new ideas and a high level of creativity from a high-trained, flexible and adaptable workforce.

According to the World Bank the four pillars of a knowledge economy are: economic incentive and institutional regime; education and human resources; the innovation system; information and communication technology (ICT). But, ultimately, a knowledge-based economy is characterized by an ecosystem of interconnected elements and networks that allow a country to generate, adopt, adapt, diffuse and commercialize knowledge-intensive products and services. Making effective use of knowledge in an economy requires the development of appropriate policies, institutions, investments, and coordination across these four pillars. Therefore, knowledge economies are increasingly based on intangible assets that foster economic development. The transformation towards knowledge economies will necessarily determine a shift in the proportion of national income towards knowledge-based industries, but also a change in the percentage of the workforce employed in knowledge-based jobs and in the ratio of firms using new technologies to innovate; however, the institutional setting is also very important to achieve a knowledge-based economy (Schilirò 2012).

If we want identify the key drivers of UAE's competitiveness in the long run, which constitute also the main factors for the development of the GCC region, we must concentrate on knowledge, education, institutions (i.e. institutional arrangements and regulatory policies), technology (i.e. new equipment and organizational capacity), environment, entrepreneurial skills.

Education, in particular, is an important and necessary condition to enhance human capital and it is also a key driver for the growth in the UAE and the whole region[42]. The education system is crucial in the knowledge economy since it can inculcate attitudes toward change and skills of learning. It is also important to promote higher education, in particular doctoral university courses in

[41] UEA Vision 2021 states that the aim is to build a Knowledge-based Economy and to strength the competitiveness of the Emirates and all this requires three thrust areas: i) The first is to promote the participation of national manpower by linking education with market needs in high value sectors. ii) The second is to develop a regulatory framework to support key economic sectors and to encourage emerging sectors by modernizing the legislative framework governing the economic activities. iii) The third is to promote the policy of scientific research – both research for knowledge and applied research – in line with the economic priorities of the Emirates and contribute to the development of a core group of committed UAE national researchers.

[42] As it is argued in the seminal papers on human capital by Schultz (1960) and Becker (1962).

engineering and applied sciences that can favor the development and application of new technologies. However, education – specifically high quality education – is a variable that takes a long time to achieve results[43]. Moreover, education is obviously linked to the skills of the workforce and, consequently, it is important for employment. Employment and the slow job growth is a major problem also in the UEA. The unemployment, in fact, is defying the economic and political stability in the MENA region. Today, the total population of UAE is almost 8 million and it is growing at a rapid rate, but only 15-20 percent is the citizens of United Arab Emirates. In addition, of this population roughly 70 percent is estimated to be male and 30 percent female, while the total median age of the people of UAE is around 30 years, which means that most of the population is young[44]. However, employment in the UEA is distributed quite unevenly. The majority of the workforce is employed in sectors that are relatively less economically productive and of secondary strategic importance in sustainable development—such as construction and utilities, government, and other services in traditional sectors. This means that a majority of workers are employed in sectors that are supporting other economic sectors, rather than driving growth themselves. Since *the most important determinant of a country's future prosperity is its ability to achieve and maintain high productivity levels,* it is necessary to make deep changes in the labor markets of the UAE. This can be done, firstly, by overcoming the wage gap between the public and private sector that makes Emirati favor public sector employment; secondly, by changing the perceived labor market inflexibility and its links to the imposition of the quota (*sponsorship* or *Kafala system*). Thirdly, by rebalancing the disproportionately large volume of low skill workers as a result of entrepreneurs that favor low cost labor intensive industries as opposed to high value-added skill driven ones (Dubai Economic Council 2011). But, above all, to create employment it is necessary to convert knowledge and skills into jobs. This requires developing a better understanding of those skills that drive strong and sustainable economic and social outcomes, which allow translating technological progress into productivity growth. It requires developing effective labor-markets that use these skill potential, but also better governance arrangements. Lastly, globalization is changing the distribution of world jobs to reflect stronger emerging market economic growth and new business opportunities. Raising the investments and the levels of education will create an increasing array of higher skilled employees and better-paid individuals[45].

Technology is also a strategic driver for the growth and competitiveness. Technological change in particular is a crucial element to boost Total Factor Productivity (TFP) and, consequently, economic growth (Helpman 2004). Poor economic diversification – reliance on a single economic sector – tends to have an unfavorable effect on the productivity and competitiveness of the economy. In addition, poor diversification limits the possibility to expand the technology frontier. Moreover, technological knowledge now disperses globally in less than a year, thus it needs to be continually produced. Developing new and better technologies becomes a primary goal of an economy based on knowledge and innovation.

Environment constitutes a qualitative element of the growth process. In UAE, there is a too great consumption of energy, in particular oil, given its low cost, but also of gas, that, despite the wide internal production, is also imported by Qatar[46]. But these natural resources are limited and their high consumption has negative effects on the environment, so a new model of growth should aim at adopting alternative renewable resources. Moving towards a *green economy* may represent a rational and feasible solution, although it is costly at least in the short run[47].

Entrepreneurial skills are another basic element for developing a knowledge economy. It is not easy to create entrepreneurship in a society. Entrepreneurs are a unique group of people. Usually these people display leadership, persuasion, personal accountability, goal orientation, and interpersonal

[43] An efficient education system must entail a lifelong learning for improving human capital.

[44] In 2012 the median age of the EU-27's population is around 40 years.

[45] A principal reason for a supply short-fall beyond increased demand is that deficient or inappropriate education or training reduces the pool of potential employees in many emerging markets.

[46] Krane (2012) argues that Abu Dhabi's renewable Energy plan is not economically convenient, but it may have the positive effect of reducing fuel consumption in conventional power plants, which will cut carbon emissions and burning of expensive backup fuels.

[47] For an analysis and solutions regarding the environment and the tourism sector in UAE, see Vij and Vij (2012).

skills. One important thing to be done to favor entrepreneurship is to create an economic environment where the business culture is welcomed, but also where the behavior towards taking responsibility and risk is looked positively.

In a sense, today UAE is already a diversified economy, where non-oil sectors account for about 70 percent of the GDP. Massive investment has been made in infrastructure in the region, in terms of tourism, real estate and leisure, in order to diversify the economy. The richest states of Abu Dhabi and Dubai have benefited from the majority of this. However, the poorer northern emirates have also been developed, with grants from Federal Government, by supporting the growth of residential and commercial properties, road and service networks.

In the country, trade has a strategic role (for instance, the ports of UAE account for 61 percent in trade volume among GCC countries), the industrial sector contributes to more than 27 percent, where in particular the contribution of the manufacturing sector to the GDP of 2011 has been equal to 9.1 percent; the construction and building sector has represented the 11.4 percent of the GDP in 2011. Instead the group of the service activities recorded a contribution to the GDP of 45 percent in 2011. Tourism in particular has become very important, in fact, the UAE ranks first in the Middle East for having the travel and tourism industry's most advanced.

The structure of the investment distribution shows that in 2011 the share of the investment of the private sector compared to domestic investment was 71.3 percent, while there was a minor contribution of investment by the government (20.2 percent) and the public sector (8.6 percent) over the total domestic investments (UAE Ministry of Economy 2012).

Regarding education and employment, in the UAE more than a third of women, between the ages of 18 and 23 years, pursue tertiary degrees and graduate degree programs. Many of these economically literate female graduates earn degrees in the natural sciences and technology, offering recruiting potential for companies.

The 2013 federal budget policy, aiming at zero-deficit, priorities to health, education, social welfare and the development of government services; in particular to education is allocated the largest single share.

Furthermore, regarding the knowledge-based economic sectors the Emirate of Abu Dhabi through its Government-owned Mubadala Development Company founded Masdar, a corporation for the evolving global energy market. In particular with the two business units, Masdar Clean Energy and Masdar City, the company is committed to focus on renewable energy so to be at the forefront of the global clean energy industry. Another important industrial activity carried forward UAE's Government is the aviation industry[48].

All this changes have contributed to ensure that today UAE is a modern, wealthy and efficient economy that belongs to the high income countries[49], in fact, in 2011 its GDP per capita has been about $ 48,800.

However, despite the notable success of the United Arab Emirates in putting together a favorable business environment for growth and private sector development with minimal restrictions on private-sector activities[50], international trade and capital movements, there are areas where much more needs to be done. In particular, the overall investment regime remains restrictive. To continue the process of diversification and development government policy should aim at promoting innovation and market sophistication through appropriate regulatory systems. This can be done, for instance, by issuing strong consumer protection laws, issuing investment laws, solving the problem of the access to commercial land and other land-related issues, making a more efficient and easy access to finance. Other economic policies should keep favoring a stable macroeconomic environment, to promote the training of skilled labor force, to implement an efficient public sector and also to put a greater

[48] The Abu Dhabi Aircraft Technologies (ADAT) company, owned by Mubadala Development Company has been set up, which offers a comprehensive set of airframe, engine and component maintenance. The company has an international workforce of over 2,000 employees,

[49] In 2012 the UAE per capita income is among the top 20 countries in the world. Moreover, the country now ranks 8th in the world for its national infrastructure.

[50] In the last years, regulatory efficiency has improved in the UAE. There is no minimum capital requirement for establishing a business, which takes much less than the world average of 30 days.

emphasis on creating an environment conducive to business, in particular to the small and medium enterprises (SMEs).

In the following section several possible new business areas are identified for the development of the United Arab Emirates as a diversified knowledge economy.

4. What are the new areas of business for the United Arab Emirates?

If we look at the oil exporting countries of the MENA region and consider some main economic indicators for the period 2012-2104, as reported in the recent IMF's World Economic Outlook, we have a short synthesis of the economic situation for the next future about GDP growth and current account balance. Hereunder Table 2 with the indicators of the real GDP and Current account balance from 2012 to 2014 of the Oil Exporting countries of MENA Region.

Table 2 Economic indicators of Oil Exporting countries of MENA Region: 2012-2014

	Real GDP			Current Account Balance**		
	2012	2013*	2014*	2012	2013*	2014*
Oil Exporters	5.7	3.2	3.7	16.6	14.3	12.0
Iran	1.9	–1.3	1.1	4.9	3.6	1.9
Saudi Arabia	6.8	4.4	4.2	24.4	19.2	16.1
Algeria	2.5	3.3	3.4	5.9	6.1	4.5
United Arab Emirates	3.9	3.1	3.6	8.2	8.4	7.9
Qatar	6.6	5.2	5.0	29.5	29.3	23.7
Kuwait	5.1	1.1	3.1	45.0	40.8	37.6
Iraq	8.4	9.0	8.4	7.0	3.6	2.9

Source: IMF (2013); * Projections; **Percentage of GDP.

According to IMF (2013), in the Oil exporters' countries of the MENA region economic growth is projected to fall to 3.2 percent in 2013 as oil production growth pauses against a backdrop of relatively weak global oil demand. To address their medium-term challenges, the oil exporters need to continue with reforms that increase the pace of economic diversification and support job creation. The former will require continued infrastructure investment and further improvements in the business climate, while the latter will require enhancing education and training, improving job placement services, and reviewing the incentives for working in the private relative to the public sector (IMF 2013, 61).

Although the UAE is in a relative better economic condition of many of the Oil exporters countries of the region, some of these advices fit perfectly to the situation of the country as, for instance, the condition of the labor market and the type of reforms to increase the economic diversification.

Looking to the future, by 2030 emerging markets are expected to produce 70 percent of world GDP growth. The United Arab Emirates can be a protagonist of this expected forthcoming scenario. All depends by the trajectory that the UAE's economy will follow in the next future. The UEA Vision 2021 already designs a well-defined path towards a diversified knowledge economy, but, as it has been argued in the preceding section, the UAE's economy must fulfill certain conditions and it should identify new areas of business for its diversification.

Production and entrepreneurship have changed in surprising ways over the past thirty years. A crucial factor of this change is the huge shift of economic power made possible by technology, especially from internet. Today, technology makes it easy to create a business, even of large

dimensions, without the large initial capital that was once required. This is another unforeseen aspect of the knowledge economy. Furthermore, technological change has determined a generational gap. Entrepreneurs, who are aged around thirty years, are the first generation digital and global together. In the United States, the young entrepreneurs under the age of forty who create companies have now become a widespread reality. These young entrepreneurs are at ease with new technologies, emerging markets and the globalized economic system, but also use the social network for their business.

It is now clear that to develop a diversified economy based on knowledge is essential to strengthen the link between innovation, education, learning and human capital. The ability to multiply the value of the resources invested in research is typical of economies based on knowledge and innovation. This ability comes from the interaction between research, innovation and finance, which is not always easy to achieve. Certainly, institutions and policy coordination in order to encourage innovation are key factors to attain the goal (Schilirò 2010).

In Cambridge (UK), the University with its knowledge especially in the areas of software and environmental sciences, but also with its ability to combine nanotechnology with the bio-sciences, has been able to develop new business through innovative start-ups. This case constitutes, therefore, an example of collaboration between university, applied research and industry that has been successful. UAE could pursue a similar pattern. Produce and combine heterogeneous technologies are proving to be a successful move in the global market. Still, this production model does not preclude that the companies of the Emirates, especially small and medium-sized enterprises, can continue to produce the products in which they have vocational skills. In this latter case, what is important is their ability to continuously innovate their products and to maintain the high quality of goods, which must be placed mainly on foreign markets, given the limited size of the domestic market[51].

Among the business sectors, tourism is already an important sector of the UAE's economy. In 2011, 8.2 million overseas visitors sought out the UAE as a holiday destination. Only the contribution of Hotel and Restaurant sector to total GDP in 2011 has been equal to 2 percent. Since several years, in Dubai the authorities have considered international tourism as a core element in their programme of economic diversification. Tourism is closely tied to advances in transport and easy access by air, the UAE is able today to provide an appropriate and modern communications infrastructure, with the civil aviation industry that has progressed at speed. However, the UAE must try to maintain a high growth of the UAE as touristic destination, by increasing the length of stay, filling expensive hotels and leisure venues, but it should also strive to establish a tourism industry that is economically and environmentally sustainable. Unfortunately the UAE is generating the highest carbon footprints per capita in the world. So the growth out of proportion of tourism will lead to environment deterioration, which, in turn, spoils the natural beauty of the destination, thus becoming an unattractive choice for the potential tourist[52]. A development model of tourism that goes towards the green economy is, therefore, consistent with the economic needs and the environment.

Another important aspect of a diversified knowledge economy is that knowledge not only is produced, but also exported. The export of knowledge and culture, which results in royalties, sale of brands, professional and technical services to businesses, has become an important economic phenomenon. For instance, during the last years in the US, services exports have increased considerably. Knowledge is not anymore necessarily conveyed in most products, but in intangible exports. Companies that are successful in global markets are those that sell knowledge in the form of product design, process organization, dislocation of the functions appropriate to the times and places of the customers. In future, more and more this knowledge will be sold directly and less and less in the form of goods.

Therefore, the UAE's economy should orientate it towards innovative industrial sectors and professional and technical services and foster the intangible exports. Among the new business activities to be promoted in the UAE, in order to diversify the economy in the direction of a

[51] The experience of the Italian medium size enterprises that have become multinationals and that have followed a peculiar model of innovation and internationalization can be illuminating. (Schilirò, 2011).

[52] The relation between tourism development and environment in the UAE has been analyzed by Vij and Vij (2012), where they examine the attempts made by the UAE Government and major tourism stakeholders to deal with the current situation, but also they try to single out the optimal methodologies for carbon mitigation in the UAE.

knowledge economy, we can mention: business services, higher education, R&D laboratories and firms to develop new technologies.

In conclusion, the UAE's economy, to become a diversified and competitive economy, must have new businesses in the Schumpeterian sense, that is, radical innovators capable of integrating heterogeneous technologies and use the best scientific and technological research, but also should produce and export immaterial assets.

Conclusions

This contribution has emphasized the key factors that characterize a diversified knowledge economy, but also it has indicated the policies that the United Arab Emirates should pursue in order to diversify and develop its economy and improve its performance at a global level.

The economy of the United Arab Emirates will continue to rely on the hydrocarbons sector to drive growth, but the non-oil sector is becoming increasingly important, thanks also to the major industrial projects that will come on stream in the next years and to its 2021 Vision, which aims to place innovation, research, science and technology at the centre of a knowledge-based, highly productive and competitive economy. UAE remains the top destination for foreign capital in the GCC region. Since 2009, global banks have actually increased lending to the United Arab Emirates, notwithstanding already high exposures. Moreover, the UAE in general, and Abu Dhabi in particular, have extensive sovereign wealth funds (SWFs), established to secure and maintain the future welfare of Emiratis, playing also a leading role in the development and governance of the industry.

Despite all of that UAE's Government should improve the regulatory systems, as it has been argued in the previous sections. More should be done, especially regarding the overall investment regime that remains restrictive. The objective of macroeconomic stability, through effective monetary, fiscal and exchange rate control policies, is also essential to implement structural reforms and to facilitate the action of investors. Although, in the current economic scenario, it is possible that there could be problems of increasing financing costs due to the increased global risk aversion influenced by the geopolitical tensions in the neighboring countries and the financial problems in the euro-area.

The functioning of labor market must be improved, so to make possible to create more productive employment. Also total factor productivity must be increased to foster growth. In addition, the gender gap must be passed within a period of time not too long and the young generations should find more opportunities for entrepreneurship and business activities.

Since the key drivers of a developed knowledge economy are technology, innovation and high quality education, then research and development must be at the center of government policies of the UAE, as well as higher education. But also the environmental policy is another important aspect for implementing a new growth model.

Finally, the new areas of business should be identified in the innovative industrial activities and innovative services, professional and technical, whose products and services, with high knowledge-intensive, must be allocated not only to domestic market, but predominantly to foreign markets.

References

[1] Abu-Quarn, A. and Abu-Bader, S. (2007). Sources of Growth Revisited: Evidence from Selected MENA Countries, *World Development*, 35(5): 752-771.

[2] Acemoglu, D., Johnson, S. and Robinson, A. (2005). Institutions as a fundamental cause of long-run growth, in P. Aghion and S. N. Durlauf, eds., *Handbook of Economic Growth, Volume 1A*, Amsterdam, Elsevier.

[3] Becker, G. (1962). Investing in Human Capital: A Theoretical Analysis, *Journal of Political Economy*, 70(5): 9-49.

[4] Foray, D. (2004). *The Economics of Knowledge*, Cambridge (MA), MIT Press.

[5] Helpman, E. (2004). *The Mystery of Economic Growth*, Cambridge (MA), The Belknap Press of Harvard University Press.

[6] Krane, J. (2012). An Expensive Diversion: Abu Dhabi's Renewables Investments in the Context of its Natural Gas Shortage, *Cambridge Working Paper in Economics* 1237, July.

[7] Masood, O. and Sergi, B.S. (2008). Quantitative Measurement of Economic Sectors Effect on the Non-Oil GDP in United Arab Emirates, *International Journal of Trade and Global Markets*, 1(3): 239-258.

[8] Pissarides, C.A. (2001). Employment Protection, *Labour Economics*, 8(2): 131-159.

[9] Romer, P. (1986). Increasing Returns and Long-Run Growth, *Journal of Political Economy*, 94 (5): 1002-1037.

[10] Rostow, W.W. (1960). *The Stages of Economic Growth. A Non-Communist Manifesto*, Cambridge, Cambridge University Press.

[11] Schilirò, D. (2010). Investing in Knowledge: Knowledge, Human Capital and Institutions for the Long Run Growth, in M.J. Arentsen, W. Van Rossum and A.E.Steenge (eds), *Governance of Innovation.* Cheltenham, Edward Elgar, 33-50.

[12] Schilirò, D. (2011). Innovation and Performance of Italian Multinational Enterprises of the "Fourth Capitalism", *Journal of Advanced Research in Management*, II (2): 89-103.

[13] Schilirò D. (2012). Knowledge-Based Economies and the Institutional Environment, *Theoretical and Practical Research in Economic Fields*, III (1): 42-50.

[14] Shah N.M. (2006). Restrictive Labor Immigration Policies in the Oil-Rich Gulf: Effectiveness and Implications for Sending Asian Countries, UN/POP/EGM/2006/03, United Nations.

[15] Shediac R., Abouchakra R., Moujaes C.N., and Najjar, M. (2008). *Economic Diversification. The Road to Sustainable Development*, Abu Dhabi, Booz and Co.

[16] Shihab M. (2001). Economic Development in the UAE, in I. Alabed, P. Hellyer (eds.), *United Arab Emirates: A New Perspective*, Trident Press Ltd.

[17] Schultz T.W. (1960). Capital Formation by Education, *Journal of Political Economy*, 68(6), pp. 571-583.

[18] Vij, M. and Vij, A. (2012). Tourism and carbon foot prints in United Arab Emirates – challenges and solutions, *Journal of Environmental Management and Tourism*, III (1): 41-54.

[19] Yousef, T.M. (2004). Development, Growth and policy reform in the Middle East and North Africa since 1950, *Journal of Economic Perspectives*, 18 (3): 91–116.

*** Dubai Economic Council. (2011). *Business Environment, Enterprise Performance and Economic Development in Dubai. A Policy Report*, Dubai.

*** Emirates Competitiveness Council (ECC). (2011). Economic Growth, Productivity and competitiveness, *Policy Action*, Issue 2.

*** IMF. (2013). *World Economic Outlook*, Washington DC, April.

*** UAE Ministry of Economy. (2012). *Annual Economic Report 2012*, Abu Dhabi, United Arab Emirates.

*** UAE National Bureau of Statistics. (2011). *UAE GDP data (2002-2011)*, National Accounts Division.

COMPOSITE LEADING INDICATORS OF ECONOMIC CYCLES IN POLAND AND SLOVAKIA

Andrea TKÁČOVÁ
andrea.tkacova@tuke.sk
Anna BÁNOCIOVÁ
anna.banociova@tuke.sk
Marianna SINIČÁKOVÁ
mariannna.sinicakova@tuke.sk
Faculty of Economics, Technical University of Košice, **Slovakia**

Abstract:

The main objective of this article is to suggest and create the composite leading indicators for a short term prediction of the business cycles in Poland and Slovakia. In the theoretical part we define the composite leading indicator and its importance for the monitoring of the economic cycles. We describe in detail the methodologies of the OECD and the Eurostat, which deal with the prediction of the business cycles in Poland and Slovakia through selected economic indicators and the reference series, which represent the economic cycle of these countries. Based on the performed analysis we define the groups of leading, coincident and lagging indicators. Subsequently, we choose out of the leading indicators group those that are the most appropriate for the creation of the composite leading indicator (CLI). Then we create the CLIs and we study their prediction abilities through the values of the cross-correlations. Besides the creation of our own CLIs, we also compare these CLIs with the CLIs of the Eurostat and OECD and bring the conclusions on suitability or unacceptability of the individual CLIs for a given V4 country. The paper was elaborated within the project VEGA 1/0973/11.

Keywords: business cycle, composite leading indicator, reference series, cyclical indicator

JEL Classification: E3, E32

1. Introduction

Business cycle was at the forefront of the economic research interest in the 20s and 40s of the 20th century. The main reason was the unstable economy and subsequently the Great Depression in the 30s. It seemed like in the 50s and 60s the economic cycle was "dead", however the 70s and the oil crisis revived it and at the same time new economic theories attempted to explain the causes of the economic cycle (Kydland, Prescott 1990).

The new wave of interest in the economic cycle, and mainly in possibilities of its prediction, came with the World Financial Crisis in 2007, which hit mostly the developed countries. Many economists started to study not only the causes of this crisis, but also the possibilities of its prediction through the different econometric models. There are indicators in the economic practice, which are able, on a certain level, to provide a short term prediction of the development of economic cycles and accordingly warn against the possible negative development of the economy. The composite leading indicator is one of these indicators. The objective of this article is to suggest the measurable composite leading indicators, which are convenient to predict business cycles in Slovakia and Poland and then compare these indicators with the indicators of the Eurostat and OECD that have been used up to now.

2. Theoretical background of the composite indicator

The composite indicator is created by the aggregation of individual indicators into one complex index, which is measurable. Its main characteristic is the ability to describe a selected economic area in more detail than individual indicators by themselves (OECD 2004).

The composite indicator of cyclical development of economy, which consists of partial indicators of the economic cycle, belongs to one of the most used composite indicators. The selection of cyclical indicators creating the composite indicator is not random, but it depends on their economic significance, their explanatory value, their predictive ability etc. (OECD 2004). Creating of the composite indicator of cyclical economic development is a relatively difficult process and it requires a precisely specified sequence of individual steps (Nardo, Saisana 2005). It is necessary to identify the leading cyclical indicators, whose main task is to predict the turning points in the economic activity

and at the same time provide us with the information on probable rate and amplitude of fluctuations in the referential series at any phase of the economic cycle. These indicators are considered to be the most important out of the entire group of cyclical indicators, due to their predictive ability (Mestre 2007).

The first leading indicator was developed by the American economist Moore (1961) from the Economic Cycle Research Institute. Later in 1960, this indicator was refined into the form of index of leading economic indicators (LEI) (Economic Cycle Research Institute 2011). Presently, there are more opinions on the composition of the composite indicators of cyclic economic development. The OECD is of the opinion that the economies are different and therefore the composition of the composite indicators varies depending on the country. On the other hand, the Eurostat states that the economic cycles can be traced through the composite indicators with the same composition.

In addition, similarities in business cycle evolution in European countries can be an important argument for a single monetary policy in the euro area (see Bartóková 2012). Following analysis will enable us to consider Polish and Slovak business cycle evolution from the point of view of monetary integration too.

3. Approaches to the creation of the composite leading indicator in the world

The institutions such as the OECD, Eurostat and Conference Board study the monitoring and the short-term prediction of the economic cycles through the CLI. These organizations have their own methods of the CLI calculation, which show some common, as well as some different signs (Tkáčová 2012a). The objective of this article is not only to create our own CLI for Slovakia and Poland, but also to compare it with the leading indicators that have been used up to now. Due to this reason we will describe the CLI of the Eurostat, as well as the CLI of the OECD, which are currently used for the prediction of the economic cycles in Poland and Slovakia. Poland and Slovakia are two central European countries with the similar transition process evolution since 1990 and with important mutual external trade. In addition to some similarities between the countries, we can observe several particularities, too. For instance, Slovakia is rather small open economy and the euro area member since 2009. On the other hand, Poland is comparatively large less open economy and crucial player in the central European region. Other differences are implied by specific inflation and interest rate evolution as analysed e.g. by Mirdala (2012) or by differences stemming from various flows of foreign direct investments (see Šoltés V. and Šoltés M. 2003). These differences have to be taken into account in the creation of their composite leading indicators.

3.1. Composite leading indicator of the OECD

The methodology of the OECD arises from the growth cycle and the time series can be split into random, trend, seasonal and cyclical components. The OECD used the modified method phase-average trend (PAT) of the American National Bureau of Economic Research (NBER), for the trend prediction until 2008. This method is relatively mathematically and statistically difficult (Boschan, Ebanks 2011). To simplify its description, the calculation of trend is based on summing the moving averages of the time series (Nilsson, Gyomai, 2007). The OECD decided to replace the PAT method by the Hodrick-Prescott (HP) filter, starting from December 2008. The main reason for this change was that the HP filter was able to eliminate the trend component in one operation and at the same time smooth the time series (Schilcht 2005). Before the HP filter was used, it was necessary to add the months for cyclical dominance method to the PAT method, which smoothed the series by using the moving averages (OECD 2008). The main advantage of the HP filter was its modesty on input data (Bezděk *et al.* 2003). Beneš and N´Diaye (2004) considered the HP filter to be the simplest variant of the modern filtration techniques. The HP filter can be relatively easily applied to any time series (Hodric, Prescott 1997). Besides this, it is necessary to input only an entry parameter λ, which optimizes the smoothing of the trend (Fabiani, Mestre 2000). The HP filter's disadvantage is the fact that its results are devious at the beginning and at the end of time series. It is called a problem of „end-

points"[53] (Trimbur 2005). The time series are supplemented with the predictions to mitigate this problem (Zimková, Barochovský 2007).

The OECD uses monthly data for the composite leading indicator calculation, and starting from March 2012 as the reference range are used monthly data of GDP. As this transformation of GDP into monthly data has not been finalized yet in Poland and Slovakia, the OECD uses in its databases the CLI with the original reference series (index of industrial production (2005=100), resp. its cyclical component) (OECD 2012).

The OECD is the only institution, which uses parameters of external economy, such as foreign trade, mainly the development of export and the exchange rates. In its approach, it combines both soft and hard data. The individual indicators have the equal weights. The reason for this is the fact that the application of different weights could lead to the minimization of the impact of those indicators, which do not show the required concurrence with other indicators. A reduced reliability of the composite indicators could be the consequence, as some of the indicators have a greater explanatory ability in one cycle and other indicators in other cycles (Gyomai, Guedette 2012). Based on the Nilsson's studies (2000), the indicators used by the OECD have a greater explanatory ability than the indicators used by the European Union.

It is typical for the OECD that every country has a different composition of the leading indicator, depending on the specifics of a given economy. The composition of the composite indicator for Slovakia and Poland is shown in Table 1.

Table 1. Composition of the CLI for Poland and Slovakia according to the OECD

COUNTRY	Composition of the CLI
POLAND	Real effective exchange rate (2005=100)
	Interest rate: 3-months WIBOR (%)
	Manufacturing production (future development in %)
	Number of vacant jobs
	Coal production (tons)
SLOVAKIA	Retail trade confidence indicator (development in %)
	Total sales in retail trade (2005=100)
	Consumer opinions, Economic situation, future tendency (development in %)
	SAX index (2005=100)
	Total import (USD)

Source: OECD, 2013

As it is shown in Table 1, the CLI has a different composition in Slovakia and Poland but the same number of components which is five. That means that for the best possible prediction of the economic cycle development it is according to the OECD better to create the CLI with different composition. The same composition for Poland and Slovakia would not necessarily mean the sufficiently precise development prediction of the economic cycles of these countries. The components create the CLI based on their correlations with the referential time series (industrial production index) and their weights in the CLI are equal.

The OECD uses, for the best possible selection of the CLI components, the systems of scoring and ranking, which are based on the level of concurrence of individual indicators with the reference series. To support statistically this level of the CLI lead, we have used the cross-correlations, which can precisely define the highest value of the correlation coefficient in regards to the period of the lead. As the data used by the OECD are set on a monthly basis, we have calculated the cross-correlations

[53] The problem of end-points means that the beginning and the end of a time series are not sufficiently smoothed, which causes that the final trend might be pulled down at the end of the time series, if the economy shows the signs of a slowdown and vice versa (see Kranendonk, Bonenkamp, Verbruggen 2005).

between the monthly cyclical components of the industrial production index for Slovakia and Poland and the monthly value of the CLI, reported by the OECD. We have studied the moves of the monthly OECD's data by 10 months back and the time *t* represents January 2000.

Table 2 shows the results of the cross-correlations with the CLI lead of 1 up to 10 months before the reference series. The most important is value of correlation coefficient in the time of lead. Based on our calculation, the CLI of Poland is able to outperform the development of the reference series by 7 months, with the value of the correlation coefficient at 0,489. This value is low, as the components included in the CLI should have the second highest absolute value of the correlation coefficient higher than 0.55 (Kľúčik 2009). In this case, the entire composite leading indicator does not fulfill this condition. The value of the correlation coefficient of Slovakia is also low (0,532). The CLI of Slovakia is not able to overrun the development of the reference series and it evolves in parallel with the reference series.

Table 2. The cross-correlation results between the reference series of the OECD and the OECD's CLI (M1 2000 –M12 2011)

COUNTRY	t-10	t-9	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1	t
POLAND	0.462	0.477	0.486	0.489	0.485	0.474	0.454	0.425	0.390	0.346	0.293
SLOVAKIA	-0.127	-0.087	-0.036	0.024	0.095	0.174	0.255	0.334	0.410	0.477	0.532

Source: authors´ calculation

To confirm the development of the OECD's CLI and the reference series in Poland and Slovakia also visually, we show Figure 1 and 2. It is clear that the OECD's CLI for Slovakia and Poland do not predict the development of the reference series very precisely because the values of the cross-correlations shown in the lead-time, indicated a big amount of false signals.

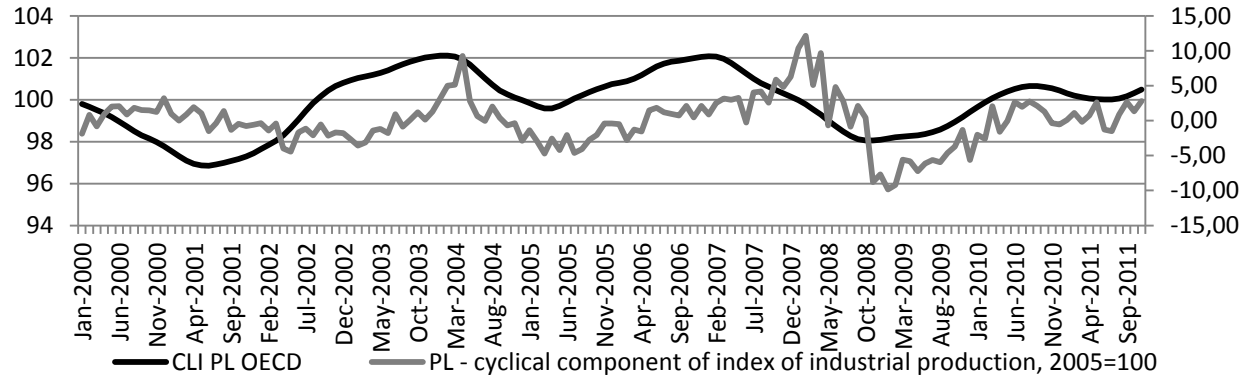


Figure 1. Evolution of the OECD's CLI and the industrial production index (cyclical component) for Poland

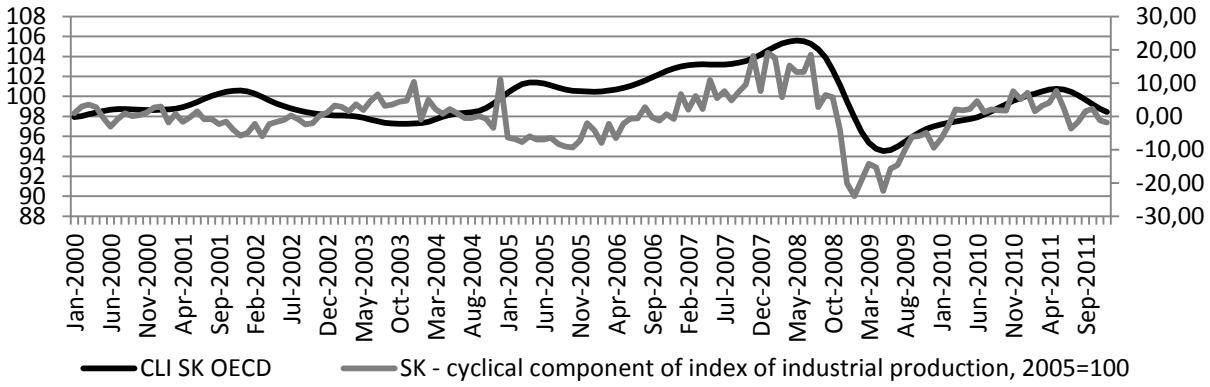


Figure 2 - Evolution of the OECD's CLI and the industrial production index (cyclical component) for Slovakia

Figure 1 and the results of the Table 1 provide us with enough information to draw a conclusion on the suitability of the OECD's CLI for the prediction of the economic cycles in Slovakia and Poland. However, the results of our studies could be distorted by the fact that we used the industrial production index (2005=100) as a reference series in the correlation. It is understandable that until 2005, the index of industrial production had to be used as a referential series with a different year that equaled to 100, e.g. 2000=100. That means that the current CLI (the reference series is the index of industrial production 2005=100) is not able to determine ex-post, if it sufficiently predicted, resp. did not predict, the future development of the reference series before 2005. Inaccuracies in the prediction in the past then distort the results of the cross-correlations. Due to this reason, we calculated the cross-correlations also from the period after 2005 and we got the results shown in Table 3. In this case the time *t* is January 2005.

Based on the data from Table 3, the length of the lead, compared to the previous time period, has not changed, so the CLI overruns the development of the reference series in case of Poland by 7 months and in case of Slovakia by 0 months. What has changed is the value of the correlation coefficients, which has grown in chosen countries. The growth went from 0,489 to 0,694 in Poland and from 0,532 to 0,718 in Slovakia. But in the case of Slovakia we cannot call it a lead as the highest value of the correlation coefficient was achieved in the time *t*.

Table 3. Cross-correlation results between the reference series of the OECD and the OECD's CLI (M1 2005 – M12 2011)

COUNTRY	t-10	t-9	t-8	t-7	t-6	t-5	t-4	t-3	t-2	t-1	t
POLAND	0.660	0.680	0.692	**0.694**	0.689	0.678	0.654	0.622	0.577	0.525	0.464
SLOVAKIA	-0.172	-0.105	-0.028	0.060	0.157	0.262	0.370	0.477	0.574	0.657	0.718

Source**:** authors´ calculation

We performed not only the analyses based on the monthly data, but we also recalculated the values of the OECD on the quarterly data, by using a simple average and we calculated the cross-correlations for the periods with moves up to 5 quarters forward and backward. We got to the following results, shown in Table 4.

Table 4. Cross-correlation results between the reference series of the OECD and the OECD's CLI (Q1 2000 – Q4 2011)

COUNTRY	t-5	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4	t+5
POLAND	0.534	0.618	0.629	0.578	0.448	0.249	-0.005	-0.244	-0.446	-0.587	-0.642
SLOVAKIA	-0.214	-0.169	-0.022	0.224	0.481	0.641	0.633	0.435	0.177	-0.038	-0.183

Source: authors´ calculation

By using the quarterly data, we can see that the CLI of Poland overruns the evolution of the reference series by 3 quarters and in the case of Slovakia, by using the quarterly data of the OECD's CLI, it shows the concurrence with the evolution of the reference series.

Generally speaking, we can summarize that the CLI, created by the OECD's methodology, can be used as a supportive tool for the prediction of the reference series for Polish business cycle. In the case of Slovakia, the composition of the CLI created by OECD has a character of coincident and not leading indicator, and therefore it is not suitable for the economic prediction of the Slovak economic cycle. It is necessary to create a CLI, which can predict economic cycle evolution in Poland and Slovakia with the sufficiently long lead.

3.2. Composite leading indicator of the Eurostat

The Eurostat, same as the OECD, takes as a base the growth cycle and uses the Christiano-Fitzgerald filter of random walk for the trend prediction. This filter was formed on the same principles as the Baxter-King (BK) filters (Everts 2006). The reference time series is represented by the time series of the quarterly GDP at constant prices, resp. its cyclical component. The Eurostat established

the composite leading indicator with the same components for all of the observed countries: industrial confidence indicator, consumer confidence indicator, construction confidence indicator and stock prices index (Czesaný 2006). The creation of the composite indicator is more or less based on the soft data (Ozyildirim 2009). The Eurostat applies the simple system of weights, while the individual components are split into two groups. The second group (construction confidence indicator and stock prices indicator) has a weight at the half weight of the first group (industrial confidence indicator and consumer confidence indicator). The advantage of the EU is the fact that all of the components are available.

To be able to visually and statistically prove the concurrence of the Eurostat's CLI and the reference series, we had to create the CLI time series first, as they are not available in the public databases. For the creation of the CLI, we have seasonally adjusted the time series by using the seasonal indexes and then we adjusted them through the Christiano-Fitzgerald filter, by which we got the cyclical components of the time series. As the next step we assigned the weights, which are for the given indicators set by the Eurostat. We get the cyclical component of GDP in the same way. The values of the cross-correlation coefficients for Poland and Slovakia, with a lag up to five quarters forward and backward, are shown in Table 5.

Table 5. Cross-correlation results between the reference series of the Eurostat and the Eurostat's CLI

COUNTRY	t-5	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4	t+5
POLAND	0,463	0,607	0,721	**0,798**	0,763	0,665	0,475	0,187	-0,086	-0,318	-0,484
SLOVAKIA	0,493	0,563	0,616	0,633	0,671	0,517	0,232	-0,080	-0,276	-0,491	-0,597

Notes: Poland (Q1 2002 – Q4 2011), Slovakia (Q1 2001 – Q4 2011)
Source: authors´ calculation

The results of the cross-correlations in Table 5 show that the CLI created by the Eurostat overruns the evolution of the economic cycle by two quarters in the case of Poland. The lead of one quarter is reported for Slovakia. The CLIs of Slovakia and Poland do not have the same lead, but neither the same value of correlation coefficients. Poland has higher value of the correlation coefficient (0.789). Slovakia reports correlation coefficient of 0.671.

The same as in the case of the OECD, we also created the figures for the Eurostat. Figures 3 and 4 record the evolution of the Eurostat's CLI and the reference series. In this case the cyclical component of GDP at constant prices (2005=100) was used as a reference series.

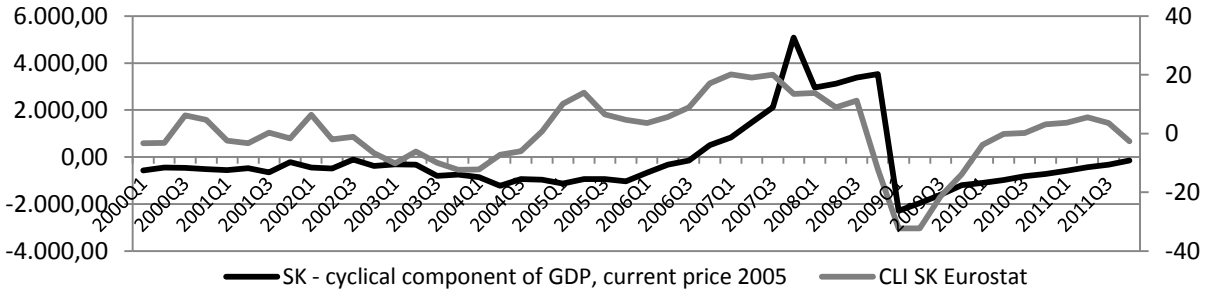


Figure 3- Evolution of the Eurostat's CLI and GDP at constant prices of 2005 (cyclical component) for Slovakia

The OECD's methodology has used the cyclical component of GDP at constant prices of 2005 as the reference series since 2005. Until then it was the cyclical component of GDP at constant prices of 2000. In the case of the Eurostat, we could again expect that the values of the cross-correlations are distorted for the period before 2005, as it was in the case of the CLI created by the OECD. However, the Eurostat's methodology is different and all four elements of the Eurostat's CLI are expressed in the form 2005=100. In the time, when the cyclical component of GDP at constant prices of 2000 was used as the reference series, all of the CLI's components were calculated as 2000=100. That means that the transfer from the reference year 2000 to the reference year 2005 should not cause any problem,

because the changes occurred in all of the used elements. We have calculated also the cross-correlations since 2005, to prove our assumption, which can be seen in Table 6.

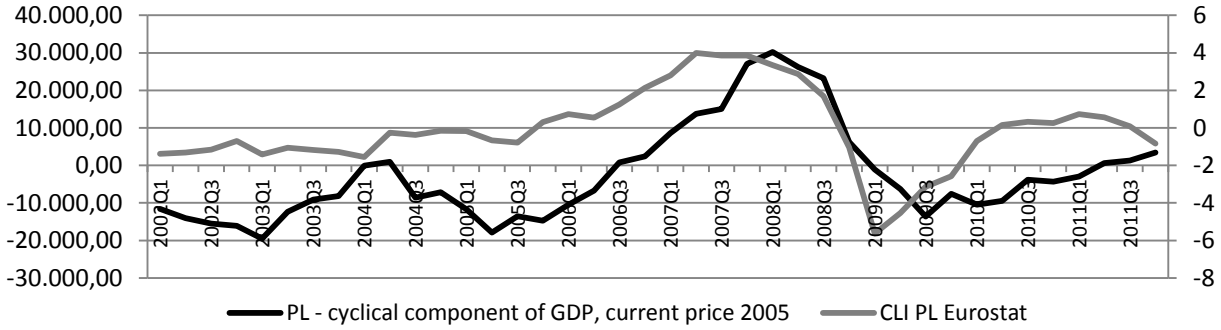


Figure 4. Development of the Eurostat's CLI and GDP in the current prices of 2005 (cyclical component) for Poland

Table 6. The cross-correlation results between the reference series of the Eurostat and the Eurostat's CLI (Q1 2005 – Q4 2011)

COUNTRY	t-5	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4	t+5
POLAND	0.406	0.607	0.744	0.834	0.779	0.636	0.409	0.066	-0.259	-0.524	-0.684
SLOVAKIA	0.435	0.524	0.591	0.610	0.667	0.499	0.199	-0.119	-0.334	-0.576	-0.701

Source: authors´ calculation

It is obvious from Table 6 that our assumption was not correct, mainly for Poland. The cross-correlation results in the case of these countries were higher from 2005 on. The change was from 0.798 to 0.834 in Poland. That means that the Eurostat's CLI before 2005 insufficiently predicted the evolution of the economic cycle in Poland. In other words, it was required to use a different composition of the CLI in that period, which would have better prediction abilities. There was no significant change of the correlation coefficient in the case of Slovakia, resp. it was only a slight drop from 0.671 to 0.667. There were no changes in the length of leads during the tracked time series Q1 2005 – Q4 2011.

The conclusion of the tracking the leading composite indicator created by the Eurostat is that it can be used as a supportive predictive indicator for Poland and Slovakia. If we want the CLI to have the sufficient predictive ability, it should have the highest possible value of the cross-correlation coefficient. However, in the case of Slovakia it would be better to look for a different composition of the CLI, which would be able to indicate the business cycles evolution more precisely in these countries.

4. Methodology of the composite leading indicator's creation

When creating our own CLI, we take as a base the growth cycle, which is more suitable for the transition economies, characteristic with a faster pace of growth (Macháčková *et al.* 2007). When the database of the time series is created, we will proceed through the following sequence of steps (Tkáčová 2012):

Selection of the reference series – it is a fundamental parameter of the cyclical evolution. The theory offers three options of the reference series and that would be GDP at constant prices, the index of industrial production and the complex parameter.

Seasonal adjustment of time series (seasonal indexes) – it is required to obtain the cyclical components from the original data and therefore we need to seasonally smooth the time series. We will use the method of smoothing through the seasonal indexes.

Elimination of trend (Hodrick-Prescott filter) – one of the reason for choosing the HP filter was the fact that it is able to eliminate the trend component in one operation and at the same time smooth the entire time series (Schlicht 2005). This allows us to get the cyclical components of the time series, which are inevitable for the analysis of the economic cycles.

Cross-correlation – enables us to express the relation between the reference series and the time series of the studied cyclical indicators. The cross-correlations are performed with the lag of five periods forward and backward, by applying the Pearson correlation coefficient, which reflects the linear dependence between the variables (Luboš *et al.* 2007). If this relation is non-linear, which we will find out through the graph, we will make it linear by the transformation of the variables (e.g. logarithm) and then we will calculate a new correlation.

Grouping of the cyclical indicators – depending on the value of the correlation coefficient, we can create these three groups of cyclical indicators, but the cyclical indicators have to meet the following conditions:

- *Coincident indicators* – the highest absolute value of the correlation coefficient is in the time *t* and the second highest absolute value of the correlation coefficient must be at least 0.55.
- *Lagging indicators* – the highest absolute value of the correlation coefficient is achieved in one of the positions on the right side from *t* and the second highest absolute value of the correlation coefficient must be at least 0.55.
- *Leading indicators* – the highest absolute value of the correlation coefficient is on the left side from *t* and the second highest value of the correlation coefficient must be at least 0.55.
- *Method of selection and scoring* – when choosing the appropriate leading indicators integrated into the CLI, we will select the data through the method of scoring, where we measure their economic and statistical significance and the statistical quality:
  - *Economic significance (10 points)* – the economic interpretation in relation to the economic cycle (10 points);
  - *Statistical significance (30 points)* – correlation coefficient (15 points), the number of leading periods (15 points);
  - *Statistical quality (10 points)* – time availability (5 points), actualization (5 points).
- *Data normalization* (standardization) – the main reason for the normalization is that we need to implement into the CLI the data in different measuring units. We will use the method of standardization, as it is done by the OECD (2008).
- *Weights determination* – for the creation of the CLI we will compare the suitability of equal and different weights. The equal weights will be calculated through the simple formula:

$$v = \frac{1}{n} \quad (1)$$

where v is a weight for each leading indicator implemented in the CLI, n is the number of leading cyclical indicators entering the CLI. For the determination of different weights, we will use the values of the correlation coefficients, where the indicator with the higher value of the correlation coefficient will have greater weight in the CLI. The calculation of different weights can be recorded in the form of the following relation:

$$v_i = \frac{r_i}{\sum_{i=1}^{n} r_i} \quad (2)$$

where v_i is a weight for leading indicator i, r_i is the value of the correlation coefficient of leading indicator i in the time of lead.

Creation of the CLI - when creating the relationship for the calculation of the CLI, we will use the sum of the indicators, multiplied by the weights, which are assigned to them.

5. Creation of the composite leading indicator for Poland and Slovakia and their comparison.

5.1. Selection of the reference series and the cyclical indicators

When creating the CLI for Slovakia and Poland, it is important to choose an appropriate reference series, which would represent economic cycle. As our goal is to ensure the comparability of the created CLI in terms of its composition, we have to select such reference series, which will be applicable for Poland and Slovakia. In this case, we have to choose between GDP and the index of industrial production. The complex indicator would probably have a different composition in Poland

and Slovakia and therefore it would not be a suitable indicator. GDP is preferred for monitoring of business cycles but has one disadvantage that we have only quarterly data series. It means that we can do only quarterly predictions. We can use index of industrial production as the reference series but this has to have parallel evolution with GDP. We can analyze Table 7 to verify this hypothesis.

Table 7. Cross-correlation results between GDP and industrial production index (cyclical components), (Q1 2000 – Q4 2011)

COUNTRY	t-5	t-4	t-3	t-2	t-1	t	t+1	t+2	t+3	t+4	t+5
POLAND	0.25	0.39	0.53	0.69	0.75	0.69	0.48	0.21	-0.05	-0.29	-0.43
SLOVAKIA	0.00	0.16	0.40	0.57	0.67	0.58	0.40	0.14	-0.09	-0.30	-0.42

Source: authors´ calculation

Table 7 displays that index of industrial production has a character of leading cyclical indicator in Slovakia and Poland. It means that this indicator predicts GDP evolution and it is not coincident indicator what was the condition for its using as the reference series for business cycles monitoring in Poland and Slovakia. The cyclical component of GDP is more convenient to monitor the business cycles in Poland and Slovakia.

In the process of the CLI creating, we have studied the relation between the selected economic indicators and the reference series. The selected indicators were from the following economic areas: industry, construction, trade, services, labor market, state budget, balance of payments, foreign trade, monetary aggregates, consumers' expectations, stock indexes, confidence indicators, etc. We have tracked 128 indicators from Poland and 112 indicators from Slovakia. The uneven number of indicators in the countries was caused by the availability of the time series and mainly by the length of the time series, which was in case of some indicators too short and consequently it restrained us from applying the given indicator. We used quantitative as well as qualitative data. The time series were in the form of the quarterly data, which was given by the selection of GDP reported quarterly.

After the time series adjustment through the selected methods, we used the cross-correlations for five periods forward and backward. The groups of coincident, lagging and leading indicators were specified on the basis of the established conditions. The numbers of these indicators are shown in Table 8.

Table 8. Number of the indicators by their relation to the reference series in Poland and Slovakia

Indicators	Poland	Slovakia
Lagging	8	10
Coincident	16	17
Leading	16	11
With the insufficient relation to the reference series	88	74
Total	**128**	**124**

Source: authors´ calculation

Table 8 demonstrates that only a small amount of the economic indicators fulfilled the conditions to be grouped into the leading indicators. In the case of Poland and Slovakia it was 16 and 11 indicators respectively.

Consequently, it was necessary to select the groups of the leading indicators, which would meet the requirements for the short term prediction of the CLI the best. Therefore we used the method of selection and scoring, which allowed us to create Table 9.

Table 9. Leading indicators after using the method of selection and scoring

COUNTRY	Leading indicators
POLAND	Manufacturing production, 2005=100; Monetary aggregate M1, 2005=100; Warszawski Indeks Giełdowy, stock index, 2005=100;

	Employment in construction, predictions, % balance; Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; Construction confidence indicator; Retail trade confidence indicator.
SLOVAKIA	Gross fixed capital formation, mils. Eur; Goods and services export, mils. Eur; Industrial production 2005=100; Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; Consumer confidence indicator; Market capitalization, mils. eur.

Source: authors´ calculation

After the selection and applying the method of scoring, we were able to eliminate those indicators from the group of the leading indicators, which were least satisfactory or which reported duplication. For the further studies, we had 7 out of 18 leading indicators in Poland and 6 out of 11 original leading indicators in Slovakia.

5.2. Creation of the composite leading indicator for Poland and Slovakia

After the selection of appropriate leading indicators for the CLI, we also studied if the given composition really shows the best prediction abilities. Therefore we created various variants of the CLI's composition for both countries. Each CLI variant was composed out of the previous leading indicators, minus the indicator with the lowest value of the correlation coefficient from the group. The variants of the CLI for Poland and Slovakia are in Table 10.

Table 10. Variants of CLIs for Poland and Slovakia

CLI	POLAND	SLOVAKIA
CLI 1/CLI A	▪ Manufacturing production, 2005=100; ▪ Monetary aggregate M1, 2005=100; ▪ Warszawski Indeks Giełdowy, stock index, 2005=100; ▪ Employment in construction, predictions, % balance; ▪ Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; ▪ Construction confidence indicator; ▪ Retail trade confidence indicator.	▪ Gross fixed capital formation, mils. Euro; ▪ Goods and services export, mils. Euro; ▪ Industrial production 2005=100; ▪ Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; ▪ Consumer confidence indicator; ▪ Market capitalization, mils. Eur.
CLI 2/CLI B	CLI 1/A - Employment in construction, predictions, % balance	CLI 1/A - Market capitalization, mils. euro
CLI 3/CLI C	CLI 2/B - Retail trade confidence indicator	CLI 2/B - Consumer confidence indicator
CLI 4/CLI D	CLI 3/C - Monetary aggregate M1, 2005=100	CLI 3/C - Industrial production 2005=100
CLI 5/CLI E	CLI 4/D - Construction confidence indicator	

Notes: equal weights are marked with numbers and different weights are marked with letters
Source: authors´ calculation

We have created five variants for Poland and four variants of the CLI for Slovakia. The newly created CLI was studied in regards to the reference series by applying the cross-correlation. We tested

the individual variants using equal, as well as different weights. The best results of the cross-correlations were achieved by the CLI presented in Table 11.

Table 11. Length of the lead and the cross-correlation value for the CLI of Poland and Slovakia

COUNTRY	CLI's lead (number of quarters)	Cross-correlation value between the reference series and the CLI in the lead-time	
		Equal weights	Different weights
The longest possible time series: Poland (Q1 2001 – Q4 2011), Slovakia (Q1 2003 – Q4 2011)			
POLAND (CLI3/CLIC)	1	0.867	0.866
SLOVAKIA (CLI1/CLIA)	1	0.821	0.820
Poland, Slovakia (Q1 2005 – Q4 2011)			
POLAND (CLI3/CLIC)	2	0.885	0.884
SLOVAKIA (CLI1/CLIA)	1	0.818	0.818

Source: authors´ calculation

We present the cross-correlation results of the created CLIs with the GDP cyclical component for each country in Table 11. We took into consideration also the length of the time series, out of which the cross-correlations were calculated. As we have already mentioned, the length of the time series influences mainly the cross-correlation value in the lead-time. Therefore we have calculated the correlations at the longest possible time series[54] and at the time series from 2005.

Based on the reported results, we can claim the following facts about the CLIs that we created for Poland and Slovakia:

- In case of the longest possible time series, the CLIs for Slovakia and Poland have the lead of one quarter before the GDP cyclical component and therefore they have the short term prediction ability of the business cycles in these countries;
- In case of the time series from 2005, the CLI for Poland reported the lead of two quarters, while Slovakia maintained the lead of one quarter.

Generally speaking, more precise CLI from the point of view of prediction of the business cycle evolution is the CLI that we created for Poland. There are no important differences in using the equal or different weights. These differences do not have a significant impact on the accuracy of the lead, expressed through the value of the correlation coefficient.

Further we show the individual relations used for the calculation of the CLI of Poland and Slovakia. These CLIs are calculated at the equal weights, as those appeared to be a little more appropriate at the cross-correlation from 2005.

CLI Poland = 0.2 * manufacturing production + 0.2 * monetary aggregate M1 + 0.2 * Warszawski Indeks Giełdowy + 0.2 * industrial turnover + 0.2 * construction confidence indicator (3)

CLI Slovakia = 1/6 * gross fixed capital formation + 1/6 * goods and services export + 1/6 * industrial production + 1/6 * industrial turnover + 1/6 * consumer confidence indicator + 1/6 * market capitalization (4)

Based on the above mentioned relations, we can see the composition of the individual CLIs. We present Table 12 for the further comparison of the selected indicators.

[54] The CLI was created by the leading indicators, which were available with different length of the time series. However, if we wanted to create the CLI, we had to take as a base length of the shortest time series of the indicator, which formed the CLI; therefore we talk about "the longest possible time series". E.g. if we had five indicators with length of the time series Q1 1999-Q4 2011 and only one with length of Q1 2003-Q4 2011, we were able to create the CLI only with the length of Q1 2003-Q4 2011.

Table 12. Composition of the CLI for Poland and Slovakia

CLI	CLI composition
POLAND (Variant CLI3/CLIC)	▪ Manufacturing production, 2005=100; ▪ Monetary aggregate M1, 2005=100; ▪ Warszawski Indeks Giełdowy, 2005=100; ▪ Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; ▪ Construction confidence indicator.
SLOVAKIA (Variant CLI1/CLIA)	▪ Gross fixed capital formation, euro; ▪ Goods and services export, mils euro; ▪ Total industrial production, 2005=100; ▪ Industrial turnover (intermediate product and capital goods), domestic market, 2005=100; ▪ Consumer confidence indicator; ▪ Market capitalization, mils eur.

Source: authors´ calculation

Table 12 displays different composition as well as different number of components of the CLIs in Poland and Slovakia. We can see that CLIs for these countries have components from industry or stock market but these components are not the same. It expresses differences in business cycles of Poland and Slovakia which we can see in the composition of CLIs. For example, the Slovak CLI comprises export of goods and services, yet this indicator is not included in the Polish CLI. This finding is consistent with macroeconomic reality as Slovak economy is more open than Polish one.

Figures 5 and 6 represent evolution of the CLIs created by us and GDP cyclical component at the equal and different weights for each country.

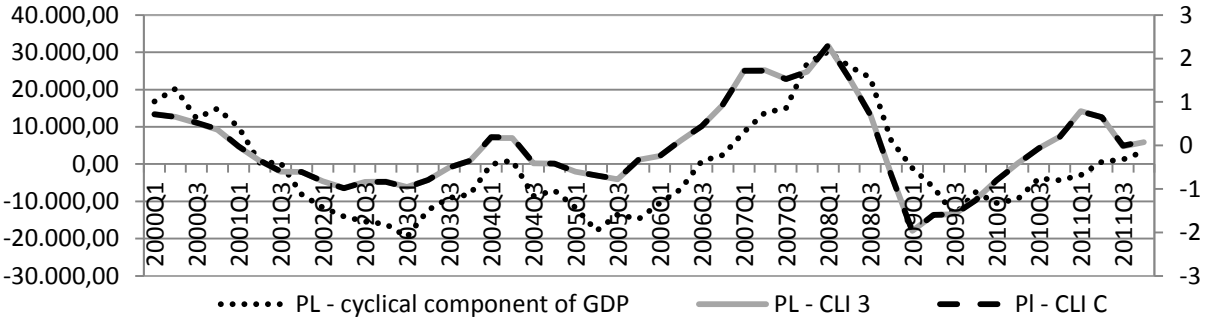


Figure 5. Evolution of our CLI (equal and different weights) and of GDP at constant prices of 2005 (cyclical component) in Poland

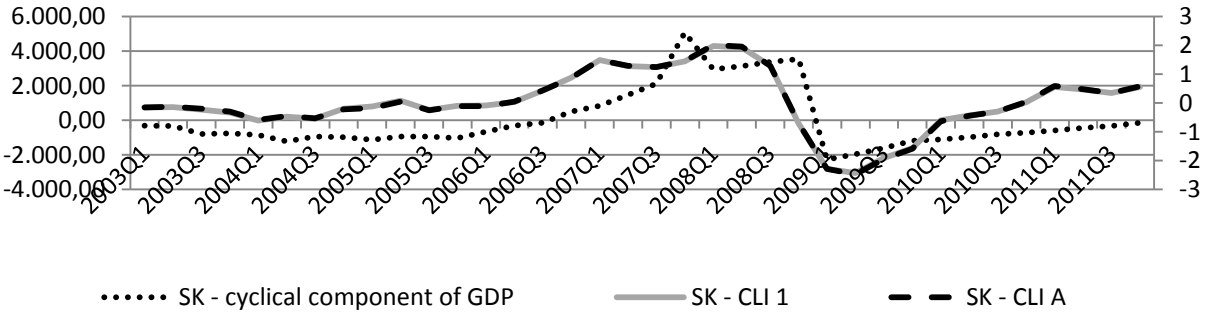


Figure 6 - Evolution of our CLI (equal and different weights) and of GDP at constant prices of 2005 (cyclical component) in Slovakia

Figures 5 and 6 demonstrate that our CLIs have the ability to lead before GDP of the given country. We can observe that the CLI evolution in Slovakia and Poland is substantially smoother and also better copies GDP evolution than it was in the case of the OECD's CLI or the Eurostat's CLI. That also relates to the fact that the CLIs created by us show lower number of the false signals about the future situation in the business cycles of researched countries.

After we had created the CLI for Slovakia and Poland, calculated the cross-correlations and graphically presented the CLIs' and reference series' evolution, we can summarize that our CLIs have the ability of the short term prediction of the Polish and Slovak business cycles and therefore it is appropriate to use them for such prediction.

5. Comparison of our CLIs and the Eurostat's and OECD's CLIs

Besides the cross-correlations calculation of our CLIs, we calculated the cross-correlations for the OECD's and the Eurostat's CLIs, too. The summary of the results is reported in Table 13.

Table 13. Cross-correlation comparisons of the OECD's CLI, the Eurostat' CLI and our CLI

CLI		POLAND	SLOVAKIA
Eurostat (1996-2011)	Lead in quarters	2	1
	Correlation coefficient	0,798	0,671
Eurostat (2005-2011)	Lead in quarters	2	1
	Correlation coefficient	0,834	0,671
OECD monthly data (1995-2011)	Lead in months	7	0
	Correlation coefficient	0,489	0,532
OECD monthly data (2005-2011)	Lead in months	7	0
	Correlation coefficient	0,694	0,718
OECD quarterly data (2000-2011)	Lead in quarters	3	0
	Correlation coefficient	0,629	0,641
Our calculation – equal weights*	Lead in quarters	1	1
	Correlation coefficient	0,867	0,821
Our calculation – equal weights (2005-2011)	Lead in quarters	2	1
	Correlation coefficient	0,885	0,818
Our calculation – different weights*	Lead in quarters	1	1
	Correlation coefficient	0,866	0,820
Our calculation – different weights (2005-2011)	Lead in quarters	2	1
	Correlation coefficient	0,884	0,818

Notes: * PL (2001-2011), SK (2003-2011)
Source: authors´ calculation

Based on the results shown in Table 11, we drew the following conclusions:

- the Eurostat's CLI, as the indicator reporting the lead before the business cycle evolution of the given country is the least suitable for Slovak cycles. The Eurostat's CLI is much more suitable for the monitoring of Polish cycles;
- the composition of the OECD's CLI is not appropriate for the prediction of the business cycle in Slovakia. It suits better for Poland;
- when comparing the Eurostat's CLI, the OECD's CLI and the CLI created by us, the CLIs created by us are the most appropriate for the short term prediction of the business cycle in Slovakia and Poland (if we evaluate the suitability based on the maximal value of the cross-correlation in the lead time), independently of the length of the time series, from which the correlations were calculated.

Conclusion

Our paper focuses on the formulation of the composite leading indicators for the short term prediction of the business cycles in Poland and Slovakia. We found out that the CLIs are generally an appropriate tool for the prediction of the cyclic behavior of economy; however, their composition must be adjusted to the economic particularities of a given country. By applying the selected approach, we created such CLIs for Poland and Slovakia, which are able, by their compositions, predict the business

cycles more precisely than the CLIs used by the Eurostat or the OECD. That does not mean that we consider the CLIs of these institutions as completely inappropriate. On the contrary, we recommend the simultaneous combination of the CLIs created by us and the CLIs of the Eurostat and the OECD. Consequently, false signals of the individual CLIs can be minimized.

Nevertheless, in the case of Slovakia, we would use the OECD's CLI rather under the form of a coincident than a leading composite indicator. Creation of our own CLIs has proved that in spite of different CLIs composition, several common features can be found in Poland and Slovakia.

The indicators of stock market or industrial indicators are appropriate for the business cycles prediction in Poland and Slovakia. This means that business cycles in Poland and Slovakia can be predicted through similar economic indicators. In general, if this composition was the same (as it is in the case of the Eurostat's CLI), we would not reach such good predictive abilities as we can get at the different composition of the CLI that we created. The selection of the components of the CLI has to be done very strictly; as other compositions do not guarantee better predictive abilities (see the OECD's CLI for Slovakia).

References

[1] Bartóková, L. (2012). Effects of Single Monetary Policy on the Selected Economic and Monetary Union Countries (Case of so Called "PIIGS" Countries), in: *Journal of Applied Economic Science*, 7(4): 351-360.

[2] Benčík, M. (2011). *Synchronizácia hospodárskych cyklov krajín V4 a eurozón: Výskumná štúdia*, Národná banka Slovenska, Working Paper 2011-1.

[3] Beneš, J., N´ Dialye, P. (2004). *A Multivariate Filter for Measuring Potential Output and the NAIRU: Application to the Czech Republic*, IMF, Working Paper 2004-45.

[4] Bezděk, J., Dybczak, A., Krejdl, A. (2003). *Czech Fiscal Policy: Introductory Analysis*, Czech National Bank, Working Paper 2003-7.

[5] Boschan, C., Ebanks, W.W. (1978). *The Phase Average Trend: A new way of Measuring Economic Growth*, Proceeding of the business and economic statistics section.

[6] Czesaný, S., (2006). *Hospodářsky cyklus*, Praha: Linde.

[8] Everts, M.P. (2006). *Measuring Business Cycles*, Berlin: Verlag im Internet GmbH.

[9] Fabiani, S., Mestre, R. (2000). *Alternative Measures of the NAIRU in the Euro area: Estimates and assessment*, European Central Bank, Working Paper 2000-17.

[10] Frankel, J.A., Rose, A.K. (1998). *The Endogeneity of the Optimum Currency Area Criteria*, in: *Economic Journal*, 108(449): 1009-1025.

[11] Kľúčik, M. (2009). *Composite Reference Series and Composite Leading Indicator for Slovakia*, The First Macroeconomic Forecasting Conference - MFC.

[12] Gyomai, G., Guedette, E. (2012). *OECD System of Composite Leading Indicator*, Paris: Organization for Economic Cooperation and Development.

[13] Hodric, R. J., Prescott, E. C. (1997). *Postwar U.S. Business cycles: an Empirical Investigation*, in: *Journal of Money credit and banking*, Vol. 29, No. 1, pp.1-16.

[14] Kranendonk, H., Bonenkamp, J., Verbruggen, J. (2005). *A Leading Indicator for the Dutch Economy: A Methodological and Empirical Revision of the CPB System*, Heidelberg: Physica Verlag.

[15] Kydland, F., Prescott, E. (1990). *Business Cycles: Real Factsanda Monetary Myth*, Federel Reserve Bank of Minneapolis, Quarterly Review 1990-1.

[16] Luboš, M. *et al*. (2007). *Statistika pro ekonomy*. Praha: Professional Publishing.

[17] Macháčková, L., Czesaný, S., Sedláček, P. (2007). *Monitorování a analýza hospodářského cyklu*. Praha: Český statistický úrad.

[18] Mestre, I.T. (2007). *Indicator approach to business cycle analysis*, in: *Fascicle of Management and Technological Engineering*, 6(16).

[19] Mirdala, R. (2012). *Interest Rates Determination and Crisis Puzzle (Empirical Evidence from the European Transition Economies)*, in: *Journal of Applied Economic Science*, 7(4): 418-436.

[20] Moore, G.H. (1961). *Business Cycle Indicators, Contributions to the Analysis of Current Business Conditions*, Princeton University Press.

[21] Nardo, M., Saisana, M. (2005). *Handbook on Constructing Composite Indicators: Methodology and User Guide*, OECD, Statistics Working Papers 2005-3.

[22] Nilsson, R. (2000).*Confidence indicators and composite indicators*, OECD, Working Paper.

[23] Nilsson, R., Gyomai, G. (2007). *Cycle extraction: A comparison of the PAT method, the Hodrick-Prescott and Christiano-Fitzgerald filters*, OECD, Working Paper.

[28] Ozyildirim A., Schaitkin B., Zarnowitz V. (2009). *Business Cycles in the Euro Area Defined with Coincident Economic Indicators and Predicted with Leading Economic Indicators,* Luxembourg: 5th Eurostat Colloquium on Modern Tools for Business Cycle Analysis.

[29] Schilcht, E. (2005). *Estimating the smoothing parameter in the so-called Hodrick-Prescott filter*, in: *Journal of the Japanese Statistical Society*, 35(1): 99-119.

[30] Šoltés, V., Šoltés, M. (2003). Foreign direct investments and their impact on economic growth in Slovakia. *Technical and economical problems*. 48(2): 605-613.

[31] Tkáčová, A. (2012a). *Metódy tvorby kompozitného indikátora pre Českú republiku a Slovensko,* in: *Ekonomika, management, inovace*, 4: 43-54.

[32] Tkáčová, A. (2012b). *Kompozitný predstihový indikátor hospodárskeho cyklu českej ekonomiky,* in: *Politická ekonomie*, 16(5): 590-613.

[33] Trimbur, T.M. (2006). *Detrending economic time series: a Bayesian generalization of the Hodrick-Prescott filter. Journal of Forecasting*, 25(4): 247-273.

[34] Zimková, E., Barochovský, J. (2007). *Odhad potenciálního produktu a produkčnej medzery v slovenských podmienkach,* in: *Politická ekonomie*, 11(4): 473-489.

*** Economic Cycle Research Institute. (2012). *Turning Points & Leading Indicators.* New York: Economic Cycle Research Institute.

*** OECD, (2004), *The OECD-JRC Handbook on Practices for Developing Composite Indicators.* Paris: OECD Committee on Statistics.

*** OECD, (2008), *Handbook on Constructing Composite Indicators: Methodology and User Guide*, Paris: OECD Publishing.

*** OECD, (2012), *Glossary for OECD Composite Leading Indicators*, Paris: OECD Publishing.

*** OECD, (2013), *Main economic indicator: Composite leading indicators*, Paris: OECD Publishing.

The 6th Online International Conference on „Advanced Researches in Management, Finance and Accounting" Craiova, Romania, 22th November, 2013

Maintaining the tradition of annual conferences, Faculty of Financial Accounting Management and CESMAA organize this year the International Conference dedicated to the *„Advanced Researches in Management, Finance and Accounting".* Each year, Research Center, CESMAA of Faculty of Accounting and Financial Management, Craiova provides an opportunity to meet and network with a diverse range of industry leaders and senior professionals through the academic area from the entire world of Economic Sciences.

To resolve the funding issue concerning the conference expenses, European Research Center of Managerial Studies in Business Administration will organize, in 22th November, an online session as an alternative approach for participation. Those who would attend to International online conference will be awarded with a certificate and their accepted papers will be considered for publications in Journal of Applied Economic Sciences and Journal of Applied Research in Finance.

Conference aims is to promoting research and provides an opportunity for intensive interdisciplinary interaction and debate between academics and practitioners with research interests in the field of economics, finance, accounting, business, marketing, management, and information technology. The conference has grown over the years and now attracts researchers of major institutions internationally.

CALL FOR PAPERS:

The conference provides a forum for disseminating new research findings, practices and techniques in management, finances, accounting, business, marketing, international affairs and information technology and exchanging ideas among academicians and practitioners to promote a better understanding of contemporary issues and solutions to the challenges. This conference would encourage the young generation to pursue research interests in the areas of economic sciences.
Academicians and researchers are invited to share their unpublished research findings in all areas mentioned below, but are not limited to:

- Accounting Challenges – Strategic Accounting;
- Management Control Systems;
- Creative Accounting and Earnings; Management;
- Forensic Accounting and Fraud;
- Tax Accounting and Fraud;
- Prevention of fraud and unacceptable accounting practices;
- Information security audits;
- Best Practices in Corporate Governance;
- Asset-liability management;
- Bank assurance;
- Corporate finance;
- Credit risk modelling and management;
- Financial engineering;
- Foreign exchange markets;
- Law and finance;
- Mergers and acquisitions;
- Mutual funds management;
- Portfolio management;
- Regulations of financial markets;
- Accounting and Finance;
- Accounting, Auditing and Performance; Evaluation;

- Banking crises;
- Organizational Reengineering;
- Efficiency and performance of financial institutions and bank branches;
- Financing decisions of banks;
- Investment banking;
- Management of financial institutions;
- Regulation and supervision of the banking industry, both nationally and internationally;
- Technological progress and banking;
- The role of central banks;
- Accountability;
- Accounting standards and regulations;
- Environmental accounting;
- Financial accounting;
- Management accounting;
- Risk management and internal control;
- Social accounting;
- Asset pricing;
- Bankruptcy prediction and determinants;
- Auditing Technology;
- Banking, Accounting and Finance;
- Behavioral Accounting and Finance;
- Corporate Governance;
- Business Intelligence;
- Economics and Accounting;
- Education Economics and Development;
- Electronic Banking;
- Electronic Finance;
- Financial Markets and Derivatives;
- Financial Services Management;
- Culture and Business Management;
- Managerial and Financial Accounting;
- Monetary Economics and Finance;
- Revenue Management;
- Strategic Engineering Asset Management;
- Applied Economic Studies;
- Complexity in Business and Economics;
- Business and Economics Engineering;
- Experimental Design and Process Optimization;
- Product Development.

Papers have to submit electronically at this e-mail address cesmaa_research@yahoo.co.uk in MS Word also in PowerPoint format (see Instructions for Authors). All papers are double peer reviewed by members of the Scientific Committee. Papers accepted will be published in official Conference eProceedings on CD, which will have assigned ISBN. Papers received after the deadline will not be included in the proceedings.

The best papers will be published in **Journal of Applied Economic Sciences** http://www.cesmaa.eu/journals/jaes/index.php which is indexed in SCOPUS, RePEc, CEEOL, Index Copernicus and EBSCO databases as well as in **Journal of Applied Research in Finance** (http://www.cesmaa.eu/journals/jarf/index), also indexed.

Important Dates:

- 20 October, 2013 - Abstract submission deadline;
- 25 October, 2013 - Notification of acceptance/rejection;
- 5 November, 2013 - Deadline for payments and Final paper submission deadline;
- 22 November, 2013 – Conference.

Conference Fee covers conference materials, (book of abstracts, eProceedings, Certification of participate).

- **100 Euro** for foreign participants;
- **200 Lei/paper** for Romanians participants;
- **50 Lei/paper** for CESMAA members.

Payment will be to perform immediately after notification of acceptance of your paper until 2013, November 5. All fees derived by the bank transfer will be supported by the sender.
Bank: Raiffeisen Bank – Victoria Agency
IBAN ACCOUNT for EURO: RO 25RZBR0000060014384461
IBAN ACCOUNT for LEI: RO 04RZBR0000060014384451

Account holder: Spiru Haret University, Central Research Institute
Address: No.1, Tineretului *Street*, District 4, Bucharest, Romania

Please mention on the payment form that the fee is for the CESMAA Conference and your name (*e.g. CESMAAConference_2013_Smith*).
It is essential to send a copy of Payment Form (Bank Transfer):

- copy by fax: 40 251 598265;
- or a scanned copy by email to: cesmaa_research@yahoo.co.uk

For more details please visit our conference`s website at: http://www.cesmaa.eu/conferences