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JOURNAL of Applied Economic Sciences

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EVALUATION OF RANDOMIZED RESPONSE MODELS FOR THE MEAN AND USING DATA ON INCOME AND LIVING CONDITIONS

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Abstract:

The surveys on Income and Living Conditions carried out by the statistical agencies of many countries may contain sensitive questions, which can induce the respondent to give a false answer or no answer. Although the most common technique to treat this is the imputation, the randomized response techniques can also be used. In this paper we evaluate the performance of two randomized response models to estimate the population mean with real data obtained from the 2012 Spanish Survey on Income and Living Conditions. For this purpose, Monte Carlo simulation studies are carried out. Empirical results indicate that no estimator presents bias when individuals provide the true answers while the direct estimator presents a large bias when providing false answers. We also observe that one of the estimators based on randomized response models is more efficient than the other.

Keywords: sensitive questions, randomized response models, Monte Carlo simulation, survey on income and living conditions.

JEL Classification: A10, C15, C46, D10

1. Introduction

The statistical agencies of many countries carry out regular surveys in order to analyze the income and expenditure of households, and other variables related to living conditions. The information collected in these surveys has multiple applications, such as the calculation of the National Accounts, the Consumer Price Index (CPI), the poverty indicators such as the poverty line or the proportion of poor, etc. In this type of survey may be *sensitive questions*, i.e., questions that by their nature can induce the respondent to give a false answer or no answered. This fact is usually treated by imputation, assigning values that are within the possible values taken by the variable with no response. However, it is also possible to use randomized response techniques.

The purpose of this study is to evaluate the performance of two randomized response models, described in Section 3, for the problem of estimating the population mean with real data obtained from the 2012 Spanish Survey on Income and Living Conditions (ES-SILC) and verify if they produce similar results. For this, Monte Carlo simulation studies are carried out. Results derived from these simulation studies are shown in Section 4. Finally, this paper concludes with some discussions in Section 5.

2. Estimation on sensitive questions

A sensitive question is one whose response is susceptible or prone to be modified or not given, being this change in the response or the lack of it due to the fact that the interviewee, for personal reasons, does not wish to provide the true answer to the question.

To conduct a study containing sensitive questions has numerous consequences. For example, in the scenario of respondents who provide other responses to sensitive questions, it is obvious that one of the most important consequences is to obtain results and conclusions different from those that really should be obtained. Statistically, this results in estimates with a large bias and a significant decrease in efficiency (see, for instance, Diana and Perry 2010). Regarding the other possible scenario, the lack of response to sensitive questions, bias in the estimates will appear and, in general, the results and the conclusions will be less reliable (Hu, Salvucci and Lee 2001; Little and Rubin 2002).

The most used and accepted quantitative techniques for the treatment of answers to sensitive questions are known as randomized response techniques. These techniques were proposed by Warner (1965) and consist in using a method of randomization, so that only the respondent knows the result of the random experiment or the device that generates a random assignment. Based on this result, the respondent will have to respond the true answer to the sensitive question or another specified random answer according to the randomized response method used. Therefore, the interviewer has no option to know the true answer of the respondent, ensuring the anonymity of the real answer, i.e., this method ensures that the respondents cannot be identified through their responses.

From the work of Warner (1965), many mechanisms, models and techniques have been proposed in order to increase the privacy protection and reduce both the rate of non-response and the bias in the estimates. Some important references are: Fox and Tracy (1986), Chaudhuri and Mukerjee (1988), Mangat and Singh (1990), Hedayat and Sinha (1991), Bhargava and Singh (2000), Chaudhuri (2004), Shabbir and Gupta (2005), Huang (2006), Saha (2006), etc.

The early works on randomized response techniques used only the information provided by the variable under study. In sampling practice, the direct techniques to collect information on non-sensitive characters make massive use of other variables, called *auxiliary variables*, which can be used to improve the sampling design or in the estimation phase in order to improve the accuracy in the estimation of population parameters (see, for example, Cochran 1977; Fernandez and Mayor 1994; Kish 1965; Särndal, Sweensson and Wretman 1992; Singh 2003). Despite the wide variety of techniques developed to estimate the parameters in the presence of auxiliary information, in the literature there are very few methods proposed for the estimation of parameters using together randomized response techniques and auxiliary variables. Some relevant references in this regard are Chaudhuri and Mukerjee (1988), Grewal, Bansal and Sidhu (2006) and Bouza (2010). For example, Zaizai (2006) uses auxiliary information directly at the stage of estimation, improving the Warner estimator through the ratio method.

Among the applications of the randomized response techniques it is worth noting the possibility of using them in the Surveys on Household Budget, Income and Living Conditions. These surveys include questions about income and expenditures, which may be considered as sensitive questions for certain individuals. In particular, economic variables, such as income, can be given as quantitative variables, but they can also be classified by intervals. In the latter case, for example, the interviewee may be tempted to answer a lower income category than that which actually belongs to him/her. Specifically, in such surveys the quantitative techniques and the models for the estimation of two parameters might be applied: the proportion of individuals who possess a certain sensitive attribute and the mean of the variable related to the sensitive question.

On the one hand, with regard to the estimation of the proportion, Warner (1965) was the first author who proposed that the information provided on the sensible attribute of each respondent was related to a randomization device. This method assumes a simple random sample with replacement of size n and an unbiased estimator.

The first alternative to the Warner method, in order to improve the cooperation with the interviewee, is known as Simmons model. This technique, first proposed by Horvitz, Shah and Simmons (1967) and later developed by Greenberg *et al.* (1969), is also based on the simple random sampling with replacement, but allows the respondent to answer one of two questions posed by the interviewer.

After these early works, note for example Kim (1978), who selects respondents from independent subsamples using simple random sampling without replacement; Singh (2003), who proposes two new randomized response models; and Diana and Perry (2009), who present a randomized response model based on auxiliary information.

On the other hand, regarding the estimation of the mean, the most relevant models are those proposed by Eichhorn and Hayre (1983) and Bar-Lev, Bobovitch and Boukai (2004); both of them are described in Section 3. The evaluation of the performance of these randomized response models based on real data obtained from the 2012 Spanish Survey on Income and Living Conditions is the main objective of this paper.

Although the randomized response models for the estimation of means proposed by Eichhorn and Hayre (1983) and Bar-Lev *et al.* (2004) are the best known and those that we will use to perform the Monte Carlo simulation studies, other randomized response mechanisms exist in the literature, such as those proposed by Eriksson (1973), Pollock and Bek (1976), Padmawar and Vijayan (2000), Gupta, Gupta and Singh (2002), Grewal *et al.* (2006), Singh and Mathur (2005), Ryu *et al.* (2006), Saha (2006), Gjestvang and Singh (2007), Pal (2008), Diana and Perry (2010), etc.

3. Randomized response models to estimate the mean

Let *X* be the random variable of interest and *Z* the random variable which denotes the random number used in a mechanism that generates a code. Thus, the respondent has the option, depending on the model used, to give a randomized answer using the true value *X* (the answer to the sensitive question) and the code or random number *Z*. The following conditions are assumed:

(C1). The variable *X* is not negative, that is, X≥0.

(C2). The variables X and Z are independent.

The aim of this section is to estimate the mean of the variable of interest *X*, i.e., to estimate $\mu_X = E(X)$.

The variance of the variable *X* can be written as $\sigma_X^2 = V(X)$. Moreover, the mean and the variance of the variable *Z* are given by $\mu_Z = E(Z)$ and $\sigma_Z^2 = V(Z)$. Finally, we assume that

$$c_X = \frac{\sigma_X}{\mu_X} \quad ; \quad c_Z = \frac{\sigma_Z}{\mu_Z} \tag{1}$$

are, respectively, the variation coefficients of the variables *X* and *Z*.

3.1 The Eichhorn and Hayre Model

Eichhorn and Hayre (1983) propose an appropriate randomized response model for the problem of estimating the mean of the variable of interest *X*. In this method, interviewees can respond to the sensitive question with a code, which is obtained after multiplying the true value of the variable of interest by some type of random number, that is, the encoded response provided by the respondent is given by $Y = Z \times X$.

Also, it can be seen that:

$$E(Y) = \mu_X \mu_Z \tag{2}$$

$$V(Y) = \sigma_X^2 \mu_Z + \mu_X^2 (1 + c_X^2) \sigma_Z^2 \tag{3}$$

Let $(Y_1, \ldots Y_n)$ be the coded responses from *n* individuals interviewed and selected by simple random sampling with replacement. The estimator of the mean proposed is:

$$\hat{\mu}_X^{EH} = \frac{\bar{Y}}{\mu_Z} \tag{4}$$

where $\bar{Y}$ is the arithmetic mean of the *n* coded responses. Eichhorn and Hayre (1983) show that the estimator $\hat{\mu}_X^{EH}$ is unbiased and its variance is given by:

$$V(\hat{\mu}_X^{EH}) = \frac{1}{n}[\sigma_X^2 + \mu_X (1 + c_X^2) c_Z^2] \tag{5}$$

It can also be seen that the variance $V(\hat{\mu}_X^{EH})$ is greater than the variance resulting from a simple random sample with replacement and non-random response, i.e.

$$V(\hat{\mu}_X^{EH}) > \frac{\sigma_X^2}{n} \tag{6}$$

3.2 The Bar-Lev, Bobovitch and Boukai Model

The model proposed by Bar-Lev *et al.* (2004) combines the randomized response mechanisms proposed by Warner (1965) and Eichhorn and Hayre (1983). In this model there is an additional random mechanism that incorporates a new parameter in the model, *p*, *where* $0 < p < 1$. The response provided by the respondent consists as follows: with probability *p* the individual will respond the true value to the sensitive question, i.e. *X*, whereas with probability $1 - p$ the interviewee will provide the randomized code proposed by Eichhorn and Hayre (1983). Mathematically, the randomized response provided by Bar-Lev *et al.* (2004) is given by:

$$Y = \begin{cases} X & \text{with probability } p \\ ZX & \text{with probability } 1 - p \end{cases} \quad (7)$$

In this case, the mean and the variance of the variable *Y* are given by:

$$E(Y) = \mu_X(p + \mu_Z(1-p)) \quad (8)$$

$$V(Y) = \mu_X^2(1 + c_X^2)\left[p + \mu_Z^2(1 + c_Z^2)(1-p)\right] - \mu_X^2\,(p + \mu_Z(1-p))^2 \quad (9)$$

And the estimator of the parameter μ_X proposed can be expressed by:

$$\hat{\mu}_p^B = \frac{\bar{Y}}{p+\mu_Z(1-p)} \quad (10)$$

We can see that the estimator $\hat{\mu}_p^B$ depends on the parameter *p*. Bar-Lev *et al.* (2004) show that $\hat{\mu}_X^B$ is an unbiased estimator and its variance is given by:

$$V(\hat{\mu}_X^B / p) = \frac{1}{n}\left[\sigma^2 + \mu_X^2\,(1 + c_X^2)\,c_Z^*(p)\right] \quad (11)$$

$$\textit{where:} \quad c_Z^*(p) = \frac{p+E(Z^2)(1-p)}{(p+\mu_Z\,(1-p))^2} - 1 \quad (12)$$

Under certain conditions, Bar-Lev *et al.* (2004) note that the variance of their estimator is smaller than the variance of the estimator $\hat{\mu}_X^{EH}$ proposed by Eichhorn and Hayre (1983). Also, for large sample sizes, Bar-Lev *et al.* (2004) propose a confidence interval for μ_X using the approximation to the normal distribution.

4. Monte Carlo simulations

The Eichhorn and Hayre model and the Bar-Lev *et al.* one have in common the use of the variable *Z*, whose data are generated by any random process. In the present simulation study this variable *Z* is generated from two different distributions, but with the same mean and variance: 10 and 4, respectively. As distributions to generate *Z*, we use the normal and the uniform distributions. Hence this study also allows ascertaining whether there are significant differences in the behavior of the estimators when using each distribution. Obviously, the normal distribution is generated with parameters 10 and 4 for the mean and the variance, respectively. Regarding the uniform distribution, from the properties of this distribution it is easy to see that parameters are 6.54 and 13.46, *i.e.*, a uniform distribution defined on the interval (6.54, 13.46). In order to get a rough idea of the range of values they can take, the generated values of the normal distribution with mean 10 and variance 4 are shown in Table 1.

Table 1 - Symmetrical intervals respect to the mean of the normal distribution (*mean* 10 and *variance* 4)

Interval	Probability (%)
(6.71,13.29)	90.0
(6.08,13.92)	95.0
(4.85,15.15)	99.0
(4.39,15.61)	99.5

From Table 1 we can observe that 90% of the normal distribution values are closer to the mean than the range of values set in the uniform distribution. Broader intervals are obtained when considering over 95% of the data from the normal distribution compared with the uniform distribution.

The Monte Carlo simulation study is based on selecting samples with size $n = \{50, 200\}$. In addition, in this study we use two new concepts: *F* and *D*. *F* is the proportion of individuals in simulation who provide false answers. For example, *F* = 10% indicates that 10% of individuals in the sample provide false answers. Meanwhile when an individual gives a false answer *D* is the difference, in percentage, between the true response of the individual and the false answer provided to the interviewer.

In this simulation study we assume that respondents only provide false answers when they have to respond directly to the sensitive response, i.e., respondents always provide true answers when a randomized response method is applied. Considering the population from the Spanish Survey on Income and Living Conditions, as the variable of interest is 'income', we will assume that false answers will be lower than the true ones because it is reasonable to think that an individual declares to have lower incomes than those which he/she really has, being the opposite situation less likely. Therefore, if an individual has an income of 1,000 euros and in the interview declares to have an income of 800 euros, the value of *D* will be 20%, that is, he/she responds with a difference of 20% respect to the true value.

The relative bias (*RB*) and the relative root mean square error (*RRMSE*) are the empirical measures used to compare the behavior of the various estimators of the unknown parameter μ. These measures are defined as

$$\text{RB} = \frac{E(\hat{\mu})-\mu}{\mu} \tag{13}$$

$$\text{RRMSE} = \frac{\sqrt{MSE(\hat{\mu})}}{\mu} \tag{14}$$

where $\hat{\mu}$ denotes a given estimator of the parameter μ. $E(\hat{\mu})$ and $MSE(\hat{\mu})$ are, respectively, the empirical expectation and the empirical mean square error based on R = 1000 independent samples selected in the Monte Carlo simulation.

These empirical measures are likely the most used for the problem of evaluating estimators. For example, these measures have been used by Rao, Kovar and Mantel (1990), Silva and Skinner (1995), Chen and Sitter (1999), etc. In this study we use the direct estimator $\bar{x}$, i.e., the sample mean of the responses obtained from the sensitive question. Alternatively, the estimators $\hat{\mu}^{EH}$ and $\hat{\mu}_p^B$ are also obtained based on randomized response models. For the estimator $\hat{\mu}_p^B$ we consider the values $p = (0.25, 0.5, 0.75)$, which also serve to analyze possible differences between the various values of *p* that have been considered.

The results from the Monte Carlo simulation study are shown below. Tables 2 and 3 contain the results from the 2012 Spanish Survey on Income and Living Conditions (ES-SILC) population, while the results obtained from the normal distribution can be seen in Tables 4 and 5.

We first analyze the bias obtained from the ES-SILC population (Table 2). When the values of *F* (percentage of false responses) and *D* (difference, in percentage, between the true answer and that provided to the interviewer) are 0, the bias obtained in the various estimators is negligible, since in any case is less than 1% in absolute terms. Note that this situation (*F* and *D* equal 0) indicates that no respondents provide a false answer. If *F* and *D* increase to 10%, the bias of the direct estimator $\bar{x}$ does not increase significantly, but in other cases significant bias for this estimator can be seen. For example, when *F* = 50% and *D* = 20% negative bias up to 25% can be obtained. In terms of bias, no differences between the selected sample sizes are observed, between the different values of *p* used in the estimator $\hat{\mu}_p^B$, or between the probability distributions considered (normal and uniform) for the variable *Z*.

Table 2 - Relative bias (RB) for the estimators of the mean from the Spanish survey on income and living conditions population

		$n = 50$					$n = 200$				
F	D	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$
0	0	0.05	*0.04*	*0.03*	*-0.12*	*0.08*	-0.04	*-0.02*	*-0.04*	*-0.06*	*0.03*
		0.05	**0.01**	**-0.01**	**-0.13**	**0.08**	-0.04	**-0.07**	**-0.10**	**-0.10**	**0.02**
10	5	-0.95	-	-	-	-	-1.04	-	-	-	-
	10	-1.95	-	-	-	-	-2.04	-	-	-	-
	20	-4.96	-	-	-	-	-5.04	-	-	-	-
20	5	-1.95	-	-	-	-	-2.04	-	-	-	-
	10	-3.95	-	-	-	-	-4.04	-	-	-	-
	20	-9.94	-	-	-	-	-10.04	-	-	-	-
50	5	-4.95	-	-	-	-	-5.04	-	-	-	-
	10	-9.97	-	-	-	-	-10.04	-	-	-	-
	20	-24.97	-	-	-	-	-25.02	-	-	-	-

Note: The variable Z is obtained from the uniform distribution (italics) and the normal distribution (bold). The values of F, D and RB are shown in percentage.

In Table 3 we analyze the efficiency, in terms of RRMSE, of the estimators considered in the Monte Carlo simulation study. When individuals provide always true answers ($F = D = 0$), the direct estimator $\bar{x}$, which is not based on randomized response methods, is more efficient than the other estimators. Even when $F = 10\%$ and $D = 5\%$ the direct estimator is still the most efficient. In all cases, regardless of the value of the parameter p, the RRMSE is smaller for the Eichhorn and Hayre estimator than for compared with the estimator of the Bar-Lev *et al.* estimator.

Table 3 - Relative root mean square error (RRMSE) for the estimators of the mean from the Spanish survey on income and living conditions population

		$n = 50$					$n = 200$				
F	D	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$
0	0	5.54	*6.36*	*10.08*	*14.26*	*19.83*	2.76	*3.17*	*5.01*	*7.06*	*9.80*
		5.54	**6.34**	**10.09**	**14.17**	**19.79**	2.76	**3.16**	**5.00**	**7.04**	**9.81**
10	5	5.57	-	-	-	-	2.93	-	-	-	-
	10	5.78	-	-	-	-	3.39	-	-	-	-
	20	7.29	-	-	-	-	5.70	-	-	-	-
20	5	5.77	-	-	-	-	3.39	-	-	-	-
	10	6.65	-	-	-	-	4.84	-	-	-	-
	20	11.17	-	-	-	-	10.36	-	-	-	-
50	5	7.23	-	-	-	-	5.68	-	-	-	-
	10	11.16	-	-	-	-	10.34	-	-	-	-
	20	25.35	-	-	-	-	25.12	-	-	-	-

Note: The variable *Z* is obtained from the uniform distribution (italics) and the normal distribution (bold). The values of *F*, *D* and *RRMSE* are shown in percentage.

Regarding the distributions considered in order to generate the variable *Z*, we observe that there is no significant difference, in terms of efficiency, between the results obtained from the normal distribution and those obtained from the uniform distribution. As expected, all estimators are more efficient as the sample size increases. Finally, we note that the estimator $\hat{\mu}_p^B$ is more efficient for smaller values of *p*.

Note that although the randomized response models may be less efficient than the direct estimator, we must remember that under the situations discussed in this paper, such estimators based on random models present a negligible bias, unlike the direct estimator that can present negative biases up to 25%.

Moreover, in order to examine if the above results would be similar in other scenarios, the Monte Carlo simulation study was repeated but using data generated from the normal distribution, instead of the real data extracted from the ES-SILC population. The results of this new simulation study can be found in Tables 4 and 5. From these results very similar findings can be observed compared with those from the ES-SILC population.

Table 4 - Relative bias (RB) for the estimators of the mean from the normal distribution

F	*D*	$n = 50$					$n = 200$				
		$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^B_{0.25}$	$\hat{\mu}^B_{0.5}$	$\hat{\mu}^B_{0.75}$	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^B_{0.25}$	$\hat{\mu}^B_{0.5}$	$\hat{\mu}^B_{0.75}$
0	0	0.02	*0.05*	*0.07*	*0.00*	*0.00*	0.00	*0.01*	*0.04*	*0.00*	*-0.08*
		0.02	**-0.01**	**0.00**	**-0.05**	**-0.03**	0.00	**-0.03**	**0.00**	**-0.05**	**-0.09**
10	5	-0.98	-	-	-	-	-1.00	-	-	-	-
	10	-1.98	-	-	-	-	-2.00	-	-	-	-
	20	-4.98	-	-	-	-	-5.00	-	-	-	-
20	5	-1.98	-	-	-	-	-2.00	-	-	-	-
	10	-3.98	-	-	-	-	-4.00	-	-	-	-
	20	-9.98	-	-	-	-	-10.00	-	-	-	-
50	5	-4.98	-	-	-	-	-5.00	-	-	-	-
	10	-9.98	-	-	-	-	-10.00	-	-	-	-
	20	-24.99	-	-	-	-	-25.00	-	-	-	-

Note: The variable *Z* is obtained from the uniform distribution (italics) and the normal distribution (bold). The values of *F*, *D* and *RB* are shown in percentage.

From Table 4 we can observe again that the bias obtained in the various estimators is insignificant when the values of *F* and *D* are 0. If *F* and *D* increase to 10%, the bias of the direct estimator $\bar{x}$ does not increase significantly, but in the other cases significant bias for this estimator can be seen, reaching negative values up to 25% when *F* = 50% and *D* = 20%. Besides, no significant differences are observed between the results for the selected sample sizes, for the different values of *p* used in the estimator $\hat{\mu}_p^B$ or for the probability distributions considered to generate the variable *Z*.

Table 5 - Relative root mean square error (RRMSE) for the estimators of the mean from the normal distribution

		$n = 50$					$n = 200$				
F	D	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$	$\bar{x}$	$\hat{\mu}^{EH}$	$\hat{\mu}^{B}_{0.25}$	$\hat{\mu}^{B}_{0.5}$	$\hat{\mu}^{B}_{0.75}$
0	0	1.43	*3.15*	*7.89*	*12.21*	*17.64*	0.72	*1.59*	*3.97*	*6.13*	*8.80*
		1.43	**3.19**	**7.96**	**12.17**	**17.58**	0.72	**1.58**	**3.98**	**6.12**	**8.79**
10	5	1.72	-	-	-	-	1.23	-	-	-	-
	10	2.43	-	-	-	-	2.12	-	-	-	-
	20	5.17	-	-	-	-	5.05	-	-	-	-
20	5	2.42	-	-	-	-	2.12	-	-	-	-
	10	4.21	-	-	-	-	4.06	-	-	-	-
	20	10.06	-	-	-	-	10.02	-	-	-	-
50	5	5.16	-	-	-	-	5.05	-	-	-	-
	10	10.06	-	-	-	-	10.02	-	-	-	-
	20	25.01	-	-	-	-	25.01	-	-	-	-

Note: The variable Z is obtained from the uniform distribution (italics) and the normal distribution (bold). The values of F, D and *RRMSE* are shown in percentage.

Finally, the efficiency of the various estimators of the mean from the normal distribution is measured by using the values of RRMSE. We observe again that the direct estimator $\bar{x}$ is more efficient than the other estimators and that the Eichhorn and Hayre estimator presents a smaller RRMSE than the Bar-Lev *et al.* one in all cases.

Conclusion

In this paper we have analyzed the randomized response models for estimating the population mean from sensitive questions with real data collected from the 2012 Spanish Survey on Income and Living Conditions. For this purpose, Monte Carlo simulation studies have been carried out, using the relative bias and the relative root mean square error as empirical measures. In addition to the estimators based on randomized response models, this work also includes the traditional sample mean, i.e., the mean of the responses obtained when asking the sensitive question directly. For this estimator, we have considered different percentages of individuals who provide false answers and different percentages of variation between the true answer and that one provided by the individual.

As we expected, the results obtained show that no estimator presents bias when individuals provide the true answers, while the direct estimator can present negative bias up to 25% for high values of individuals providing false answers. Furthermore, the fact of higher sample sizes does not make these biases decrease.

Moreover, the direct estimator is more efficient than the estimators based on randomized response models when individuals do not provide false answers, but this situation is reversed due to the large bias of the direct estimator. The Eichhorn and Hayre estimator is more efficient than the Bar-Lev *et al.* one, although we must not forget that the latter model is based on an additional random mechanism, which increases the possibility that the respondents provide a true answer. It is also reasonable that increasing the sample size results in more efficient estimators in all considered methods.

Finally, note that the randomized response models do not present very different results because of considering various distributions to generate the new random variable.

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DETERMINANTS OF STOCK MARKET DEVELOPMENT IN ROMANIA

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Abstract

This study aims to evaluate the impacts of some central explanatory variables namely Foreign Direct Investment (FDI), infrastructure facility, saving, inflation, income and energy use on Romanian's stock market development measured by market capitalization. For empirical examination, this study used annual time series data over the period of 1990 to 2013. The study employs various diagnostic tests including normality test, Pearson correlation test, Park test and DW- test, which shows that there is no problem of skewness and kurtosis, no problem of heteroscedasticity and no problem of autocorrelation in the model of market capitalization used for Romania. The Johanson co-integration results indicates that there exists three co-integrating relationship among the variables. Further, least squares estimate indicates incoming FDI, infrastructure, saving, energy usage and income are important determinants of Romanian's stock market in selected macroeconomic variables used in the study. The empirical findings suggests that management authorities of Romania needs to formulate prudent macroeconomic stabilization policy in order to encourage incoming FDI, facilitate physical infrastructure, encourage saving, maintain sustainable energy use. Thus, all these measures will further develop largely Romanian's stock market.

Keywords: Stock market development, FDI, GDP, Infrastructure, Romania.

JEL classification: F20, E44, H54, O43, O52

1. Introduction

Generally, it is believed that stable and well-functioning stock market plays important role in the process of economic growth and development everywhere. Therefore, researchers have exposed visible interest in various factors determining stock market for different countries. The supporters of stock market supposed that it perform a better role in the expansion of commerce and industry and consequently it contributes to the macroeconomic performance of country. The contemporary theoretical research reveals that long-standing stock market development can bolster economic growth, whereas, empirical studies be likely to offer some encouragement to this affirmation. In a study, Demirguc-Kunt and Levine (1996) have shown that utmost stock market indicators are vastly connected with the development of banking sector. So those countries which have well-developed and stable stock markets have a tendency to have well-developed banking sector. In a similar vein, study of Levine and Zervos (1998) indicates that stock market development plays a crucial role in expecting forthcoming economic growth of a country. According to Levine (1996:7) "Do stock markets affect overall economic development? Some analysts have viewed stock markets in developing countries as "Casinos" that have little positive impact on economic growth".

Caporale *et al.* (2004) notes that sound stock market facilitates the investors to bypass risk when capitalizing in promising projects. Moreover, energetic stock markets carry out a conclusive role in assigning investment to the corporate sector, which will have undeniably a verifiable impact on the overall economy. Sound stock market provides profitably to total productivity and established financial markets are usually well-thought-out a vital factor of long-run economic growth (Levine *et al.*, 2000; Barna and Mura, 2010; Cooray, 2010; Shin, 2013; Al-Qudah, 2014; Kaserer and Rapp 2014). It is therefore, foreseeable that every established stock market will certainly speed up the suitability of long-term capital for cost-effectively beneficial activities which is mandatory for the

encouragement of economic growth and development. In addition, suitable and smooth functioning of stock market be a sign of an extensive condition for financial sector evolution which is considered a pre-requisite to contributes to the economic development and provide sound environment to attract more foreign investors.

It is therefore, important to explore various determinants affects stock market. Though, there are enormous factors explaining stock market development, however, the main focus of the present study is more on the impacts of income, inflation, energy, foreign direct investment on stock market development in the context of Romania.

The study of Brasoveanu *et al.* (2008) finds a significantly positive relationship between capital market development and economic growth in Romania on quarterly data from 2000: 1 to 2006: 2. In a study, Barna and Mura (2010) mention that Romanian capital market grown sluggishly starting since 1995. It is evident, that many years after 1989 Romania had undesirable real rate of Gross Domestic Product (GDP) growth. While, it is recorded that since 2000, Romania exhibits positive and desirable economic growth rates associated with the progress of the financial system. Regarding the importance of capital market, Prime Minister Victor Ponta stated that the existence of solid capital market is an important part for Romania's development[1]. The economy of Romania showed a marvelous performance in 2013, GDP growth rate is estimated to have touched or even surpassed 2.5% in 2013. The performance of Romanian's capital market remained outstanding and undoubtedly it is considered best year in the previous five years where some initial public offerings (IPOs) at highest values. The upward trend is expected to be continued during 2014 also. The capital market will certainly play a leading role in development of overall Romanian economy. Evidently, a significant growth of the capital market has been observed in 2013, with two IPOs of state-owned enterprises. Moreover, the growing involvement of retail investors could be another vital component in the expansion of Romania's market[2].

The broad aim of this study is to evaluate the influence of some macroeconomic variables namely FDI inflow, inflation, energy, and infrastructure on Romanian's stock market. For empirical analysis, time series data over the period of 1990 to 2013 are used. According to the knowledge of the authors, therefore is no similar studies exist on the Romania. Moreover, this study is different from the previous studies in terms of the period length taken into consideration. Several studies have surveyed the factors affecting stock market through different viewpoints and with different regressors for different countries. In spite of this, the assortment of regressors with holistic approach used in this study is emphatically different as compared to the past studies carried out in the context of Romanian's stock market determinants. Therefore, the present study will constructively contribute to the growth of literature on the determinants of stock market for Romania and can be extended to other countries also.

The rest of the study is structured as follows. Section 2 discusses literature review on the factors affecting stock market development. Section 3 deals with data sources, and the methodology used. Section 4 interprets the empirical results. Section 5 concludes the study.

2. Literature review

The existing literature reveals that though empirical studies on the factors determining stock market development are many but studies in the context of Romanian stock market are very scarce. Using panel data for fifteen industrial and developing countries during 1980-1995, Garcia and Liu (1999) discovers that financial intermediary development, real income, saving rate, and stock market liquidity are the crucial factors influencing stock market capitalization. The study of Wongbangpo and Sharma (2002) finds that high inflation in Indonesia and Philippine has a long run negative association between stock prices and money supply, while the money growth in the case of Malaysia, Singapore and Thailand suggest the positive influence for their stock market during 1985-1996. Naceur and Ghazouani (2007) carried out an empirical study using unbalanced panel data from MENA-12 countries. The empirical results reveals that macroeconomic variables such as , credit to private sector, inflation rate, saving rate, and stock market liquidity are significant factors

[1] Romanian National News Agency (2014)
[2] Franklin Templeton Investments (2014)

determining stock market development in MENA-12 countries. The study of Yartey (2008) investigates the institutional and macroeconomic factors of stock market development for 42 emerging economies during 1990-2004. The study observes that macroeconomic determinants namely income level, gross domestic investment, banking sector development, private capital flows, and stock market liquidity are the key factors determining stock market development in 42 emerging market countries during the period under the study. Moreover, the empirical findings reveal that political risk, law and order, and bureaucratic quality are significant factors of stock market development because they attract the sustainability of exterior finance. The study suggests that analysis also reveals the determinates detected earlier mentioned as determining stock market in emerging economies can also describe the stock market development in South Africa.

Similarly, Billmeier and Massa (2009) examines the macroeconomic factors of stock market capitalization for 17 countries from Middle East and Central Asia. The macroeconomic determinants considered in the study were an institutional variable, remittances, GDP, gross fixed capital formation to GDP, inflation change, domestic credit to private sector and to GDP, stock value traded to GDP and oil price index among explanatory variables. The results indicate institutions and remittances have significantly positive effect on stock market development, whereas in resource-rich countries, stock market development is mostly pushed by the oil price. Cherif and Gazdar (2010) examine the influence of macroeconomic determinants and institutional factors on stock market development for fourteen Middle Eastern and Northern African (MENA) countries during 1990-2007. The results show strong effects of income, saving, stock market liquidity and interest rate on equity market development for MENA-14 countries. While, the study fails to find that institutional environment as captured by a composite policy risk index is a motivating force for the stock market development in MENA countries. Al-Halalmeh and Sayah (2010) find that FDI has a significant impact on shares market value for Jordon over the period of 2006-2009.

Using a panel of country observations assembled for 30 countries over the period of 1960-2007, Evrim-Mandaci *et al.* (2013) finds that FDI, foreign remittances and bank credits to private sector had significantly positive influence on stock market development measured by market capitalization. In a similar vein, Azam and Ibrahim (2014) observe that FDI inflow, domestic investment, domestic saving rate, GDP growth rate and inflation rate are important determinants of Malaysian's stock market in the selected set of explanatory variables used in the study during 1988 - 2012. Şukruogl and Nalin (2014) observe that monetization ratio and inflation rate have significantly inverse impacts on stock market development, while income, liquidity ratio, saving rate have significantly positive impacts on the stock market development for 19 European Countries during 1995-2011. The study of Burca and Batrinca (2014) investigates the factors determining the financial performance in the Romanian insurance market during 2008-2012, while employing specific panel data techniques. The empirical findings show the financial leverage in insurance, company size, growth of gross written premiums, underwriting risk, risk retention ratio and solvency margin are the main determinants of the financial performance in the Romanian insurance market. Table 1 portrays brief prior selected empirical studies on the determinants of stock market.

Table 1- Compact previous selected empirical studies on the determinants of stock market

Author (s)	Sample periods, Methodology used	Dependent variable	Independent variables	Findings
Şukruogl and Nalin (2014)	1995-2011 - 19 European Countries[3] dynamic panel data estimation	Stock market development	GDP, liquidity ratio, Monetization ratio turnover ratio, Inflation, budget balance and saving rate	Income, Monetization ratio, liquidity ratio, saving rate and inflation effect on stock market development.
Shahbaz *et al.* (2013)	1971-2006 - Pakistan ARDL Bounds Testing Approach	Stock market development	FDI, GNP per capita, inflation rate and domestic savings	Results support the complementary role of FDI in the stock market development

[3] Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Netherlands, Portugal, Slovenia, Spain, Sweden and United Kingdom

Author (s)	Sample periods, Methodology used	Dependent variable	Independent variables	Findings
Abdelbaki (2013)	1990-2007, Bahrain ARDL	stock market development	Inflation, income, banking system development, stock market liquidity, private capital flow investment and saving	Income, domestic investment, banking system development; private capital flows and stock market liquidity
El-Nader and Alraimony (2011)	1990-2011, Jordan VECM model	stock market development	Money supply, GDP, inflation, real exchange rate, interest rate	Money supply, inflation, real exchange rate, interest rate
Kurach (2010)	1996-2006 - 13 CEE states[4] Fixed-effects and Random-effects	stock market development	Inflation, Budget balance, saving rate, Turnover ratio, liquidity ratio, Monetization ratio and GDP per capita	GDP, banking sector growth, stock market liquidity, budget balance are main determinants
Yartey (2008)	1990- 2004 42 economies GMM	Stock market capitalization	Private credit, value traded, Log GDP per capita, credit, FDI, inflation, political risk, law and order, corruption, bureaucratic quality and democratic accountability	Income level, gross domestic investment, banking sector development, private capital flows, and stock market liquidity are key factors

Source: Authors compilation

3. Data description and methodology

Data sources

Annual time series data ranging from 1990 to 2013 is used for empirical investigation. The data were obtained from the World Development Indicator (2014), the World Bank database (http://data.worldbank.org/news/release-of-world-development-indicators-2014).

Model Specification

This study adopt a single multivariate framework methodology where market capitalization is the response variable. Log-linear multiple regression model is used in order to examine the impacts of various determinants of market capitalization namely FDI, energy usage, inflation rate, saving, infrastructure proxy used utilization of landline telephone per 1000 people, and GDP on market capitalization. The proposed model of market capitalization for Romania is given in the following functional equation:

$$MC_t = f(FDI_t, EU_t, Inf_t, S_t, \text{Infr}_t, \text{GDP}_t) \quad (3.1)$$

Equation (3.1) can be written in the following log-linear general market capitalization function:

$$MC_t = \alpha_0 + \alpha_1 FDI_t + \alpha_2 EUg_t + \alpha_3 Inf_t + \alpha_4 S_t + \alpha_5 Infr_t + \alpha_6 GDP_t + \varepsilon_t \quad (3.2)$$

Where, α_0 is the intercept and t for time period. MC indicates market capitalization, FDI denote foreign direct investment, EU is energy usage, Inf is inflation, S is saving Infr is infrastructure, GDP is Gross Domestic product and ε is error term, which shows effect of the other factors. Data are converted into in log form. The parameters α_1, α_2, α_3, α_4, α_5 and α_6 are the long-run elasticities of all regressors. Equation 3.2 postulates that all the coefficients signs are predicted would be positive with exception of inflation rate which expected to exhibit negative coefficient sign.

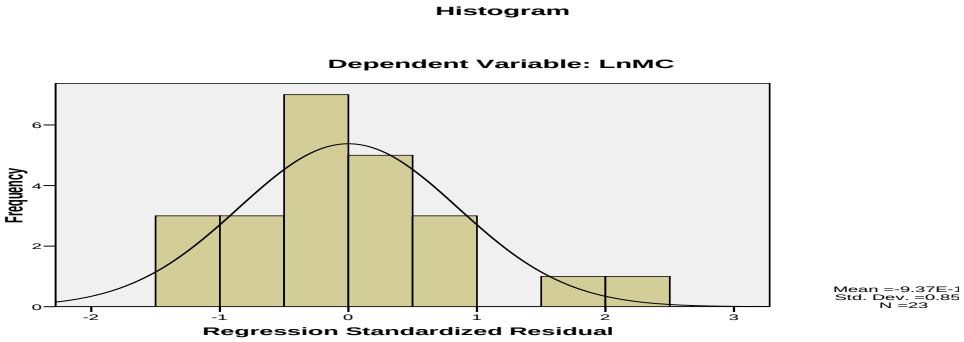
[4] Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russian Federation, Slovak Republic, Slovenia and Ukraine

4. Empirical Results

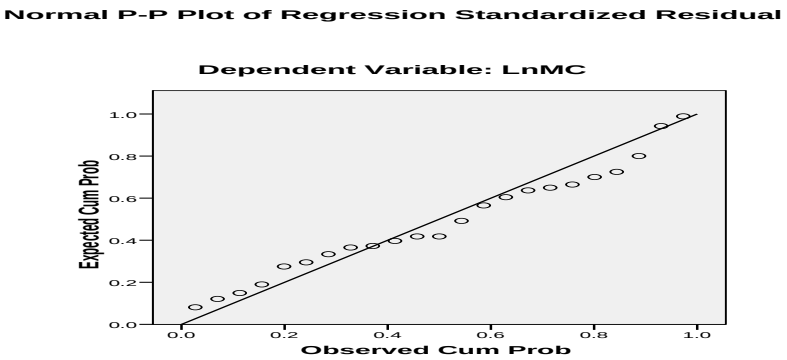
Normality of the Data

It is an important and a necessary process to check the data for its normality before going to put the data in linear model for its coefficient determination. Histograms and normal probability plot of regression standardized residuals were obtained and is used here to check the normality. It is a very simple and easy approach to visually check normality of the data. The results are given in Graph 1 and Graph 2 of the histogram and normal of NPP.

Graph 1: Histogram of Residual



Graph 2: Normal of NPP



A visual study of the histogram (Graph 1) reveals that most of the residuals lie within the normal curve, very few numbers of residual lie outside, both on the left and right side, showing minor positive and negative Skewness, some residual lies outside on top peak, causing a little Kurtosis. As a whole the data is normally distributed as mostly the residuals lie inside the normal curve. From the normal of NPP (Graph 2) reveals that the residual is normally distributed if NPP draws in a straight line. In the above case, the most part of the NPP seems to be approximately in a straight line, with the exception of a small part which does not coincide exactly with the straight line.

Park Test

Park test is used for the detection of heteroscedasticity. The log-linear model is run and save the residual, then took the square of the saved residual and regress all the independent variables on the square of the residual. The results of Park test are given in Table 2.

Table 2: Park Test coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t-ratio	Sig.
	B	Std. Error	Beta		
(Constant)	4.214	10.679		0.395	0.698
FDI	0.078	0.091	0.421	0.860	0.402
EU	-0.491	1.767	-0.503	-0.278	0.785
Inf	-0.068	0.147	-0.354	-0.462	0.650
S	.189	0.371	0.438	0.509	0.618
Infr	-0.113	0.075	-1.650	-1.502	0.153
GDP	-0.011	.013	-0.240	-0.830	0.419

Dependent Variable is residual square lne2

It is evident from Table 2 that coefficients values of all the independent variables are statistically insignificant as the calculated t-statistic in absolute term is smaller than the tabulated value, showing no heteroscedasticity in the model.

Descriptive Analysis and Correlation

A brief summary of the descriptive statistics are presented in Table 3, which explains the actual value deviation from mean value of seven variables for Romania. The data statistics indicates that market capitalization deviate from mean value by 2.35 standard deviation, foreign direct investment deviate from mean value by 1.47 standard deviation. Table 3 also demonstrates that energy usage deviate from mean value by 0.290 standard deviation. Similarly, inflation, saving, infrastructure and gross domestic product deviate from mean value by 1.46, 0.625, 4.02 and 5.96 standard deviation respectively.

Table 3: Descriptive Statistics Analysis

Variables	Minimum	Maximum	Mean	Standard Deviation
MC	-2.66	3.67	0.77	2.35
FDI	-3.00	2.42	0.42	1.47
EU	4.63	5.47	3.25	0.29
Inf	1.20	5.54	3.25	1.47
S	1.75	3.56	2.57	0.63
Infr	10.12	21.84	17.11	4.02
GDP	-0.12	12.90	-1.24	5.96

Table 4: Pearson Correlation Analysis

		FDI	EU	S	Infr	GDP	Inf
FDI	Pearson Correlation Sig. (2-tailed)	1	-0.639** 0.001	0.488* 0.015	-0.250 0.239	0.505* 0.012	-0.539** .007
EU	Pearson Correlation Sig. (2-tailed)		1	-0.838** 0.000	-0.194 0.365	-0.452* 0.027	0.846*** 0.000
S	Pearson Correlation Sig. (2-tailed)			1	0.455* 0.026	0.176 0.411	-0.522*** 0.009
Infr	Pearson Correlation Sig. (2-tailed)				1	-0.079 0.715	-0.010 0.963
GDP	Pearson Correlation Sig. (2-tailed)					1	-0.624*** 0.001
Inf	Pearson Correlation Sig. (2-tailed)						1

Table 4 illustrates Pearson correlation result for correlation among the six independent variables used in the study. It is evident from Table 4 that foreign direct investment has statistically significant relationship with energy usage, saving, gross domestic product and inflation in Romania. Energy usage has negative and statistically significant connection with gross domestic product and saving, and positive significant relationship with inflation. It is observed that saving has significant negative relationship with inflation and significant positive relationship with infrastructure. GDP has significant negative relationship with inflation.

Unit Root Analysis

Before beginning to do any empirical estimation of the model, it is necessary to examine the time series data. The analysis of data depends on finding out whether the series is stationary or non–stationary. Augmented Dickey-Fuller (ADF) test examines the hypothesis that the variable in question holds a unit root. If the series is found to hold a unit root differencing the data is appropriate to make it stationary, in parliamentary procedure to avoid the problem of spurious regression arising from non-stationarity in the time series. Thus, results of unit root test are reported in Table 5. All the seven variables included in the study are non-stationary at level when both intercept and trend is included in the model and becomes stationary after taking first difference of the data except saving which become stationary after differencing it twice.

Table 5: ADF Test for Stationarity

VARIABLES	Include Intercept Only		Include Intercept and Trend		Result
	Test statistics[1]	Critical Value	Test statistics[1]	Critical Value	
MC	-1.2870[1][2]	-3.7667	-1.8583	-3.2712	I(1)*
	-3.9583[3][0]	-3.7856	-5.2209	--4.4415	I(1)**
FDI	-1.5387[1]	-3.7667	-1.6344	-4.4167	I(1)*
	-4.9437[0]	-3.7667	-4.9061	-4.4415	I(1)**
EU	--1.2825[1]	-3.7667	-1.4985	-4.4167	I(1)*
	--4.5656[0]	-3.7667	-4.7273	-4.4415	I(1)**
S	-0.1845[1]	-3.7576	-1.9292	-4.4415	I(2)*
	-2.9052[1]	-3.7856	-3.0579	-4.4691	I(2)**
	-6.2747[1]	-3.8067	-6.1189	-4.5000	-
Infr	-1.0654[1]	-3.7667	-0.6300	-4.4415	I(1)*
	-4.9712[0]	-3.7667	-5.3761	-4.4415	I(1)**
GDP	-3.4113[1]	-3.7576	-2.6126	-4.4167	I(1)*
	-5.2736[0]	-3.7856	-5.3311	-4.4415	I(1)**
Inf	-2.2517[1]	-3.7667	-2.5362	-4.4415	I(1)*
	-4.8760[1]	-3.7856	-5.2672	-4.4691	I(1)**

[1] Figures in square brackets besides each statistic represent optimum lags selected using the minimum AIC value.
[2] Figures in square brackets besides each statistics represent optimum lags, selected using the minimum AIC value'
[3] Figures in sub second row of main row represent value of variable at first difference. * indicates result when only intercept is included only and ** indicate results when both intercept and trend is included.

Cointegration Analysis

Summary of the detail of regression estimates of the Johansen co-integration test are given in Table 6. Where, the result indicates that first three null hypothesis are rejected as Maximum Likelihood Ratio statistics are greater than critical value at 1 percent level of significance indicating that there exists three co-integrating relationship among the variables.

Table 6: Cointegration Test Results

N. Hypothesis	A. Hypothesis	Maximum Likelihood Ratio Test	
		Statistics	**Critical Value**
r = 0	r = 1	166.99**	103.18
r <= 1	r = 2	97.900**	76.07
r <= 2	r = 3	51.887*	47.21
r <= 3	r = 4	25.633	35.65
r <= 4	r = 5	7.891	20.04
r <= 5	r = 6	0.0247	6.65

Note: *(**) denotes rejection of the hypothesis at 5% (1%) significance level; L.R. test indicates 3 cointegrating equation(s) at 5% significance level

5. Regression results

The result of the linear regression model is presented in Table 7. Generally, the results are logical because the explanatory power of R^2 is fairly high, there is no serious autocorrelation problem as shown Durban Watson Statistics and F-ratio further reveals that all the independent variables jointly influence the response variable during the period under the study.

Table 7: Regression Result (Dependent variable is MC)

Variables	coefficients	t-statistics	Prob.
Constant	-51.433	-2.61	0.019
FDI	0.702*	04.19	0.001
EU	7.06**	2.16	0.046
Inf	0.19	0.70	0.497
S	1.87**	2.73	0.015
Infr	0.67*	14.80	0.000
GDP	.033	1.39	0.184
R^2	0.968		
adj. R^2	0.956		
DW	2.128		
F-stat	81.274		
Prob.	0.000		

Note: *, ** and *** indicates statistical significant at 1% , 5% and 10% levels respectively.

It is evident from Table 7, that the estimates of linear regression indicate that market capitalization is positively related to foreign direct investment, energy usage, inflation, saving, infrastructure and gross domestic product. The coefficient of foreign direct investment and infrastructure are statistically significant at 1% level of significance, energy usage and saving are statistically significant at 5% level of significance while the coefficient of inflation is statistically insignificant. The result shows that 1 percent increase in FDI and infrastructure lead to increase market capitalization by 0.70, and 0.67 percent respectively. The result for energy usage and saving indicate that 1 percent increase in energy usage and saving lead to increase market capitalization by 7.06 and 1.87 percent respectively. While, impact of inflation rate on stock marker found is statistically insignificant with wrong positive sign.

Overall the empirical results are logical and extensively satisfactory. The R^2 value is 0.968 indicate that 96.8 percent variation in market capitalization is due to foreign direct investment, energy usage, infrastructure, saving, inflation and gross domestic product, while remaining 3.2 percent variation in market capitalization is due to the other variables which are not included in the model. Durban Watson value (2.128) lying between Durban upper limit and 4 minus upper limits, indicate that the value lying in no autocorrelation zone. F-statistics value (81.274) is reasonably high

indicating that all the independent variables have joint significance effect on the response variable which is market capitalization in the study.

Concluding remarks

The main objective of this study is to empirically verify the impacts of some central explanatory variables namely FDI, infrastructure, saving, inflation, income and energy use on stock market development of Romania measured by market capitalization. The study used annual time series data ranging from 1990 to 2013. The study applied various diagnostic tests including normality test, Pearson correlation test, Park test and DW- test, which shows that there is no problem of skewness and kurtosis, no problem of heteroscedasticity and no problem of autocorrelation in the model of market capitalization used for Romania. Data have been checked for stationarity using ADF test. The Johanson co-integration results indicates that there exists three co-integrating relationship among the variables. Further, least squares estimate reveals that the impacts of FDI, infrastructure, saving, energy usage and income on market capitalization are positive and statistically significant.

The results of this study are vigorous and reasonable, therefore, alluring for sound policy consideration. The findings of the study suggest that policy makers needs to create investment-friendly environment in order to enhance more FDI inflows into the country, infrastructure development, saving enhancement techniques, more energy usage but care should be taken to design energy supply policy appropriately to meet increase energy demand handsomely, all these factors expand market capitalization.

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OIL PRICE FLUCTUATIONS AND TRADE BALANCE OF TURKEY*

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Abstract:

The relationship between oil price fluctuations and the trade balance of Turkey is the main concern of this paper. Economic growth performance of Turkey depends on imported capital goods as well as imported oil. Oil price increases bring a heavy burden for Turkish economy. Therefore, it is important to analyze the effects of oil price increases on external balances of Turkey. We specifically aim to examine the effects of price fluctuations of imported oil on Turkey's trade balance using a structural vector autoregression (VAR) model. The variables used in this model are imported crude oil price, imports of crude oil, industrial production index, and trade balance to GDP ratio. Monthly data set for the period of September 2009 - June 2014 is used. The results show that the oil price shock creates a negative impact on trade balance and this effect continues while declining in magnitude for more than 10 months. Most of the variation in forecast error of trade balance ratio is explained by the shock on itself and only a limited variation, around 4%, is explained by oil price shock for a 10 months period.

Keywords: Oil price; trade balance; structural VAR; Turkish Economy.

JEL classification: F14, C32, F41

1. Introduction

The relationship between increasing oil prices and macroeconomic indicators such as economic growth rate, inflation rate, and external balances has been an important area of study in economics. The interest on the topic mainly started after the drastic oil price increases experienced during the oil shocks of 1970s. Initial studies after 1970s focused on the effects of increasing oil prices on macroeconomic performance of industrialized economies. As expected, it was mainly concluded that increasing oil prices lowered the GDP growth rate and contributed to the inflation problem.

Studies showed that the degree of the impact of increasing oil prices on macroeconomic variables varied over time. Hamilton (1983) showed that while the negative impact of oil prices on explaining US recession during the period of 1949 – 1972 was significant, its size weakened in 1973 – 1980 period. Later studies argued that not all oil shocks were the same in terms of their nature and also in terms of their effects on the related economies. Some of these studies agreed that oil shocks of 1970s and early 1980s were supply side shocks while the ones after 1980s including the ones after 2000 were demand side shocks (Archanskia *et al.*, 2012; Hamilton 1983) in which oil prices are determined endogenously. However, not everyone agreed with this classification. For example, Kilian (2009) claimed that oil price shock of 1979/1980 should be considered as a result of both supply and demand shocks which were worked out together. For the oil shocks experienced after 2000 most of the studies agreed on the opinion that they are not supply side shocks (Archanskaia *et al.*, 2012; Hamilton, 2009; Kilian 2009). Determining the nature of oil price increase and therefore the nature of the shocks is important to understand the underlying reasoning behind the shock so that policymakers could take appropriate precautionary actions for their economies in a timely manner.

The issue of increasing oil prices and oil price fluctuations captured the attention of economists one more time after the year 2000 as oil prices started to fluctuate considerably one more time. Small number of studies conducted was on emerging economies during this period. The response of economic growth rate and inflation rate of oil importing countries to the surge in world oil prices was one of the research topics of this period (Ghosh, 2009; Barsky and Kilian 2004; Hamilton, 2005). Studies on the external balances of oil importing countries were very limited in numbers (Bodenstein *et al*., 2011; Kilian, L., Rebucci, A., and Spatafora, N., 2009; Narayan *et al.*, 2014).

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As Turkey moved to export oriented growth strategy after 1980, trade and current account balances gained importance in evaluation of Turkey's economic performance. According to the new growth strategy, export has become the new engine of growth in Turkey. As an oil importing developing country, it is widely believed that oil price fluctuations have created significant negative effects for Turkey. Moreover, Turkish growth experience showed that there is a significant correlation between economic growth and imports.

This paper is organized as follows. Section 2 reviews the previous literature on oil shocks and their effects on macroeconomic indicators such as growth rate and external balances. Section 3 gives brief information about the empirical methodology used in the paper and the main findings. Section 4 includes the concluding remarks.

2. Literature Review

The results of oil shocks for both oil exporting and oil importing countries as well as the main factors behind oil shocks are studied especially after the oil shocks of 1970s. As the oil price stayed relatively stable during the period of 1985 to 2000, the interest on the subject was declined. As the prices started to increase one more time after 2002, the interest on the topic is on the rise again.

Most of the literature consists of studies analyzing the association between external balances of developed economies such as the US. For example; Kilian (2010) used five variables which are the percent change of world production of crude oil, the measure of global real economic activity, the real price of imported crude oil, the real price of gasoline in the US, and the percent growth rate of the quantity of gasoline consumed in the US. Peersman and Robays (2011), on the other hand, analyzed the effects of oil price shocks on macroeconomic indicators using various countries. They concluded that oil price increases create different effects depending on the nature of the increase and results also differ depending on whether the country is an oil importer or an oil exporter.

Le and Chang (2013) took three different types of countries in their paper. This study included Malaysia as an oil exporter, Singapore with an oil refinery and Japan as an oil importer country to see the effects of oil price increase on countries with different economic characteristics relating oil.

Archanskaia, Creel, and Huert (2012) wanted to determine the driving force behind oil shocks in 1970-2006 period with the distinction of supply side and demand side shocks in their model. They argued that while supply side oil shocks have created negative external balance effects, demand driven oil shocks did not have such negative effects. Kilian and Murphy (2014), on the other hand, used unobservable shifts in expectations about future oil demand and supply conditions in the demand for above-ground crude oil inventories. They concluded that traditional estimates of the short-run price elasticity of oil demand are downward biased because of ignoring the endogeneity of the real price of oil.

There is a strong dependence on imported oil in case of Turkey and it is believed that this fact plays a significant role in high trade deficit problem of the country. The issue of oil prices and economic growth relationship is covered by a number of studies (Erdal *et al.*, 2013; Ozlale and Pekkurnaz, 2010; Aydın and Acar, 2011; Sozen and Nalbant, 2007; Lise and Van Montfort, 2005).

Erdal *et al.* (2013) questioned the nature of the energy consumption and economic growth performance using Granger causality framework. They found a bidirectional relationship between energy consumption and economic growth for the period of 1970-2006. Similar conclusion was reached by Lise and Montfort (2005) as they found a co-integration between oil price and GDP for the period of 1970-2003 and concluded that it possibly shows a bi-directional causality relationship between these two variables. Irhan, H. B. *et al.* (2011) could not find any significant effect created by oil price on Turkey's trade balance based on 1990-2007 quarterly data using ARDL bounds testing analyses. Ozlale and Pekkurnaz (2010), after controlling for exchange rate misalignment and output gap, based on 1999-2008 monthly data, concluded that oil price shocks played a role on affecting Turkish current account balance but it was short term in nature. Ugurlu and Unsal (2009) studied on 1971-2007 to see the relationship between crude oil import and economic growth for Turkey and found no long run relationship between these variables.

3. Empirical Methodology

Structural Vector Autoregressions (SVARs) are a multivariate, linear representation of a vector of variables on its own lags. This approach is used by econometricians to recover economics shocks from variables by imposing a minimum of assumptions compatible with a large class of models.

Kilian *et al.*, (2009) propose a decomposition of shocks to the real price of crude oil into three components as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} e_t^{\text{oil supply shock}} \\ e_t^{\text{aggregate demand shock}} \\ e_t^{\text{oil specific-demand shock}} \end{pmatrix} \quad 3.1$$

where: - Δ prod is the percent change in global crude oil production;
- rea denotes the index of real economic activity;
- rpo defers to the real price of oil.

The author finds that oil price increases due to surging global demand produce and positive but small effect on real economic activity.

Kilian (2010) decompose the error as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta global\ oil\ production} \\ e_t^{global\ real\ economic\ activity} \\ e_t^{real\ price\ of\ crude\ oil} \\ e_t^{real\ U.S.\ price\ of gasoline} \\ e_t^{U.S.gasoline\ consupmtion} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{54} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{oil\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{oil-market\ specific\ demand\ shock} \\ \varepsilon_t^{refinery\ shock} \\ \varepsilon_t^{gasoline\ demand\ shock} \end{pmatrix} \quad 3.2$$

3.1. Data

Monthly data is collected that cover the sample period of 2009:01- 2014:06. We investigated the effect of crude oil import price on trade balance. As an oil-importing emerging economy oil prices play a crucial role in Turkey's economic performance. Turkey has high unemployment and high trade deficit problems. In order to grow at a desirable and at a sustainable rates Turkey has to depend on imported capital goods and oil.

While studying the oil price and trade balance dynamics, GDP performance of the country is also important. Total imports and oil imports play a significant role in determining Turkish GDP performance. To capture the production activity, we chose to use Industrial Production Index (IPI) as a proxy. IPI is also useful since GDP values are not available on a monthly basis. We use crude oil import (COI), industrial production index (IPI), crude oil price (COP) and trade balance (TB) as important variables of the model. See Appendix for the detailed definition and the source of data.

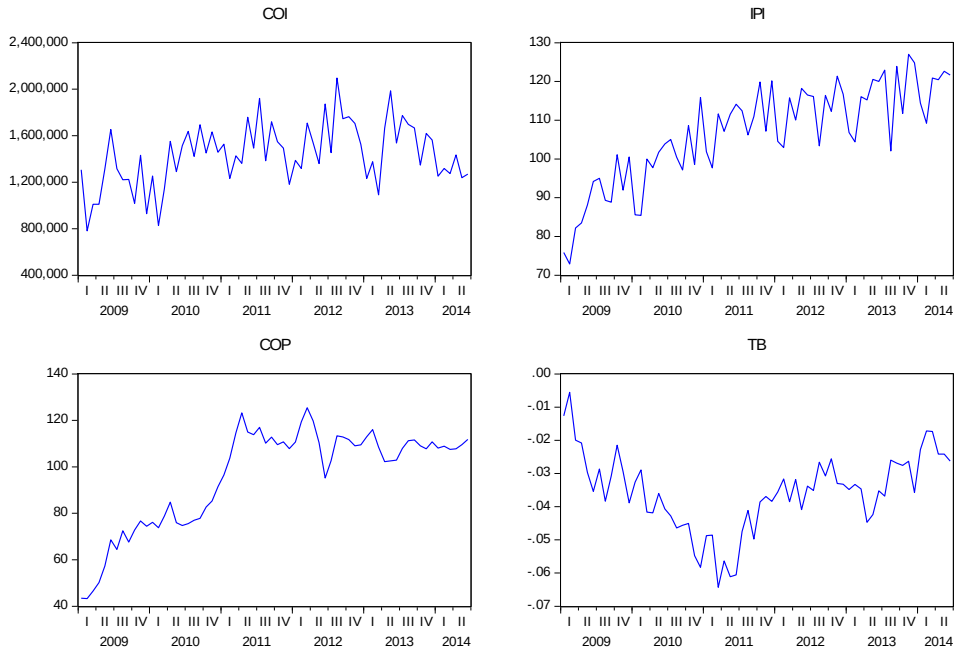

Figure 1: Graphs of Variables and Source: Authors' calculations

3.2. Unit Root Tests

Time series properties of our data are investigated by using ADF and DF-GLS tests. Table 1shows the results of unit root tests. The null hypothesis of existence of unit root is rejected for IPI and TB variables in level thus these variables are stationary. The other variables, namely COP and COI are non-stationary. We concluded that IPI and TB are I (0) and COP and COI are I (1).

Table 1: Unit Root Tests results

		LEVEL		First Difference	
Variable	**Model**	**ADF**	**DF-GLS**	**ADF**	**DF-GLS**
COI	CONSTANT	-3.0565(1)**	-1.7326(1)	-15.3418(0)***	-4.8383(2)***
IPI		-1.9258(1)	-1.4377(1)	-6.2519(10)***	-14.2207(0)***
COP		-2.5200(0)	-0.2005(0)	-7.4265(0)***	-2.3874(0)***
TB		-3.0306(0)**	-2.8192(0)	-13,5153(0)***	-3.1433(0)***
COI	CONSTANT + TREND	-3.1239(1)	-2.8170(1)	-15.2954(0)***	-6.5781***
IPI		-6.6772(0)***	-4.0868(1)***	-6.0803(10)***	-14.3071(0)***
COP		-2.0157(0)	-1.3638(0)	-7.6222(0)***	-3.9253(0)***
TB		-3.8800(0)**	-3.1430(0)**	-13.4749(0)***	-12.0322(0)***

Values between parentheses show the value of lag in terms of SIC criterion. ***, **, * shows that rejection of H_0 in 1%, 5% and 10% significance level respectively. Null hypothesis is "the series has a unit root".

3.3. The Model

Structural VAR models could impose two kinds of restrictions on the system of equations which are short-run and long-run restrictions. Some of the previous researches imposed only short run restrictions on residuals. We use crude oil import variable as an oil supply and following Kilian (2009), the oil import (supply) shocks are accepted as unpredictable innovations to global oil production. Before the SVAR model is estimated VAR model must be constructed. We estimate VAR model with 1 lag length based on selection criteria (SC) (See: Appendix).

The structural VAR representation is as follows:

$$C_0 z_t = \alpha + \sum_{i=1}^{p} C_i z_{t-i} + \varepsilon_t \quad 3.3$$

where p is the lag length, ε_t denotes the vector of serially and mutually uncorrelated structural innovations. Given the identifying assumptions above C_0^{-1} has a recursive structure. Thus the reduced form errors (e_t) is as follows:

$$e_t = C_0^{-1} \varepsilon_t \quad 3.4$$

Then we employ only short-run restrictions on residuals as follows:

$$e_t \equiv \begin{pmatrix} e_t^{\Delta COI} \\ e_t^{IPI} \\ e_t^{\Delta COP} \\ e_t^{TB} \end{pmatrix} = \begin{bmatrix} c_1 & 0 & 0 & 0 & 0 \\ c_2 & c_3 & 0 & 0 & 0 \\ c_4 & c_5 & c_6 & 0 & 0 \\ c_7 & c_8 & c_9 & c_{10} & 0 \end{bmatrix} \begin{pmatrix} \varepsilon_t^{oil\ supply\ shock} \\ \varepsilon_t^{aggregate\ demand\ shock} \\ \varepsilon_t^{oil\ price\ shock} \\ \varepsilon_t^{?trade\ shock} \end{pmatrix} \quad 3.5$$

Table 2 shows the estimates of coefficients of C_0^{-1} matrix.

Table 2: Structural VAR Estimates

	COEFFICIENT	STD. ERROR
C(1)	246843.1***	21484.94
C(2)	0.330996	1.047295
C(3)	8.505045***	0.740269
C(4)	0.802635	0.636456
C(5)	-0.715162	0.629541
C(6)	5.089349***	0.442971
C(7)	-0.000819	0.000847
C(8)	-0.002846***	0.000807
C(9)	-0.001083	0.000762
C(10)	0.006143***	0.000535
***,**,* shows ; 1%, 5% and 10% significance level respectively.		

Source: Authors' calculations

Table 2 shows that c2, c4, c5, c7, c9 are not statistically significant. Then oil supply (c2) has no effect on Industrial Production Index, itself, crude oil import (c4) and IPI (c5) have no impact on oil import price, crude oil import (c7) and crude oil import price have no effect on crude oil price.

3.4. Impulse Responses

After the model was estimated, responses to a shock in the crude oil price are examined through impulse response functions by using error-terms of the model.

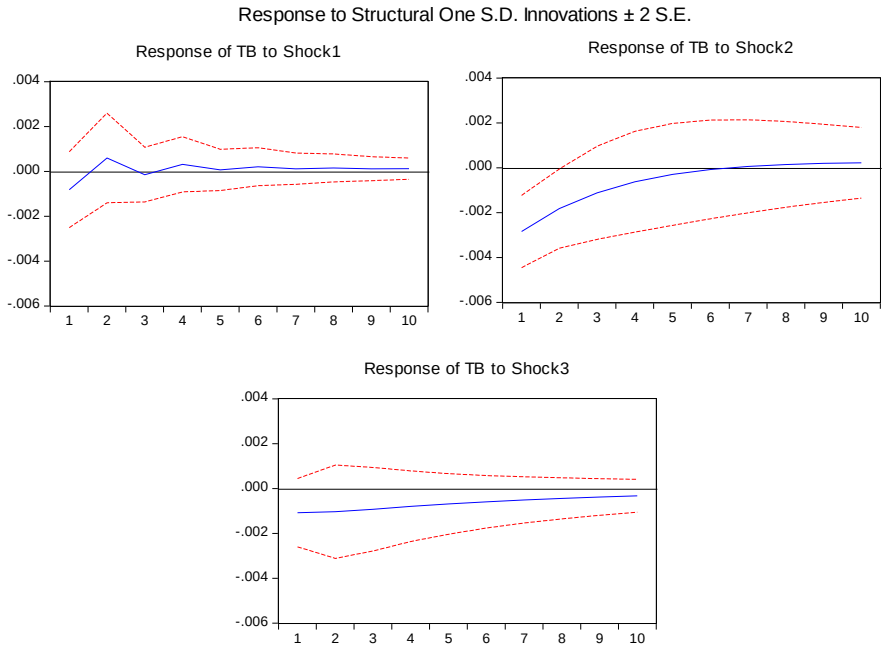

Figure 2: Impulse Response Functions

Source: Authors' Calculation

Figure 2 shows that the response of Trade Balance (TB) to shocks of other variables: crude oil import (COI), industrial production index (IPI), and crude oil price (COP).

Response of TB to crude oil import shock shows a negative effect in the first period and turns into a positive effect immediately in the second period and stays positive but at a very low level after the 4th period. Shock of IPI has a stronger negative effect in the 1st period but it declines gradually for 7 periods and stays at a positive but very low level after 7th period until the 10th period. Response of TB to crude oil price shock stays always negative. This negative effect, however, is the highest during the first period and gradually declines for the total of 10 periods. All of these responses could be classified as short run in nature.

3.5. Variance Decomposition Analysis

In addition to impulse response functions, variance decomposition analysis can be carried out in structural VAR models as in VAR models. Variance decomposition determines which variable is the most effective in explaining the variation in the forecast error for the model under investigation.

Table 3: Variance Decomposition

VARIABLE	TB			
Period	Shock1	Shock2	Shock3	Shock4
1	1.405077	16.98784	2.460597	79.14649
2	1.286806	14.36913	2.830862	81.51320
3	1.041880	12.63608	3.100812	83.22123

VARIABLE	TB			
Period	Shock1	Shock2	Shock3	Shock4
4	0.996234	11.38398	3.260545	84.35924
5	0.919658	10.54433	3.383520	85.15249
6	0.901920	9.976387	3.467889	85.65380
7	0.877778	9.606863	3.531703	85.98366
8	0.870946	9.367587	3.577322	86.18414
9	0.863332	9.216827	3.611302	86.30854
10	0.860844	9.122899	3.635960	86.38030

Source: Authors' calculation

Shock 1, shock 2, shock 3 and shock 4 refer to shocks given to the crude oil import, industrial production index, crude oil price and trade balance. Most of the variation in the forecast error of TB comes from shocks to itself which is %79 in the first period and increases to %86 in the tenth period. Second variable with a low but considerable effect on TB is IPI with %17 in the first period and decreases to %9 by the 10th period. Price shock has only a very limited effect of the variation in the forecast error of TB with 2.4% in the first and 3.63% in the tenth period.

Conclusion

In this paper, we investigated the relationship between imported oil price and trade balance of Turkey for the period of January 2009 – June 2014. We use the trade balance (TB), crude oil import (COI), industrial production index (IPI), and crude oil price (COP) as the variables of the model in the interested question of effects of oil price shocks of trade balance dynamics.

The empirical application is started with the unit root tests. Based on the unit root tests, we use difference of COI and COP and the level of IPI and TB. After the structural VAR model was constructed, the impulse response function and variance decomposition results are evaluated.

These results showed that imported oil price shock has a negative effect on TB. The trade balance values of Turkey were all negative during the investigated period. Meaning all monthly trade deficit values showed a trade deficit. Therefore, the negative effect meant that the trade deficit was worsened. Most of the variation in the trade balance however is explained by itself. IPI was the other variable with the second highest explanatory power. The variation explained in the trade balance by the oil price was very low.

Based on our findings, we can conclude that oil price fluctuations have a negative but weak effect on Turkish trade balance in the short run. Industrial production index, a proxy for the domestic production activity, show a stronger effect explaining the variation in the trade balance and this effect also exist in the short run. This could be an indication of the fact that Turkish growth performance is strongly correlated with total Turkish imports and therefore also correlated with oil imports.

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APPENDIX

Definition and Source of the Variables		
IPI	Industrial Production Index (2010=100)(TÜİK)(Monthly)(NACE REV.2)	TCMB
COI	Imports of crude petroleum, 1996-2014	TÜİK
COP	Europe Brent Spot Price FOB (Dollars per Barrel)	EİA
GDP	Gross Domestic Product (Quarterly) (Current) (Thousand TL)	TCMB
ER	USD Exchange Rate (Sale) Monthly	TCMB
TBraw	Foreign trade by months Balance (Thousand US$)	TÜİK
TB	TBraw/(GDP*ER)	Authors Calculation

VAR Lag Order Selection Criteria
Endogenous variables: D(COI) IPI D(COP) TB
Exogenous variables: C
Sample: 2009M01 2014M06
Included observations: 66

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1180.098	NA	4.50e+10	35.88177	36.01448	35.93421
1	-1096.265	154.9639	5.77e+09	33.82623	34.48976*	34.08842
2	-1066.479	51.44962*	3.82e+09*	33.40845*	34.60281	33.88040*
3	-1054.270	19.60850	4.35e+09	33.52333	35.24851	34.20503
4	-1041.935	18.31472	4.99e+09	33.63441	35.89041	34.52586
5	-1026.540	20.99357	5.31e+09	33.65273	36.43956	34.75394
6	-1012.009	18.05386	5.94e+09	33.69724	37.01490	35.00821

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

CATEGORISATION OF THE EUROPEAN UNION COUNTRIES IN RELATION TO EFFICIENCY ADJUSTMENT OF VALUE ADDED TAX COLLECTION USING CLUSTER ANALYSIS AND MULTIDIMENSIONAL SCALLING

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Abstract:

The issue of the value added tax efficiency is intensively debated these days both at the level of individual governments, and the level of the European institutions and bodies, as well. The whole Europe is trying to mobilize and implement effective measures which would be able to improve the collection of taxes without increasing tax rates. VAT is currently the most harmonized tax, but states still retain some sovereignty regarding the level of rates, reduced rates and exemptions. Different Tax legislation in the countries, in combination with the application of its own VAT policy preferences and lack of control of tax administration causes growing the gap between actual and theoretical base for income taxes. The paper is devoted to the quantification of VAT system setup from the view of revenue collection efficiency of this tax using cluster analysis including 27 EU countries. It is also devoted to the identification of countries groups with similar situation of VAT collection and their common features. In a statistical meta-analysis there are compared several methodological approaches: variant of agglomerative hierarchical cluster analysis, the outputs of k-means, k-medoid and also fuzzy c-means method. The results are in qualitative agreement with multidimensional scaling.

Keywords*: Value-addeded tax, tax harmonization, tax rate, Cluster analysis, Multidimensional scaling*

JEL Classification: C52, H20, H26

1. Introduction

According to (Novysedlák and Palkovičová, 2012) discuss that the primary objective of any tax system is to provide an efficient collection of taxes through the legislative and institutional conditions. These two components must operate and complement each other. Successful in tax legislation and tax administration is the foundation of a good functioning, steady source of income. Although states on the one hand may have tax legislative treated well, it still does not designate them to generate a sufficient amount of tax revenue. In the countries there are some obstacles in the form of bureaucracy, bad practices in the collection of the tax, weak controls, taxes unnecessary complexity in the form of a large number of legislative exemptions, exceptions and multiple rates application. This fact is confirmed by several studies, such as (CASE, 2013) and (Reckon LLP, 2009), which findings concerning the EU countries point to the fact that the growth of VAT revenues not reflect macroeconomic base applied within this tax. According to estimates of the VAT gap for EU-27 between 2000 and 2011, the average value of the VAT gap ranged at 17% in the Member States, while the median is 13%. Regardless of the objective reasons causing the gaps, loss of income has a major influence on economic policy. That is why tax revenue should produce stable income for the development of public finance and enable the efficient consolidation of public finances without taking any consolidation measures on the expenditure side.

2. Research objectives and methodology

The main aim of this paper is to create an economically transparent and effective categorisation of EU countries in relation to efficiency adjustment of VAT collection and to identify collecting VAT in the countries regarding the efficiency of three indicators (VRR, VPR and G, theoretically defined in section 4).

To fulfill the main objective there are formulated two hypotheses:

H1: The more advanced economies have effectively set the VAT system, which is characterized by small gaps in the selection VAT.

H2: Countries with excessive indebtedness or failing countries are separated from the cluster of developed economies.

The analysis is performed in two steps:

1. VRR efficiency indicators, VPR and G take vastly different values, so in the first step of analysis there has been provided the data transformation performed through conversion to z-scores. Each item has been standardized/normalized by subtracting the mean and dividing the standard deviation. Transformation caused achieving a zero value mean and one standard deviation value. They has been displayed in one of the multidimensional scaling means through procedure *cmdscale* () and then evaluated whether the data show signs of clustering or not. The transformed data has been processed using selected methods for cluster analysis - Ward single linkage clustering, k-*means* and k-*medoids*. To test the quality of clustering, interpretation and validation of data clusters there were used a methodology silhoutte (Rousseeuw, 1987).
2. Using cluster analysis in the paper there have also been performed categorization of countries with similar settings tax system. The categorisation has been realised by means of a number of methodological approaches to data analysis that are based on the concept of the Euclidian metric. These methods are used to be mentioned mainly in the context of issue of the so called manifold learning (Rosman, Bronstlin, Bronstein and Kimmel, 2010). We mainly address to the traditional hierarchical cluster analysis with Ward´s linkage, as well as to application of the methods such as: k-means; k-medoids; and fuzzy c-means.

For use of these methods, we have chosen the implementation in the R environment. For hierarchical clustering, it was the standard routine *hclust*() (R CORE TEAM, 2013); for k-means, we used the routine *kmeans*(). Its extension is fuzzy logical variant c-means implemented by means of the routine *cmeans*(). Dimensional scaling (also called principal coordinates analysis) has been realised by means of the routine *cmdscale*() (Venables and Ripley, 2002).

Data has been collected from Internet databases and statistics provided by the European Statistical Office of the European Union (Eurostat), OECD reports and IFP.

3. Literature review

Indicator of the efficiency of VAT collection compares a real collection with an efficient one. Calculated as a share of the actual VAT collection on an effective collection of VAT. VAT collection efficiency reaches 72% of the EU average. In comparison with Slovakia, there is 57.4%, the results comes from the survey evaluation of structural indicators, published by (IFP, 2012). (Bodin *et al*., 2001) monitored the dependence of the efficiency of VAT expressed as VRR (Vat Revenue Ratio) on a variety of factors. The authors (Bánociová, Jakubíková and Mihoková, 2012), (Glova, 2013), (Filip, 2009), (McGee Tušan, 2008) determine the VAT revenues as a function of fiscal variables and economic variables, while fiscal variables considered to be legislatively set and dependent on economic factors, as well. The authors finds that the growth of VAT rates cause a disproportionately increase of VRR. (if rate increase by 10% then VRR increase by only 7%). It could conclude that the growth of rates causes tax evasion, but on the other hand, it could be due to transfer consumpiton because of the preferences changes regarding goods and services with a lower tax rate, or even the tax exemption. (Aizenmann and Jinjarak, 2005) found a positive relationship between GDP and VRR, thus the effectiveness of the VAT system. This variable was also examined in the studies of (Reckon LLP, 2009), in both cases, however it was statistically insignificant.

Because the calculation of the VAT gap has been monitored for the last 15 years, many authors like (Sanack, Velloso and Xing, 2010), (Bodin.*et al.*, 2001), (Aizenman and Jinjarak, 2005) do not focuse on the determinants of tax gaps but they use VAT revenues or VAT performance as a dependent variable which is given by VRR. The second indicator is the Gap, which determines the gap between the base and the implicit rate. Both implicit and base VAT rate represent the tax burden. Implicit rates, however, is the effective tax rate, because as opposed to the base rate reflects the actual tax burden on consumers. It is structured as an income from all excise taxes and thus not only VAT but also consumer and environmental related to the total final consumption of households.Goods and services subjected to excise taxes are more often the subject of tax evasion because overall taxation of these products is due to other goods and services higher. Just this fact expresses implicit tax rate. The third studied variable VPR (Vat Productivity Ratio) represents VAT incomes to GDP and it is a part tax quota, which approximates to the tax burden. It is easily accessible data, which has similar properties, such as an average rate of VAT throughout the economy. There is a prerequisite for a positive impact on the VAT gap as with the base and the implicit rate of taxation of consumption. But

on the other hand, it can not be excluded the reverse causality of the higher taxation in the countries with a VAT-term committee. VAT ratio to GDP was tested in a study of (Agha and Haughton, 1996). His result showed that it was statistically significant.

4. Features Value Added Tax efficiency ratio and data preparation

There are a number of indicators of efficiency VAT settings, which construct individual organizations to review the efficiency of tax revenue collection in the country. Some indicators take into account the reduced rates and their impact on the final selection of VAT, others have compared the actual income with the theoretical. In the present analysis for 2012 there have been selected three indicators, which have created 3 clustering component vectors:

- VRR (Vat Revenue Ratio) is the ratio between an actual VAT yield and the theoretical one, while theoretical yield is calculated by multiplying the base rate and the VAT base. The higher this percentage, the more efficient is the VAT system set up. This ratio is a measure of the ability of countries to achieve the highest revenue to its tax base. (Novysedlák and Palkovičová, 2012).
- VPR (Vat Productivity Ratio) is characterized as the ratio of VAT revenue to the country's GDP, multiplied by the base rate. Presents the percentage of GDP the country is able to collect on one percentage point of the standard rate. The Interpretation of the indicator height is the same as VRR indicator. (European Commision, 2013).
- G (Gap) is a gap between the base rate and the implicit rate. The implicit rate has been calculated as the ratio of total income to countries consumption. The bigger gap the less efficient a collection of taxes is. (Soukopová and Šinkyříková, 2014).

In the groups there are monitored three above-characterized quantitative features for each object.

Table 1 Value Added Tax Efficiency indicators 2012

	VRR	*VPR*	*G*
BE	***0,668665***	***0,340735***	***33,13349***
BG	***0,769185***	***0,468292***	***30,1267***
CZ	***0,693033***	***0,361284***	***30,69669***
DK	***0,823624***	***0,398318***	***17,6376***
DE	***0,703369***	***0,383012***	***29,66313***
EE	***0,827435***	***0,432958***	***17,25652***
IE	***0,650939***	***0,296839***	***40,56646***
EL	***0,34735***	***0,308367***	***57,14286***
ES	***0,428736***	***0,264042***	***54,06398***
FR	***0,636944***	***0,357741***	***40,55191***
IT	***0,472238***	***0,290146***	***52,77621***
CY	**0,708552**	**0,523663**	**29,14478**
LT	**0,784414**	**0,481798**	**21,55859**
LV	**0,5764**	**0,364417**	**47,61905**
LU	**1,248548**	**0,475886**	**6,666667**
HU	**0,621296**	**0,346967**	**37,87036**
MT	**0,626582**	**0,432872**	**37,34178**
NL	**0,736734**	**0,33131**	**26,32663**
AT	**0,718053**	**0,400044**	**28,19474**
PL	**0,524384**	**0,317768**	**47,56162**
PT	**0,549758**	**0,368535**	**45,02419**
RO	**0,602191**	**0,35504**	**50,987**

SI	**0,671445**	**0,40902**	**32,85552**
SK	**0,53793**	**0,304356**	**46,20701**
FI	**0,736948**	**0,39873**	**26,3052**
SE	**0,784571**	**0,371354**	**21,54285**
UK	**0,57622**	**0,363368**	**42,378**

Source: own processing based on Eurostat data

4 Hierarchical clustering methods of countries

Before the start of analysis, the data have been processed through multidimensional scaling (see Figure 3). On this basis there has been monitored the classification of countries within four groups. After visual evaluation, the data has been transformed to z-*core* (transfermedn to z-*scores*) using selected methods of cluster analysis - Ward method and single linkage clustering (Subchapter 4.1), k-*means method* (subsection 4.2) and k-*medoids* (Subchapter 4.3), which were suitable to test hypotheses.

Each of those methods has led to foursome of clusters in line with the preliminary estimate. Content of clusters has been compared with each other and there have been identified clusters common to all, which is the core of the mentioned meta-analysis. Indexes of clusters were reimplemented into output of multidimensional scaling and evaluated in terms of the relative distribution of countries.

4.1 Analysis throught Ward method

Within the hierarchical method there is not specified the number of clusters. This method results in dendogram from which we can indentify 4 main clusters, under condition that Luxembourg will be considered to be an outlier that does not fall into one cluster. With the "cutree" program R there were these four clusters plotted.

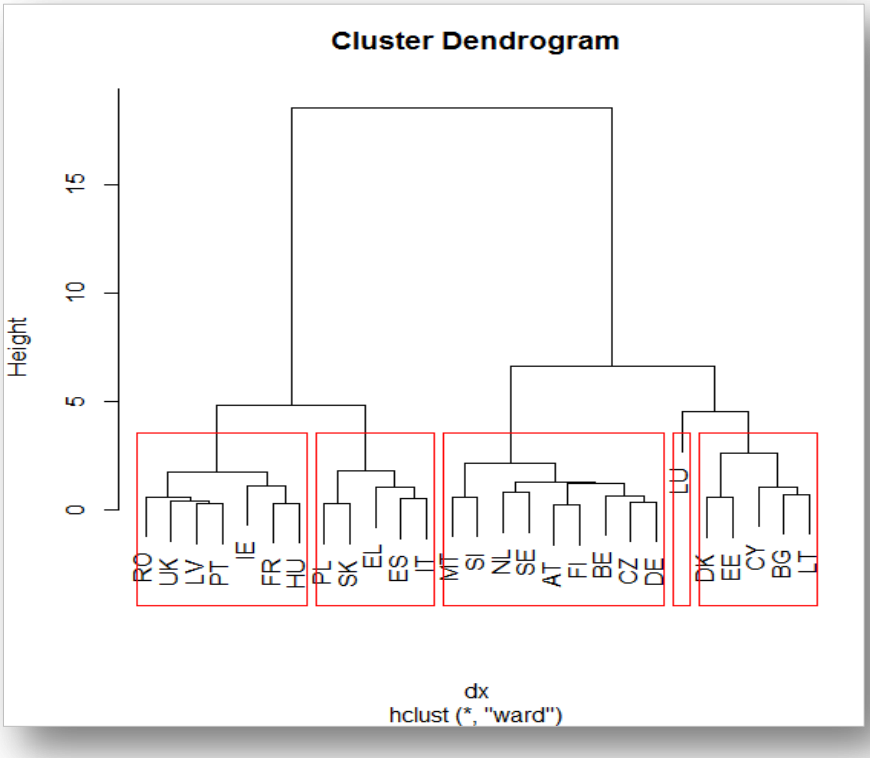

Figure 1 Dendogram designed by Ward´s method. Four clusters obtained by command *cutree*() and *Source*: output of the programme R

The first cluster is composed of 9 countries (MT, SI, NL, SE, AT, FI, BE, CZ and DE). Indicators results are slightly better than for the other cluster, but between the first cluster and second one considering Slovakia and Poland, there has been only nuance in comparison with some countries belonged to the first cluster. For these 9 countries, it is not possible to say with certainty that this is a less or more advanced economies. If we should focus on the use of reduced rates, most of these countries apply two reduced rates at least, and countries such as Ireland, France use 3 reduced rates. Just this factor can cause that real incomes are not as high as the theoretical ones for a given tax basis. Regarding countries like Romania and Latvia they were at the end of the scale in the success of choice, after Slovak. Therefore, this cluster includes countries that are close to the second cluster, like Slovakia and Poland are close to the first cluster.

The second cluster is composed of the 5-countries (PL, SK, EL, ES and IT), between them is also Slovakia. These are the countries which in our indicators achieved the worst results. Within this cluster, we confirmed our initial hypothesis that individual clusters will form on the basis of economic advancement, in this case the debt economies. Greece, Spain, Italy are the countries most in debt, bankrupt countries. As regards Poland and Slovakia, as mentioned above, these countries defy the indebtedness. Here is conformed the statement IFP (Novysedlák and Palkovičová, 2012), in which in 2011 Slovakia ended in 2011 on the 5th worst place in the ability of collecting revenue to the tax base. Slovakia and Poland were also among the countries whose implicit rate to the base rate was quite a bit lower, so it was the largest gap between these rates. Greece ended on the third worst place between expected and actual revenue collected from VAT under the IFP in 2011. Comparing the results of the IFP there is confirmed that in 2012 in the countries there is still an inefficiency of the tax collection.

Luxembourg is an outlier among the countries studied. Also apply the lowest long-term rate at a level of 15% since 1992. This is the most advanced economy, where GDP per capita is the highest among all member states. Luxembourg reached in 2012 the highest households consumption among all member countries, including indicators have reached the highest values.

A third cluster can be assessed by grouping together the most advanced EU economies. Reaches one of the best achievements according to our calculated indicators. Includes the Nordic countries-Sweden, Finland, applying the highest base rates among member countries. Other countries are Germany, Austria, which are also among the most developed economies. On the other hand we have countries such as Slovenia, Czech Republic, Malta, which are not among the most powerful economy, but in terms of VAT settings, placed comparable with other countries.

The fourth cluster consists of Cyprus, Bulgaria, Lithuania, Denmark and Estonia. These economies are among the new EU member states except Denmark. Regarding implicit rates calculated by our own, these had the slightest gap on base rates and also in other indicators they reached the best results. The common feature of these economies is that it is relatively geographically small countries with a high share of consumption in GDP, which could affect the overall collection of taxes. Bulgaria is a country that shifts between countries with a small area, but in recent years their consumption to GDP increased. Denmark is a country that as one of the few EU countries, does not apply any reduced rates, which may also be a reason for its good results and it is one of the most efficient countries. Another factor that could affect the integration of these countries is related to their small area. These economies are largely dependent on a significant part of imports, which also increases VAT revenues because the tax goes to the consumpiton- imports country's budget. Similarly is LU, which has been separated by its results. While these economies are not among the most advanced economies, achieve the most effective levying of VAT.

4.2 Analysis through K-means method

Within an analysis using k-*means* method there were considered 5 clusters, in which it is possible to consider that a fifth, cluster will likely be Luxembourg, that escape its above-average results among states. Based on this assumption LU will not be classified as a cluster.

Table 2 Classification through K-*means* method

CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4
Belgium	Belgium*	Greece	Bulgaria
Czech Republic	Ireland	Spain	Denmark
Germany	France	Italy	Estonia
Malta	Slovakia	Slovakia*	Cyprus
Holand	Poland	Poland*	Lithuania
Austria	Latvia		
Slovenia	Hungary		
Finland	Portugal		
Sweden	Romania		
	Great Britain		

Source: own processing of outputs from programme R
Note: *Countries Belgium, Slovakia and Poland were originally under the first method in another cluster, because these are shown two times.

Based on the results (Table 2) confirmed the status of Luxembourg as an outlier in the observations. Like in the previous analysis can be defined similar groups of countries. The first group consists of countries representing the advanced economies, which are characterized by relatively high consumption; values of studied variables among the second-best group. The second cluster represents less and more developed countries, however, the setting and collection of VAT belongs to the second worst. Change is that this group has been downgraded as Slovakia and Poland, which we classify among the worst countries according to the initial analysis: Greece, Spain and Italy. It is caused by the fact that under indicators was little difference between the two groups. On the other hand this does not exclude Slovakia from the group of countries that belong to one of the five worst countries. A third cluster includes after separation of Slovakia and Poland, countries with the greatest economic problems. They amounted to less efficient VAT system. The fourth cluster remained the same as in the previous method; therefore it is possible the countries included in it be considered well classified.

4.3 Analysis through K-medoids method

The k-medoids method try to find the optimal cluster of its center, and thus its average distance to the rest of clusters should be minimized. Within the method there is used the method PAM (Partition around medoida) and to confirm the findings method Silhouette.

Testing using method Partition around medoida. Using PAM clustering method begins by finding a representative group of objects, where the first object is characterized by the shortest distance to other elements. That is the optimal cluster center.

Table 3 Classification through PAM method

CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4
Belgium	Bulgaria	Belgium	Spain
Czech Republic	Estonia	Ireland	Greece
Denmark	Dánsko	Latvia	Italy
Germany	Cyprus	Hungary	Poland
Malta	Lithuania	Portugal	Slovakia
Holand		Romania	

Austria		Great Britain	
Slovenia		France	
Finland			
Sweden			

Source: own processing of outputs from programme R

On the basis of the results of the clustering (Table 3) it is possible to identify similar groups of the countries classified into the clusters as in previous methods. Belgium and Denmark are countries that have been included in other clusters by this method. Slovakia and Poland have been again incorporated back standing among the worst countries. Based on the comparison results of the all three analysis we can conclude that Slovakia, Poland, Belgium and Denmark are countries that have not been clearly identified in the three methods. Poland and Slovakia were at the interface between a group of countries with the worst countries on the stage and with better results. Ward method and PAM method placed them the same, K-means moved these countries among the countries that are better off.

The inclusion of Denmark is the same with Ward's method and K-means method, which ranked him among the most efficient systems. However, the PAM method included it in the lower level of the group. The last country is Belgium, which ended under the PAM method and K-means methods in the same cluster and vice versa Ward's method placed it at the lower category in terms of efficiency, calculated indicators.

Testing through Silhouette method

Silhouette method can be considered as a supplementary method of the previous PAM method. Silhouette quantifies for each object a value in the range from -1 to 1. The values closer to 1 means the more the cluster and the countries included in it better, while values closer to zero, reducing the percentage of inclusion. Negative values indicate that the country may be poorly identified within the cluster.

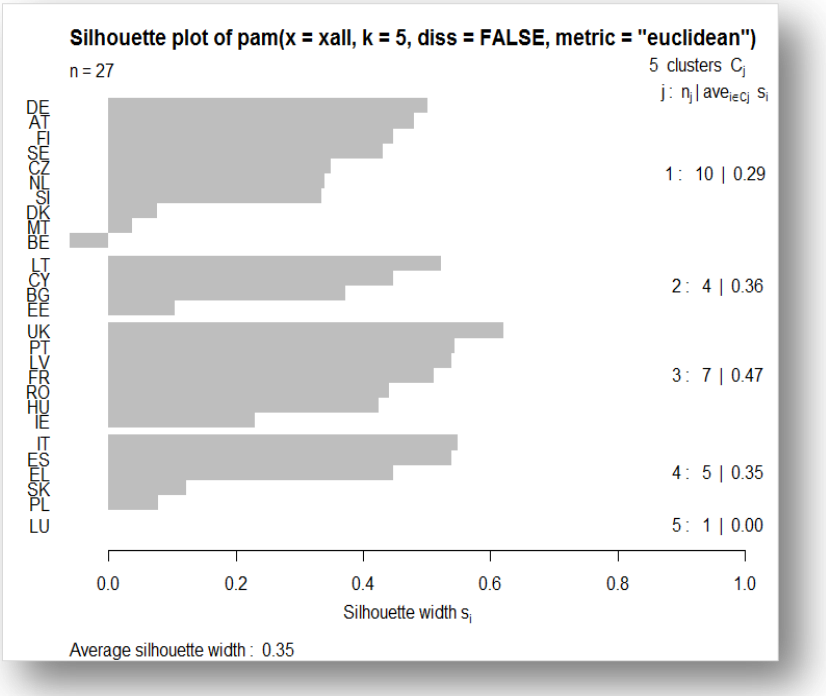

Figure 2 - Graphic illustration of validation of data clustering and Source: output of programme R

The strongest cluster of countries generated by PAM is the third one defined as a weaker structure, but it close to the average structure characterized by variable average silhouette width 0.61. Other clusters of countries are weaker structure. When analyzing those whose inclusion within the clustering methods can be distinguished by the method Silhouette, Belgium may be based on negative values considered misplaced country. Slovakia, Poland, Denmark have negative values, but are among the countries that have the lowest values for the average success of the cluster in which they are located.

4.4 Verification examined relations through multidimensional scaling

Multidimensional scaling (MDS) is a useful method for reducing the data into two-dimensional space. On this basis it is easier to identify relationships between countries and the potential outlier in the study group. The method analyzes the matrix similarities and differences, and the output is a multidimensional map (Meloun and Militký, 2004), this analysis a map of EU countries.

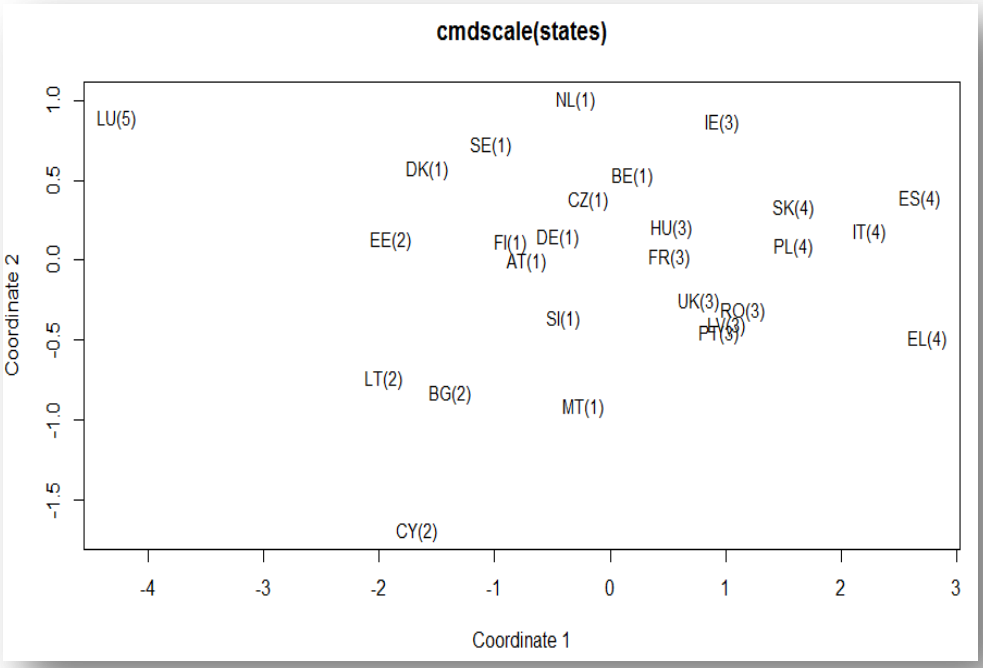

Figure 3 Alignment of the results of multidimensional scaling with the results of PAM analyses

Source: output of programme R

Figure 3 confirmed that Luxembourg is an outlier among the observed countries. There is also a visually confirmed cluster of countries that method Silhouette identified as the strongest (third cluster: countries UK, RO, LV and PT).

Confirmation of the methods results methods is also visible in the case of countries PL and SK, which represented countires tending to be rearranged between clusters. These countries also form the boundary between the first and second group of clusters according to the method of PAM. Precisely for these countries would be appropriate to create a new cluster.

Belgium is a country which method Silhoette identified as a misplaced country. Like Slovakia, and Belgium is quite at the interface between the first and third groups, and thus is more to our discretion other information where Belgium should be included. According to the visual scaling it would be more preferable to include Belgium in the third cluster between countries like the UK and France, according to the results of the PAM method and the same methods Ward.

Multidimensional scaling confirmed that the first best allocation method used Ward, to which they also incline.

Discussion and conclusions

Through the provided cluster analysis for the EU-27 on the basis of three indicators (VRR, VPR and G) were identified countries with similar state efficiency of the VAT system. The first two indicators (VRR and VPR) take into account the efficiency of VAT collection to the tax base and ability to generate revenue from the one percent rate in relation to GDP. The third indicator (G) is the gap between the base rate and the implicit rate.

Initial hypotheses H1 and H2 were determined at the beginning of the analysis and assumed EU countries distribution only by economic advancement and indebtedness, as well.

Hypothesis H1 that advanced economies have effectively set the VAT system can be considered partially confirmed. For the confirmation of the hypotheses can be considered the third most important cluster obtained by applying the Ward method. The third cluster of countries unite advanced economies of the EU, which has been placed on the second best place under monitoring of the indicators VRR, VPR and G. Cluster was characterized by the following features:

- Associates particularly the Nordic countries, which characterize their high-set VAT rates;
- With economies such as Germany and Austria have a stable social and economic environment and strong state legal system. Just these factors may affect the integration of these countries into a single cluster.
- The cluster is demonstrated a significant geographic dependence, as this is the vast majority of neighboring countries. As the only country of the V4 it was Czech which achieved comparable results with those countries. It is also a neighboring country with Germany and Austria;
- Hypothesis H1 can be considered partially confirmed as in clusters with developed economies there were also placed a less efficient economy. First cluster in the method Ward suggested that it is a advanced and less advanced economies, such as. France, Hungary, Ireland, Portugal. Their common feature is that they employ more than one reduced rate and reach the second worst record after bankrupt economies in southern Europe.

France and Ireland are among countries which apply up to 3 reduced rates. According to many studies, such as. (CASE, 2013) and (Reckon LLP, 2009), this dependence in the use of reduced rates was confirmed. Working on an analysis of reduced VAT rates and their impact on revenues from (Borselli, Chiri and Romagnano, 2012), confirms that the reduced rates have a negative impact on the overall levying of VAT. Specifically, only 60% of total household consumption is taxed at the full rate. According to a study by Copenhagen Economics: "… From a purely economic point of view is clearly the best approach one applicable rate of VAT. Less complicated rate structure would clearly create significant savings by reducing the costs associated with VAT obligations for businesses, both on the tax administration."

Hypothesis H2 predicted that countries with excessive indebtedness or failing countries are separated from the cluster of developed economies. That assumption was confirmed as a second cluster in the Ward method. It was the countries that are characterized by high debt and mismanagement of the government deficit. The countries have also a tendency less working tax administration in the form of high corruption. Countries during crises and unrest become non-standard economies with optimal settings for an inefficient tax administration. The analysis was conducted on specific countries Italy, Spain and Greece.

This group falls well as Slovakia and Poland. Although it is not the economy that is extremely indebted, it is neighboring countries within the V4, which are similar economic and legislative setting. In terms of foreign trade, Poland is an important trading partner for Slovakia. Even just this fact can have a big impact, that between our economies and Poland in the supply of goods and services may circumvention of legislation in the form of fraud, and so there is a choice of reducing VAT.

An interesting finding is that the best placed geographically small countries with a high share of consumption in GDP, which the cluster analysis included the fourth cluster. Achieve the best results examined indicators, which is mainly due to high consumption, but also that small countries are largely dependent on the import of what they can greatly increase the revenue from these taxes. E.g. Estonia, Bulgaria, Lithuania, Cyprus ended for 2012 with a negative balance of trade. This result confirms that it is the economy that is dependent on the import of goods and services. Denmark is the country, which in turn ended with an active trade balance. It is a specific country, as the only from

EU-27 does not use any reduced rates. This fact in this country plays an important role in the classification of the economy with the most efficient VAT collection.

Regarding the resetting VAT systems, many organizations set different recommendations and proposals for action. To (OECD, 2002) increasing rates of individual countries within the consolidation has its limits, particularly in countries whose base rate is already quite high. With an increase in rates, the amount of revenue losses expected increases as a result of the application of reduced rates and tax exemptions. Therefore, the recommends of the reforms to improve the performance and efficiency of the various VAT systems, among others, the expansion of the tax base, and the way that goods and services is to reduced rate or zero, will be progressively taxed at the full rate. The effective VAT system could thus be lower basic rate.

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FOREIGN DIRECT INVESTMENT AND MALAYSIA'S STOCK MARKET: USING ARDL BOUNDS TESTING APPROACH

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Abstract

The broad aim of the present study is to examine the influence of Foreign Direct Investment (FDI) inflow and in addition, some other macroeconomic variables namely domestic investment, inflation rate, domestic saving and GDP on Malaysia's stock market. This study is based on annual time series data covering the period ranging from 1988 to 2012. After checking the data for stationarity purpose, an Autoregressive Distributed Lag (ARDL) bounds testing approach has been employed for parameters estimation. The empirical results of ARDL bounds testing approach suggest that FDI inflow has a positive influence on the stock market. It is also found that domestic investment, domestic saving rate, GDP growth rate and inflation variables influence stock market. The estimated coefficient of FDI is found to be positive, which implies that the policy makers need to devise a friendly and conducive investment policy in order to enhance FDI inflow and encourage domestic investment. In addition, inflation rate needs to be controlled and the domestic savings should be encouraged in order to promote stock market. This study offers prodigious insights on the important implication of the FDI in stock market. The positive influence of FDI on stock market demonstrates the complementary role of inflows of FDI in the stock market. This study will certainly contribute to the growth of literature on the impact of FDI inflows on stock market capitalization.

Keywords: FDI, stock market, ARDL model, Malaysia

JEL codes: C50, F20; G20

Introduction

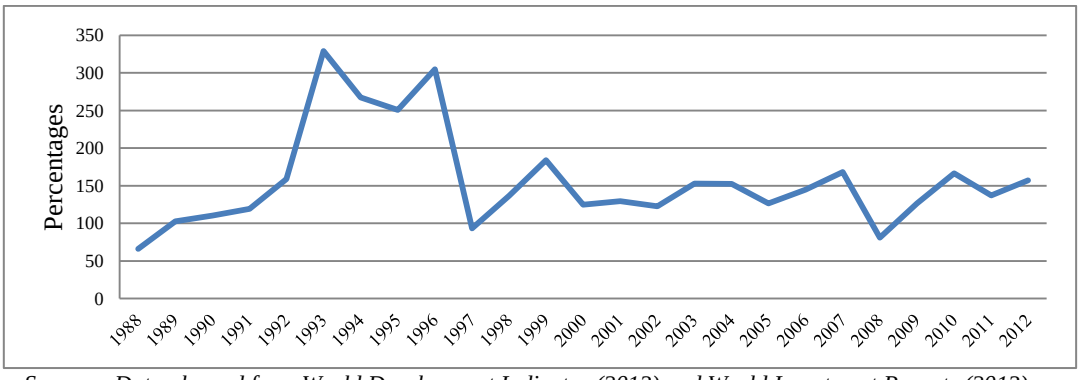
The importance of financial market, especially stable stock market has been growing largely at the global level. It is believed that stable stock market is an indicator of sound macroeconomic performance. The stock market plays a decisive role in the development of the commerce and industry in any country and consequently it affects the economy of the country to a large extent. Several prior studies argue that well-functioning stock market contributes positively to aggregate output (Singh, 1997; Levine *et al.*, 2000; Caporale *et al.*, 2004; Husain, 2006; Yartey, 2008; Adjasi and Biekpe, 2009; Cooray, 2010). In South Asia, the foreign investors have focused on the emerging financial markets, where the stock market have the potential and provide lucrative environment for the international investors (Wongbangpo and Sharma, 2002). Hussain (2006) stated that Japan is the most advanced market followed by East Asia such as China, Korea, Malaysia, Thailand, Singapore, Hong Kong, Philippines and Indonesia. Among the East Asia, Malaysia has a large equity and bond market in relation to its Gross Domestic Product (GDP). However, according to Levine (1996) "*Do stock markets affect overall economic development? Some analysts have viewed stock markets in developing countries as "Casinos" that have little positive impact on economic growth*". In a study, Sarkar (2007) has shown that there is no relationship between stock market and economic growth.

Foreign capital inflow provides many benefits include contribution to the recipient countries capital formation and production capacity, modern technology, knowledge and enhance tax revenue. Therefore, foreign capital inflows have sound effects on the recipient country's production, employment, income, balance of payments and economic development and growth (Gumus and Gungor, 2013). Though, both components of the foreign capital inflows i.e., FDI and portfolio investment are the paramount variables affecting the stock market. However, the focus of the present study is mainly to explore the role of FDI along with a few noteworthy factors influencing the Malaysia's stock market. In a study, Wang and Shen (1999) have noted that the proponents of foreign investment claim that due to its stabilization and demonstration effects, it has a vital positive effect on

domestic stock market in the recipient country. The inflows of foreign capital have long term influence on stock market development and further enhance investment (Errunza, 1983; Sing, 1997; Claessens *et al.*, 2002; Yartey, 2008; Malik and Amjad, 2013). Karthik and Kannan (2011) found positive relationship between FDI and the stock market development of India during 1971-2006. Doytch (2013) has concluded that from macroeconomic perspective, it is however expected to have a positive impact of foreign capital on domestic stock market capitalization, while at the microeconomic level; it is a complex decision that requires further analysis and more thorough understanding. Acheampong and Wiafe (2013) have shown that the incoming FDI flows have positive impact on stock market development of Ghana. On the other hand, some earlier studies, for example, Wang and Shen (1999) concluded that foreign investment had a mild effect on the volatility of the stock returns in Taiwan during January, 1991 to November, 1995.

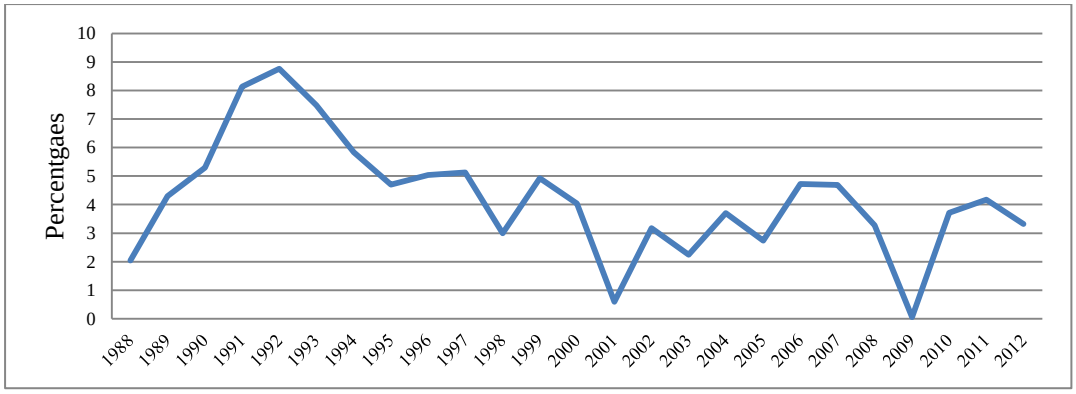
According to the US Department of States (2013), Malaysia's stock market (Bursa Malaysia) is open to foreign investment and foreign corporation issuing shares. In market capitalization, Malaysia has the 3rd largest corporate bond market, behind only Japan and Korea where both domestic and foreign investors often intend to trade in securities and derivatives. It became evident in 2011, when inflows of foreign capital shifted back into Malaysian bonds after a US $ 35 billion outflow during the 2008-9 global financial crises. Malaysia's percentage of overall investment in the ASEAN member states is now lower than its share of the group's GDP. The inflow of FDI from Japan to Malaysia has been estimated to the largest inflows of RM 26.3 billion from 2009 to August 2013 (Bernama, 2013). Due to constant efforts, Malaysia has regained its position to enhance foreign investment, where around US$10 billion worth of FDI flows was received in 2012. The Malaysian Investment Development Authority attempts to establish the country as a global outsourcing hub for high-tech manufacturing value chains (UNCTAD, 2013).

The World Investment Reports (2013) have reported that out of the FDI flows to East and South-East Asia, China is at the top, followed by Hong Kong, Singapore, Indonesia and Malaysia. The data statistics indicates that FDI flows to Malaysia are relatively at the lowest level if compared with other countries in the region. Figures 1 and 2 show the trend analysis of market capitalization and FDI inflows as percentage of GDP into Malaysia respectively. It can be read from Figure 1 that after a sharp decline in 1997, the market capitalization upsurged gradually. However, Figure 2 reveals that FDI inflows after 1992 have not yet recovered its previous level. Though, UNCTAD's World Investment Report (2011) proposes that global inflows of FDI will continue to regain from pre-crisis position. In 2013, FDI flows are expected to hit US $ 1.9 trillion. The government of Malaysia believes that key factors play crucial role in enhancing more FDI such as conducive and stable business environment, market orientation, sound infrastructure comprising excellent transport connectivity and advanced communications infrastructure, cost effective, appropriate government policies and tax incentives. However, more committed and practical efforts are required to enhance foreign investment.



Sources: Data gleaned from World Development Indicator (2013) and World Investment Reports (2013)

Figure- 1: Trend in market capitalization ratio to GDP of Malaysia



Sources: Data gleaned from World Development Indicator (2013) and World Investment Reports (2013

Figure-2: Trend in foreign direct investment inflows as percentage of GDP to Malaysia

The main purpose of this paper is to test the impact of FDI inflow on Malaysia's stock market. Prior theoretical and empirical studies on the impact of FDI on Malaysia's stock market have either unobserved or shed cursory light on the impact of FDI on stock market. This paper is distinguished from the prior ones in terms of the longevity of the period it takes into account. Many studies have surveyed the factors affecting stock market through different viewpoints and with different explanatory variables. However, the portfolio of regressors with holistic approach used in this paper is certainly different as compared to prior studies conducted on Malaysia's stock market determinants. Thus, the current study will positively contribute to the growth of literature on the subject matter particularly with reference to Malaysia.

The present paper is designed as follows. Section 1 above explains introduction along with some stylized facts and figures of Malaysia. Section 2 reviews the relevant literature on the factors influencing stock market. Section 3 discusses data sources, explains variable and elaborates the methodology used. Section 4 present estimations and interprets the empirical results. Section 5 concludes the paper.

Literature review

Though, vast abundance of literature exists on the factors influencing stock market capitalization, where, literature on the impact of FDI on Malaysia's stock market is seemingly scarce. It is also noticed by Hosseini *et al.* (2011) that quantitative studies on the impacts of macroeconomic variables on stock market in developing Asian countries including China, India, Indonesia, Iran, Malaysia, Singapore, and Thailand etc. are less obvious. The existing literature indicates that there are many factors determining stock market. Some earlier studies, for example Garcia and Liu (1999) found that saving rate, real income, financial intermediary development and stock market liquidity are the essential factors influencing stock market capitalization in fifteen industrial and developing countries during 1980-1995. Wongbangpo and Sharma (2002) observed that high inflation in Indonesia and Philippine affected the long run inverse relationship between stock prices and money supply, while the money growth in the case of Malaysia, Singapore and Thailand revealed the positive influence for their stock market during 1985-1996. In a study, Hosseini *et al.* (2011) found that there are both long and short run relationships between macroeconomic variable (i.e., crude oil price, money supply, industrial production and inflation rate) and stock market index during January 1999 to January 2009 in China and India. Evrim-Mandaci *et al.* (2013) used a panel of country observations gathered for 30 countries during 1960-2007. The results revealed that FDI, remittances and bank credits to private sector had significant positive effects on stock market development measured by market capitalization.

The study of Katerina *et al.* (2004) applied Bayesian analysis and found that FDI does not exhibit any significant impact on the rate of growth of a panel of 17 transition economies during 1995-1998. Ferreira (2013) findings show non-linearities of FDI with stock markets and of oil prices with stock markets since the explanatory variables have significant and negative effect on lower quantiles and significant and negative effect on lowest and highest quantiles during 1995-2012 for

eight Eurozone countries namely Austria, Finland, France, Germany, Italy, Netherlands, Portugal and Spain.

Presumably, available studies on the relationship between FDI inflow and Malaysia's stock market are skimpy. According to Rahman *et al.* (2009), the lag exclusion test demonstrated that all selected variables add extensively to the co-integrating relationship. This revealed that the Malaysian stock market is sensitive to changes in the variables namely real exchange rate, industrial production index, interest rate and money supply on Kuala Lumpur Composite Index proxy for Malaysian stock market during January 1986 to March 2008. In a study, Bekhet and Othman (2012) found that there exists long run association among stock index, fiscal (i.e., government operating expenditure, government development expenditure and tax revenue) and monetary (i.e., interest rate and money supply) tools for Malaysia during 1999:Q1 to 2011:Q4. The study argues that seemingly monetary tools can work relatively quicker than fiscal tools. After a comprehensive look on the available literature on the factors determining stock market in general and role of FDI in particular, it is not exaggeration to expound that work on the area which is under the study is imperative. The outcomes of this study will certainly highlight the importance of incoming FDI in context of Malaysian stock market in particular. In addition, the outcomes will help to advise the policy makers in order to enhance more FDI inflows by formulating relatively conducive and investment friendly environment in the country. Some selected erstwhile empirical studies on factors affecting stock market are given in Table 1.

Table 1- Some selected empirical studies on factors affecting stock market

Author (s)	Country, Sample periods, Methodology	Response variables	Explanatory variables	Findings
Shahbaz *et al.* (2013)	Pakistan, 1971-2006 ARDL Bounds Testing Approach	Stock market development	FDI, GNP per capita, inflation rate and domestic savings	Results support the complementary role of FDI in the stock market development of Pakistan
Bekhet and Othman (2012)	Malaysia, 1999:Q1 to 2011:Q4 VECM	Stock index	Fiscal tools and monetary tools	Monetary tools can work faster than fiscal tools
Al-Halalmeh and Sayah (2010)	Jordan, 2006-2009 Amman exchange market	Shares market value	FDI	FDI has a significant impact on shares market value
Rahman *et al.* (2009)	Malaysia January 1986 to March 2008, VAR	Malaysian stock market	Industrial production index, real exchange rate, money supply and interest rate.	Malaysian stock market is sensitive to changes in the all explanatory variables used in the study.
Adam and Tweneboah (2008)	Ghana 1991:QI to 2006:QIV, Cointegration test and VECM	Stock market development	Net FDI inflow and exchange rate	Positive and significant influence of FDI on the development of stock market
Yartey (2008)	42 emerging economies 1990- 2004 GMM	Stock market capitalization	Private credit, value traded, Log GDP per capita, credit, FDI, inflation, political risk, law and order, corruption, bureaucratic quality and democratic accountability	FDI has positive impact on stock market

Note: Almost all erstwhile studies to measure stock market development using market capitalization as a proportion of GDP

Data, Variables and Methodology

This study is based on secondary data covering the time period from 1988 to 2012. Data on all variables have been extracted from the World Development Indicator, the World Bank database (2013) and World Investment Reports, UNCTAD (2013). The raw data were in current US$ but have

been arranged properly for robust empirical investigation purpose. A brief explanation of the variables used in this study is narrated below:

Market capitalization or market value as a proportion of GDP is proxy for stock market as the dependent variable. Listed domestic companies are the domestically included companies listed on the country's stock exchanges at the end of the year. However, it does not incorporate investment companies, mutual funds, or more collective investment vehicles. Most of the erstwhile studies used this proxy for stock market development or performance (Garcia and Liu, 1999; Yartey, 2008; Malikand Amjad, 2013; Evrim-Mandaci *et al.*, 2013).

Foreign investors have been focusing constantly on investment in those countries where they can maximize their profit. Hence, due to globalization, the foreign capital inflows have increased tremendously. Some prior studies have also discussed and explored empirically the impact of FDI on stock market development (Errunza, 1983; Sing, 1997; Yartey, 2008; Acheampong and Wiafe, 2013).

Saving has a positive influence on the stock market performance. The higher the savings, the greater the amount of capital flows through the stock market. Garcia and Liu (1999) found that increase in savings is channeled through the stock markets. Studies like, Yartey (2008), Akpan *et al.* (2009) and Shahbaz *et al.* (2013) have shown evidence about the positive relationship between domestic saving and stock market. Gross domestic investment as a determinant of stock market has also been used by some erstwhile studies such as Garcia and Liu (1999) Yartey (2008) and Cherifand Gazdar (2010).

Sustained and desirable level of economic growth has been observed to be closely related to the size of market. Similarly, large market size of a country is certainly a good indicator for foreign investors. Prior studies including Yartey (2008); Naceur *et al.* (2007) and Raza *et al.* (2013) have also used income as an explanatory variable.

Macroeconomic instability may be discouraging development of the stock market, while macroeconomic stability encourages it. In the presence of stability in a country, investor expects relatively more profit which is their main objective and investors have to join in the stock market. Usually, macroeconomic stability is measured through inflation. If inflation is low, it indicates macroeconomic instability and vice versa. Thus, high inflation negatively affects the development of stock market. Fama (1981) and Zhao (1999) observed that inflation rate has a negative effect on stock market. Choudhry (2001) finds a positive relationship between current stock market returns and current inflation, whereas, Christos (2004) reports that the inflation rate is not correlated with stock returns.

In order to empirically test the long run relationships among the variables of interest namely FDI, domestic investment, domestic saving, GDP growth rate, inflation rate and stock market, this study employs the Autoregressive Distributed Lag (ARDL) Cointegration technique. The ARDL by (Pesaran and Shin, 1997; Pesaran *et al.*, 2001) is a widely used approach designed for testing cointegrating analysis. According to Pesaran and Shin (1997), *the ARDL approach has the additional advantage of yielding consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying regressors are I(1) or I(0).*

The standard equation after following cautiously the systematic procedure for the ARDL bounds testing approach can be expressed as unrestricted error correction model as follows:

$$\Delta SM_t = \beta_0 + \beta_1 SM_{t-1} + \beta_2 FDI_{t-1} + \beta_3 GDI_{t-1} + \beta_4 DS_{t-1} + \beta_5 G_{t-1} + \beta_6 P_{t-1} + \sum_{i=1}^{q} \beta_7 \Delta SM_{t-i}$$

$$+ \sum_{i=1}^{q} \beta_8 \Delta FDI_{t-i} + \sum_{i=1}^{q} \beta_9 \Delta GDI_{t-i} + \sum_{i=1}^{q} \beta_{10} \Delta DS_{t-1} + \sum_{i=1}^{q} \beta_{11} \Delta G_{t-1} + \sum_{i=1}^{q} \beta_{12} \Delta P_{t-1} + \varepsilon_t \quad (3.1)$$

Where, SM denotes stock market proxy as market capitalization of listed companies ratio to GDP, FDI is the net inflows of foreign direct investment ratio to GDP, GDI is the gross capital formation (previously gross domestic investment), G is GDP growth rate annual percentage, P is inflation, GDP deflator (annual %), DS denotes domestic savings ratio to GDP, Δ denotes the first-difference operator and ε is error term. The subscript (t) indexes time. It is assumed that the ε is to be independently and identically distributed ($\mu_t \sim$ iid (0, σ2).

It is postulated that the impacts of domestic saving, domestic investment and GDP growth rate would be positive on stock market. However, inflation is expected to be negatively related to the stock market. Likewise, the impact of FDI inflows on stock market would be determined.

A brief detail of the descriptive statistics of variables used in this study is presented in Table 2. It is evident from the Table 2 that Malaysia's stock market proxy as market capitalization as percentage of GDP recorded the maximum value of 328.876 % in 1993, while the lowest was estimated at 66.0583 % in 1988. The maximum inflows of FDI ratio to GDP into Malaysia was documented to be 8.763% in 1992, while the lowest value of 0.057 % was reported during 2001. The GDP growth rate was estimated at 10.003% during 1996, while it recorded minimum value of -7.359% in 1998. The maximum value of gross domestic investment to GDP ratio was estimated to be 43.640% in 1995, while it recorded the minimum of 17.836 % in 2009. Inflation, GDP deflator (annual percentage) recorded the highest value of 10.389% in 2008, and its minimum value was -5.992% in 2009. Likewise, the highest gross domestic investment to GDP ratio was estimated at 48.670 % in 1998, while it recorded the lowest value of 33.749 % in 1988. The correlation matrix results are also reported in Table 2, where all the variables bear correct signs and support the hypothesis of the study.

Table 2 - Descriptive statistics and correlation matrix

Statistic & Variables	SM	FDI	GDI	G	DS	P
Mean	156.454	4.203	28.664	6.288	40.862	3.891
Median	137.212	4.168	24.777	6.783	41.838	3.806
Maximum	328.876	8.762	43.640	10.003	48.670	10.389
Minimum	66.058	0.057	17.836	-7.359	33.749	-5.992
Std. Dev.	65.728	2.033	7.942	4.027	4.191	3.397
SM	1					
FDI	0.401	1				
GDI	0.553	0.672	1			
G	0.288	0.5889	0.5047	1		
DS	0.094	-0.226	-0.226	-0.453	1	
P	-0.103	0.209	0.039	0.125	0.336	1

Estimation and Empirical Results

Using time series data, it is mandatory to check for stationarity of the data. Therefore, this study employs the standard unit root test for checking stationarity of the data and the results of Augmented Dickey Fuller (ADF) test are reported in Table 3. Table 3 indicates that some variables are integrated of order zero, I(0), whereas some are integrated of order one, I(1). Results of various diagnostic tests are reported in Table 4, which reveals that there is no econometric problem including serial correlation.

The next step is the ARDL bounds testing approach. The F-test for the joint significance of the coefficients of the lagged levels of the variables is used to decide the acceptance or rejection of the cointegration hypothesis. The null hypothesis of the presence of cointegration is stated as: H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$, and tested against the alternative hypothesis of no cointegration: H_a: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq 0$. This study signifies that the F-statistic of the test which normalizes on F_{SM} *(SM\FDI, GDI, DS, P, G).* Maximum lag order of 2 chooses for the conditional ARDL vector error correction model by operating the Akaike Information Criteria (AIC) as the data is time series and the results of bounds test are given in Table 5. From the result in Table 5, the F-statistics estimated is 5.315 which is higher than the upper level of bound critical value of 4.781 at 1 percent level of

significance. The respective lower bounds value is 3.516. It can be inferred from these results that there are long run relationships among the variables when stock market is the dependent variable.

In a similar vein, Table 6 indicates the long term coefficients using the ARDL approach. The empirical results show that FDI, domestic saving and GDP growth rate have positive influence on stock market. The estimated coefficient for FDI is statistically insignificant. Inflation has negative and significant impact on stock market, whereas domestic investment is found to be insignificant with unexpected sign.

For more robustness, this study utilizes the other estimators such as FMOLS approach suggested by Phillips and Hansen (1990) and the results are reported in Table 7. It is evident from Table 7 that FMOLS estimates are quite interesting and all variables carry their expected sign, support the hypothesis of the study. In addition, the OLS approach introduced by Gauss (1795) was used for parameters estimation and the results are presented in Table 8. From the results, the R^2 is around 45% and adj. R^2 is 30 %. These represent the percentage of variation in dependent variable explained by the regressors. The F-ratio is also acceptable indicating the joint influences of regressors in the response variable. The D.W. ratio demonstrates that the model is free of serial correlation with its value greater than R^2 value. This further indicates that regression is not spurious but acceptable. Furthermore, the Breusch-Godfrey Serial Correlation LM Test was used and the results found are in favour of D.W. ratio. This further confirms the nonexistence of serial correlation problem. Table 8 portrays that FDI, domestic investment, domestic saving and GDP growth rate are positive, while inflation exhibits a negative impact on stock market capitalization.

The findings of this study are in accord with findings by Zhao (1999), Adam and Tweneboah (2008), Yartey (2008), Akpan *et al.* (2009), Cherifand Gazdar (2010) and Acheampong and Wiafe (2013). Overall, results obtained are satisfactory, based on R^2, adj. R^2, t-ratio, F-ratio and other relevant diagnostic tests during the period under the study. The estimated coefficients bear the correct expected signs which further indicates that estimated models have goodness of fit and the results are reasonable for onwards policy considerations.

Table 3-Results of ADF unit root test for stationarity

	Level		First Difference	
Variables / Constant		Trend & Constant	Constant	Trend & Constant
SM	-3.053831(0) -2.432636(1)	-3.165714(0) -2.673538(1)	-6.217689(0) -4.733837(1)	-6.123854(0) -4.701606(1)
FDI	-2.565668 (0) -2.035334 (1)	-3.615331(0) -3.173502 (1)	-5.683931(0) -4.004846(1)	-5.558378(0) -3.886160(1)
DS	-1.839486(0) -1.850521(1)	-0.925077(0) -0.871404(1)	-4.463429(0) -2.428675(1)	-5.249148(0) -3.242534(1)
GDI	-1.418784 (0) -1.393002(1)	-2.744335(0) -2.528174(1)	-4.550489(0) -3.390714(1)	-4.407219(0) -3.313616(1)
G	-4.034327(0) -3.114718(1)	-4.633029(0) -3.867234(1)	-	-
P	-7.287916(0) -4.240163(1)	-7.110885(0) -4.127599(1)	-	-

Note: The MacKinnon (1996) critical values for constant are -3.7343, -2.9907 and -2.6348 and for constant & trend are -4.3942, -3.6118 and -3.2418 at 1%, 5% and 10% levels of significance respectively. Figures in brackets shows lag length.

Table 4- Relevant diagnostic tests

Item	Test applied	CHSQ	Prob.
Serial Correlation	Lagrange Multiplier Test	0.3569	0.551
Heteroscedasticity	White Test	2.0348	0.154

Table 5-Results from Bounds Test for Cointegration Analysis

Critical value	Lower Bound Value	Upper Bound Value
1%	3.516	4.781
5%	2.649	3.805
10%	2.262	3.367

Note: Computed F-statistic (p-value): 5.3148 (0.099). Testing the existence of a long run relationship: critical value bounds on the F statistic are gleaned from appendix C, Case II intercept and no trend for k=6 (Pesaran and Pesaran, 1997, p. 478).

Table 6- Estimated Long Run Coefficients using the ARDL Approach

Regressors	Coefficients	Std. Error	T-Ratio
FDI	14.3930	10.6917	1.3462
GDI	-6.1109	4.5301	1.3489
GDS	9.3857	4.0162	2.3370
G	11.9807	9.2652	1.2931
P	-26.4279	10.1196	2.6116
Constant	-84.1073	172.0857	0.4887

Table 7- FMOLS estimates

Variable	Coefficient	Std. Error	T-Ratio
FDI	2.947042	5.887591	0.500552
GDI	3.244841	1.295844	2.504036
G	3.948977	2.666733	1.480829
DS	5.839201	2.375392	2.458205
P	-5.272946	2.557819	-2.061501
Constant	-188.8878	105.9527	-1.782756
R^2	0.404597		
adj. R^2	0.239208		
Durbin-Watson stat	1.948657		

Table 8 - OLS estimates (Dependent variable is stock market)

Variable	Coefficient	Std. Error	T-Ratio
FDI	3.896865	8.295746	0.469743
GDI	3.932455*	1.960821	2.005514
DS	6.800161*	3.353664	2.027681

Variable	Coefficient	Std. Error	T-Ratio
P	-6.191582	3.802572	-1.628262
G	3.487683	3.912679	0.891380
Constant	-248.3524	147.5559	-1.683107
R^2	0.446791		
adj. R^2	0.301210		
Durbin-Watson stat	1.967766		
F-statistic	3.069012		
Prob (F-stat)	0.033874		
Diagnostic tests: Breusch-Godfrey Serial Correlation LM Test (p-value)= 0.023 (0.977), Heteroskedasticity Test: Breusch-Pagan-Godfrey (p-value)=2.591(0.059)			

Asterisk * indicates 10 percent level of significance

Summary and Conclusion

The present study has attempted to examine empirically the impact of FDI with some other macroeconomic variables namely domestic investment, inflation rate, domestic saving and GDP on Malaysia's stock market capitalization using an annual time series data for the period from 1988 to 2012. The distinctive feature of this study is that it offers enriched insight from a new dimension. The empirical results obtained bear the correct signs, which support the study hypotheses. Nevertheless, some variables are statistically insignificant. It is evident from the data statistics on FDI inflows, that Malaysia has not yet regained the previous incoming FDI level as in during 1992. However, the estimated coefficient of FDI found is positive as expected. It implies that if the FDI inflows are enhanced, it will certainly have further progressive effect on the stock market.

The main conclusion that can be drawn based on the empirical results discovered is that FDI is the important factor affecting stock market. This study also has some policy implications, that in order to stimulate Malaysia's stock market development, it is imperative for the policy makers to control inflation, boost domestic savings through satisfactory incentives, control exchange rate from further depreciation, and most essentially is to create conducive environment for foreign investment. A suggestion for future research is to include portfolio investment in the model in order to determine their significance as a factor of stock market in the context of Malaysia.

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MARKETING PRICING STRATEGY AS PART OF COMPETITIVE ADVANTAGE RETAILERS

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Abstract:

The article is focused on pricing policy and marketing pricing strategies applied in the branches of retail chains in the selected region of Slovakia. An important part of this article is a demonstration of the most commonly used marketing pricing strategies from the perspective of marketing managers of affiliates of retail chains operating in the examined region of Slovakia. The aim of this article is to detect and highlight the most utilized marketing pricing strategy within the surveyed branches of retail chains operating in the North East of Slovakia. The analysis of variance (ANOVA) and Student two-sample test were used to detect differences of comparison.

Keywords: pricing policy, marketing pricing strategies, retail trade, competition.

JEL Classification: M30, M31

1. Introduction

For most of history prices were wagered by negotiation between a buyer and a seller. Negotiation is still a popular discipline in some areas. The idea of setting one price for all buyers was developed with the beginning of mass retailing in the late 19th century. F. W. Woolworth, Tiffany & Co., John Wanamaker and others advertised "one price policy" because they offered a large number of items and employed many employees. Traditionally, price acts as a major factor influencing the choice of the buyer (Kotler and Keller, 2013; Pudło and Gavurová, 2012). Several authors Kotler *et al.* (2009), Solomon *et al.* (2006), Kotler and Keller (2007), Štefko (2003), Gburová (2011) point out that price decisions and pricing strategies are considered as a highly accented issue that must be to a large extent handled by marketing. Pricing issue in market conditions is also the specific issue of each company. Price is an item of the mix marketing; its task together is to with other instruments bring the company to its marketing objectives (Kita *et al.*, 2010).

Economic fall in recent years caused the "price pressure" for a lot of companies. Price cutting is not always the best answer, because unnecessary cutting can lead to a profit loss or dangerous price wars (Užík and Šoltés, 2009; Szabo *et al.* 2013). This may indicate to customers that a price is more important than a brand. In pricing companies must carefully consider a number of internal and external factors while choosing a price, which provides them the biggest competitive advantage on the selected markets. Pricing decisions are limited by laws and ethical factors (Kotler *et al.*, 2007; Foust, 2003; Gavurová, 2011, 2012). Currently, companies have to face constant price change of their competitors. The strategy often depends on whether the company produces homogeneous or non-homogeneous products (Kotler *et al.*, 2009). Pricing must become an integral part of the marketing strategy of the company and must also comply with corporate and marketing objectives, as well as other elements of the marketing mix. In addition to these inputs a prices trader has to consider the demand, price and competition while making decisions about prices (Gavurová *et al.* 2014; Laucaster and Massingham, 2010). Making the qualitative pricing strategy requires an understanding of various situations, considerable background material and results of proven experience in a variety of situations, which arised during the competition compete. Their use and good theoretical knowledge are prerequisites for the success of processed procedures in price area of every businessman (Olah *et al.*, 2009; Šoltés and Gavurová, 2013). Companies usually do not provide the only price, but rather a pricing structure that reflects the diversity of demand and costs between different regions, the

requirements of individual market segments, timing of purchase, warranty, service contracts, and other factors. As a result of rebates, deductions and sales promotion company rarely achieves the same profit from each unit sold product (Kotler and Keller, 2013). Price is often the most important, in some cases, the only factor that can influence the consumer to purchase.

2. Aim, methods and materials

The aim of the research was to identify the most used marketing pricing strategy of retailer affiliates in North-Eastern Slovakia. The base set consisted of all retail affiliates in the territory of North-Eastern Slovakia. The sample was obtained by selection of easy accessibility. We used questioning to get obtain primary data. Regional managers of retail affiliates were questioned, in total 107 respondents. Structure of respondents by age and gender of regional managers is presented in Table 1.

Table 1 - Structure of the sample by age and gender of regional branch managers of retail chains

	Frequency	Percent	Valid Percent	Cumulative Percent
age 18 - 29	11	10.3	10.3	10.3
age 30 - 39	36	33.6	33.6	43.9
age 40 - 49	41	38.3	38.3	82.2
age 50 - 59	19	17.8	17.8	100
Man	41	38.3	38.3	38.3
Woman	66	61.7	61.7	100
∑	107	100	100	x

Source: own elaboration

Another reference identifier was the range of retailer affiliates offers Table 2.

Table 2 - Structure of the sample by region range offers of retailers affiliates

	Frequency	Percent	Valid Percent	Cumulative Percent
Food	4	3.7	3.7	3.7
Food and toiletries	40	37.4	37.4	41.1
Mixed goods	15	14.0	14.0	55.1
Drugstore	10	9.3	9.3	64.5
Clothing, footwear	14	13.1	13.1	77.6
Furnishings	11	10.3	10.3	87.9
Electronics	7	6.5	6.5	94.4
Other	6	5.6	5.6	100
∑	107	100	100	x

Source: own elaboration

In terms of the offered range of surveyed retailer affiliates in the North-Eastern Slovakia, the largest area are food and toiletries i.e. 40 (37.4%) of the 107 respondents, followed by mixed goods 15 (14%) (the most common type of goods offered by large retail chains such as. Tesco, Billa, Hypernova and others), a third area consists of clothing and footwear 14 (13.1%) followed by furnishings and carpets 11 (10.3%), drugstore 10 (9.3%), electronics 7 (6.5%), 6 (5.6%) other (toys, garden furniture and others.) and the last group of the area offered range i.e. 4 (3.7%) is separate food.

To achieve the main objective of the research we have set the following hypotheses:

H1: We expect that there are applied only some of the known marketing pricing strategies in surveyed retailer affiliates in North-Eastern Slovakia.

H2: We assume that the choice of marketing pricing strategies is related to the size of the surveyed retail affiliates located in the North-Eastern Slovakia.

Marketing pricing strategies listed by a subject of examination (S1 - S13):

S1 - high introductory prices strategy,
S2 - penetrating price strategy,
S3 - premium price strategy,
S4 - price strategy of a main competitor,
S5 - high price/quality pricing strategy,
S6 - promotional discounts strategy,
S7 - geographic pricing strategy,
S8 - single price strategy,
S9 - permanently low price strategy,
S10 - cost-plus pricing strategy,
S11 - current cost strategy of a main competitor,
S12 - discriminatory pricing strategy,
S13 - action price strategy.

Respondents (regional managers of retail affiliates) answered closed questions. The obtained primary data were then processed in a statistical program. Selected statistical methods as analysis of variance (ANOVA) and Student two-samples test were used.

3. Results and discussions

Retailers work with a broad portfolio of marketing pricing strategies. Marketing managers of retailer affiliates included discount promotional strategy among the most used marketing pricing strategies (S6; 1.710, Table 3). Pricing strategy of a main competitor (S4; 2,168) was identified by respondents as the second most used marketing pricing strategy and action prices strategy took third place (S13; 2,178).

Conversely the least used marketing pricing strategies in a surveyed locality (North-Eastern Slovakia) were based on respondents' answers included premium pricing strategy (S3; 3.477) and high introductory pricing strategy (S1; 3,131). Table 3 and Figure 1 presents the order of used pricing strategies (S1 - S13) of individual branches of retail chains operating in the North East of Slovakia in terms of their marketing managers.

Table 3 – Marketing pricing strategies

	N_i	Average	Min.	Max.	Std. Dev.
S1	107	3.131	1.000	5.000	1.237
S2	107	3.000	1.000	5.000	1.197
S3	107	3.477	1.000	5.000	1.022
S4	107	2.168	1.000	4.000	1.023
S5	107	2.850	1.000	5.000	1.164
S6	107	1.710	1.000	4.000	0.813
S7	107	2.841	1.000	5.000	1.074
S8	107	2.654	1.000	5.000	1.229
S9	107	2.720	1.000	5.000	1.180
S10	107	2.841	1.000	5.000	0.837
S11	107	2.336	1.000	4.000	1.081
S12	107	2.879	1.000	5.000	1.187
S13	107	2.178	1.000	5.000	0.989

Source: own elaboration

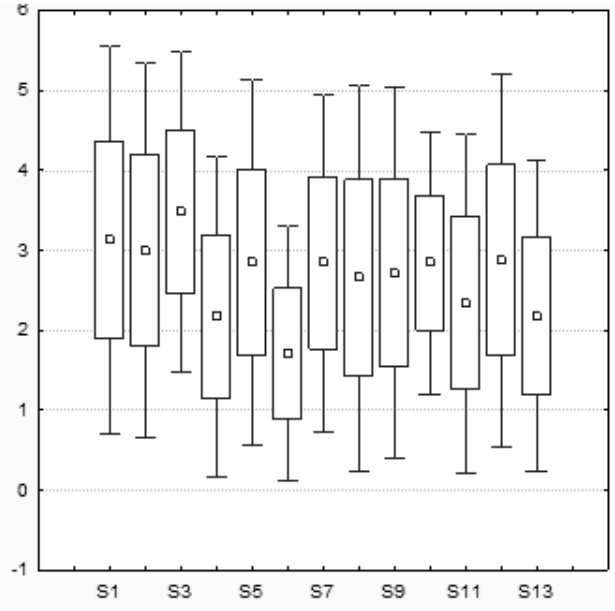

Figure 1 – Box plot – Marketing pricing strategies

Source: own elaboration

To detect the use of different marketing pricing strategies, we used analysis of variance (ANOVA) for repeated measurements. The results are presented in Table 4.

Table 4 – Analysis of variance (ANOVA) of using of marketing pricing strategies

Source of variance	Sum of squares	df	Average square	F	p
Model	10117.122	1	10117.122	4807.050	0.000
Error	223.092	106	2.105		

Source: own elaboration

Based on the results presented in Table 4, it can be stated that the retail affiliates operating in the region of North-Eastern Slovakia apply only some of the known marketing pricing strategies. On the chosen level of significance ($\alpha = 0.05$) there was measured a difference in responses to individual questions big enough to be merely coincidental. The difference in diameters issues is statistically significant.

The aim of the solution of the second research hypothesis was to determine whether the choice of marketing pricing strategies is related to the size of the retail affiliate. Since only one retail affiliate of all the surveyed retail affiliates had more than 50 employees, we did not include it in the calculations. We compared the retail affiliates, which had 25 employees and 26-49 employees. We used t-test for two independently choices (the Student two-samples test) result is elaborated in Table 5.

Based on the results processed in Table 5 we can conclude that a statistically significant difference between the studied branches of retail affiliates with a different number of employees is only for premium pricing strategy (S3). Based on a comparison of averages, which are listed in Table 3, we consider which group was more similar to the marketing price strategy.

Table 5 – Connections between choosing of studied marketing and pricing strategies and the size of the branch retail chain

Evaluated marketing pricing strategy	number of employees	n	average	variation	t	p
s1	to 25 employees	90	3.19	1.22	1.309	0.193
	26 – 49 employees	16	2.75	1.34		
s2	to 25 employees	90	3.00	1.16	-0.165	0.871
	26- 49 employees	16	3.06	1.44		
s3	to 25 employees	90	3.41	1.08	-2.263	0.029
	26 – 49 employees	16	3.81	0.54		
s4	to 25 employees	90	2.14	1.01	-0.378	0.706
	26- 49 employees	16	2.25	1.13		
s6	to 25 employees	90	1.76	0.85	1.444	0.152
	26 – 49 employees	16	1.44	0.51		
s8	to 25 employees	90	2.59	1.22	-1.626	0.107
	26- 49 employees	16	3.13	1.20		
s13	to 25 employees	90	1.60	0.73	-0.124	0.901
	26 – 49 employees	16	1.63	0.81		

Source: own elaboration

Although in the case of premium pricing strategy (S3) it is shown that the choice of marketing pricing strategies is related to the size of the retail affiliate, and in other cases it is rather different, because the value of $p > 0.05$ (which means we no relation). Since the hypothesis examines only all variables simultaneously, so we can say that the choice of marketing pricing strategies with the size studied retail affiliate located in a region of North-Eastern Slovakia is unrelated.

Conclusion

Due to the recent economic recession and ever-changing economic situation, consumer attitudes to prices are also changing, because many of the consumers found that they are no longer able to maintain their current lifestyle. Consumers have begun to focus more of their purchases on the real needs and satisfied themselves with cheaper products. The results of our research show us this fact because marketing managers of retailer affiliates ranked promotional discounts as the most used strategy. According to surveyed regional managers action prices strategy is also one of the most used marketing pricing strategies within the branches of retail affiliates operating in the North-Eastern Slovakia.

We can say that Slovak trade is already European trade, because in recent years we dealt with Europe, not only in the assortment, quality environment, but also in offering services. The problems we have are also European: rise in food prices, but also specifically "Slovak", which are translated into laws. Regarding to the obtained results, there is a question whether there is a need for change of determining marketing pricing strategies in retail affiliates operating in the North-Eastern Slovakia. Based mainly on the findings of the convention, provided that the coherence of determining the price of marketing strategies within the branches of retail chains operating in the North-Eastern Slovakia is not enough and competitive enough.

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TECHNICAL, ECONOMIC AND MANAGERIAL STRUCTURES IN THE FIELD OF ENERGY IN THE VISION IN THE EUROPEAN UNION

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Abstract:

In the global context, emphasis is strongly placed on the attempt to render extractive mining and energy industry profitable with the help of improved or innovative technologies. Yet, in the field of mining-energy there occurs a noticeable gap between the operational levels of highly developed, underdeveloped or emerging countries. The last have more flexible laws related to environment. The development of new technologies and cooperation to improve the situation of those in operation are topics for technical and commercial approach, but the demarches were marked by economic, contextual circumstances. Worldwide including Romania, they require a central qualitative and strategic parameter, in what concerns the the mining and energy technologies, to be taken into account, namely international competitiveness.

Keywords: energy, efficiency, energy sector, economic development, renewable energy, European strategy, sustainable energy.

JEL Classification: M12, M54, J53

Introduction

In early 2006 the European Commission launched a broad public debate on the future of the EU's energy. For Romania as a member state it is particularly important to adapt to the general framework of Community energy policy. It is marked by three important objectives in the medium and long term, namely:

- increasing the security of energy supply;
- increasing competitiveness in the energy field;
- reducing environmental impact.

To successfully address these objectives, the European Union aims to establish and implement a common policy in the field of energy where, traditionally, national competences are very extensive and the Community instruments are limited.

From this perspective, it should be stressed that EU Member States remain sovereign in establishing the forms of energy that they want to use. On the other hand, each selection must be accompanied by the implementation of measures adopted at Community level for that form of energy.

Among the priorities proposed at European level we mention:

- The initiation of analysis regarding the long-term energy demand and the way it is provided;
- Elaboration of an action plan for energy efficiency;
- The implementation of an action plan regarding biomass;
- Development of an interconnection plan and facilitation of the achievement of priority infrastructure projects which contribute to supply diversification and integration of regional markets into the EU internal market, recognizing the essential role of economic operators in these projects;
- The improvement of the dialogue on energy between Russia and the EU, including the ratification by Russia of the Energy Charter Treaty and the finalization of negotiations on the Transit Protocol;
- Development of a strategy to promote the concept of the internal market in EU neighboring countries;
- Ensuring appropriate priorities for the energy sector in FP7 research program;
- Improvement of energy markets transparency, particularly in respect of storage capacities and oil stocks data;
- The organization of a European debate about the future of nuclear energy, with accurate information of European citizens on the current state of energy, advantages and

disadvantages of this form of energy, the progress made in the field of nuclear safety and radioactive waste management.

2. The Green Paper - A European strategy for sustainable, competitive and secure energy

If energy and power resources are unreliable, then society and economy cannot function. Therefore, after the Second World War, many European countries decided that the energy sector is a strategic one, too important to be left to the discretion of individual countries. A much better solution has been identified, namely joining efforts in the development of energy sources through the association of two structures: European Coal and Steel Community and EURATOM.

Subsequently, the existence of some relatively cheap and safe energy sources diverted the attention of public opinion and politicians to energy issues.

Short term refocus, generated by the oil crises, appeared in the 70s. In recent years, however, there were some elements that have brought attention to energy issues: climate change, the tripling of oil prices, dependence on Russian gas, electricity supply interruptions in large areas of Europe.

In March 2006, the European Commission analyzed the situation of EU energy and possible developments in the field, publishing their findings in a document entitled *Green Paper - A European Strategy for Sustainable Competitive and Secure Energy*. The very title reflects the objectives the European Union set for its energy policy: the sustainable development of the sector, in harmony with environment, and the transformation of the energy sector in a factor of competitiveness and stability, both in terms of meeting the European energy demand and in respect of imports.

The main finding of the Green Paper is that the EU still lacks a common energy policy and therefore it may not be able to achieve the basic objectives, such as long-term energy security, a functional energy market, sustainable economic development and reduced impact on environment.

Green Paper proposes a number of areas where the member countries should cooperate more: energy saving, promotion of renewable energy, investment in new energy technologies and the use of a common voice in international discussions and negotiations on energy issues.

2.1. The uncertainties of the future

Despite the efforts to reduce energy demand of the EU the Member States continue to increase power consumption by 1-2% per year. At this rate, in 10 years consumption will increase by at least 10%, considering that two thirds of primary energy resources will be provided by imports. Currently, 80% of energy consumption is represented by fossil resources: oil, natural gas and coal. This proportion is growing, consumption of exhaustible resources evolving faster than consumption of renewable resources. As a direct outcome, greenhouse emissions could be 5% higher in 2014 as compared to 2006, while the target set by the Kyoto Protocol, namely a 8% reduction in emissions in 2014, became impossible.

And global energy demand increased, reaching record values, despite price increases of primary fossil resources. It is noteworthy that developing countries had growth rates much higher than developed countries.

At the same time the map of energy consumption changes gradually. Thus, China and India are becoming increasingly great energy consummers. China alone contributed by 75% to the increase in demand for coal in the world. Accordingly, it is expected that the European Union has serious competition in the procurement of fossil primary energy resources from third countries.

2.2. Measures taken at European Union level

In recent years the European Union has adopted a series of measures in the energy sector, with the purpose of helping economic development and environmental protection. Among these, we mention:

- Development of competitive markets for electricity and natural gas;
- Allocation of funds for research in the field of new energy technologies;
- The introduction of competition-based mechanisms to reduce the environmental impact of the energy sector (examples: emissions trading and the promotion of renewable support schemes);
- Measures to promote energy efficiency.

Through these actions, the European Union has clearly demonstrated that it has the political will to coordinate national efforts in identifying and implementing solutions to energy and environmental issues. At the time of *Green Paper - A European Strategy for Sustainable Competitive and Secure Energy* publication the Union had 25 countries and 450 million consumers of energy. In January 2007, Romania and Bulgaria's membership number of people increased by another 30 million. In these circumstances, Europe holds significant importance in world energy consumption and can not be neglected in the international dialogue on the future of energy and environmental impact of this economic sector. Speaking as "one voice" in this dialogue, the EU is likely to positively influence other countries to coordinate actions on the conservation of primary energy resources and reducing the environmental impact of the energy sector. For Union´s arguments be convincing it would have been necessary that policies implemented in Europe in this area be successful and have tangible results.

Among the targets in the energy field adopted by European Union through binding directives on Member States we mention:

- doubling the share of renewable energy resources in the Union's gross energy consumption from 6% to 12% in 2015;
- increasing the share of electricity produced from renewable resources in total consumption from 14% to 22% in 2015;
- increasing the share of biofuels in transport to 5.75% in 2015; it is also expected to reduce energy consumption by 20% in 2020.

Using an integrated approach communicated through a "common voice" in the post Kyoto negotiations, and discussions in the various bodies such as the World Trade Organization will turn European position in negotiations into not negligible one. Also, an integrated approach to energy issues and solidarity between Member States will increase the acceptability of European citizens and national industries to harsh measures that must be implemented in order to achieve the targets.

2.3. Measures proposed by the European Commission

In the *Green Paper - A European Strategy for Sustainable Competitive and Secure Energy*, European Commission proposes that, in a number of areas, efforts be coordinated at Community level, thus avoiding the dissipation of resources through initiatives and actions unrelated at national level. The identified areas for joint action are:

- energy for jobs and development in Europe;
- increasing the security and competitiveness of energy supply;
- solidarity between Member States;
- reducing the impact of energy sector on climate change;
- encouraging innovation and research in the field;
- relations with third countries.

A series of concrete actions have been identified, such as:

- Development of internal electricity market and natural gas.
- The process of creating these pan-European markets is in full swing and it should be accelerated through measures meant to develop new interconnections and a European Network Code, to promote investments in the field and, last but not least, the possiblility to create a European Regulator and a European Centre for Energy Networks with roles in managing cross-border trade.
- A review of policies on mandatory stocks of oil and gas. The objective of this review is to improve the response to crisis in the supply of primary energy resources from outside the EU.
- A European Energy Observatory, with the effect of increasing transparency on energy demand and production in member countries.
- Improving network security. This objective can be achieved through increased cooperation between rational network operators and, perhaps, by establishing a new structure in Europe - European Centre for Energy Networks.
- A new mechanism to prepare and ensure solidarity and assistance will be granted to countries in difficulty as a result of natural disasters affecting energy infrastructure.
- A wide debate within the EU on the future of the different energy sources, including issues related to cost and environmental impact resulting from the use of these sources. As a general goal, through

these debates the established European energy mix will meet the criteria of food security in the long term competitiveness and sustainable development.

- An action plan for energy efficiency, with mutually agreed objectives. In addition, it will be possible to establish an international agreement on energy efficiency.
- A roadmap for renewable energy resources, ensuring a predictable framework on measures to promote these resources at Community level. The measure may include a new target for the share of renewables in total gross energy consumption in the EU for 2020 and an action plan to reduce dependence on oil imports.
- A strategic plan for technological innovation. Developing research on new energy sources and improving current technology generation, transmission, distribution and consumption will contribute to solving current problems of the sector.
- A coherent foreign policy at EU level, combining Community and national instruments in dialogue with third countries on energy issues, including the supply of primary resources imports.
- A revision of the EU energy policy. Proposals to this effect were scheduled for presentation to the European Parliament and the European Council in the spring of 2007, after public debate of the Green Paper. EU foreign policy proposals aimed at reducing dependence on energy imports, a roadmap in the field of renewable energy, proposals to develop markets for electricity and natural gas, the diversification of the energy mix and reduction of the climate impact.
- A list of priorities for the construction of new infrastructure elements needed to ensure safe energy supply: new main natural gas and liquefied natural gas terminals new cross-border power lines.
- Reviving the dialogue with Russia, particularly the Energy Charter Transit Protocol.
- A European Energy Community Treaty. Based on experience gained through the establishment and implementation of the Southeast European Energy Community Treaty, the proposed new treaty will include gradually the neighboring countries of the Union.
- A new mechanism at Community level for a rapid and coordinated response to crises affecting the supply of energy resources of the Member States.

The measures provided in *Green Paper - A European Strategy for Sustainable Competitive and Secure Energy*, were publicly debated for nearly a year, the European Commission receiving 1500 written responses from organizations and associations interested in the Union's energy future, and from ordinary citizens. Following the analysis of these reactions, the Commission published a coherent package of documents which form a new European Energy Policy. Documents published by the European Commission under the name,, A new European energy policy ", are built on three ideas:

- to demonstrate that the objectives established at the community level in the energy field can not be achieved with current policies, being necessary to review these policies;
- to propose a strategic objective which is the basis for all subsequent energy policy decisions;
- to propose a concrete action plan to achieve the strategic objective.

3. The strategic objective of European energy policy

As a strategic objective the Commission proposed to reduce emissions of greenhouse gases by 20% by 2020. Focus on emissions of greenhouse gases is justified by the fact that the energy sector contributes a proportion of 800/0 at total emissions. This objective is part of the broader objective managing climate change and represents a good target for the promotion of renewable subsequent targets, improving energy efficiency and developing clean technologies. The target of 20% reduction in emissions of greenhouse gases is a minimum, unilateral commitment of the European Union. The European Commission believes that if they come to a widely accepted international agreement on reducing global environmental impact, the EU should increase its target to 30% reduction by 2030 and 60 -80% until 2050.

3.1. Action Plan

In order to achieve the objectives in the common energy policy, the European Commission has developed a ten-point action plan.

Better use of the domestic energy market. The report of the Commission's General Directorate for Competition, resulting from the sectorial analysis on energy, reveals that the expected benefits from restructuring of the energy sector and the introduction of competition mechanisms have not yet

been achieved. The main reasons for this situation are on one hand the existence of a mosaic of national markets, in each being one or more companies with dominant market power and, on the other, the limited cooperation between national agencies, mainly, regulators and transmission and system operators.The proposed measures aimed at creating effective competition with equal opportunities for all market participants and all energy sources. Action to remove discrimination shall be taken towards the new entrants and a unitary regulatory mechanism will be created at European level. Greater attention will be given to consumers whose voice will be listened to by policymakers. One of the possible ways to achieve this is to create a Charter of European consumers.

Facilitating mutual assistance among Member States in an energy crisis. In this area it is projected to increase solidarity among the countries that form the European Union in the event of energy crises. For example, the use of oil stocks achieved by each member will improve. It is expected that assistance be achieve preventively through active support in diversification of the energy mix of countries dependent on a single supplier of natural gas or oil.

Improving the mechanisms for marketing the greenhouse effect gas emissions licenses. By improving the mechanism they intend to transform it into a true catalyst for emissions reduction and a factor to stimulate investment in clean technologies.Tangible, envisaged measures are presented in a separate report entitled *"Limiting Climate Change to 2 degrees Celsius - Policy Options for Europe and mankind for 2020 and beyond."*

Energy efficiency. Saving energy reduces pollution, energy bills, reduces the need for investment in new power plants, oil terminals and so on. It is estimated that under current technological development, up to 20% of energy consumption can be saved. The European Commission has already launched an *Action plan to involve civil society in the joint effort to reduce energy consumption.* This message will also be promoted by the European Union in its dialogue with international partners to launch a global initiative to increase energy efficiency.

Increasing the proportion of renewable energy sources. All Member States have committed to support the development of renewable energy: solar, wind, photovoltaic, biomass, biofuels and geothermal energy, as well as their use in electricity generation and transport. Commitments are still below the existing potential, and some states do not even realize their commitments. The European Commission proposes in a Road map, a series of measures to ensure, by its application, the tripling of share of renewable energy in the energy balance of the Union, from 7% in 2006 to 20% in 2020.

Tehnology. There are many clean and efficient technologies for the production and use of energy, but they remain marginal because they either are more expensive or are not widely available. Examples of such technologies are low power light bulbs, solar thermal panels for hot water, hybrid cars and thermal insulation in the case of buildings. They should strive to reduce the costs of these technologies. At the same time they must develop new technologies to replace oil and natural gas shortages or price conditions that are prohibitive for the population.

Clean technologies for fossil fuels. Chiar dacă Uniunea Europeană reuşeşte să-şi modifice mixul energetic în favoarea surselor regenerabile şi să-şi reducă substanţial consumul de energie, tot va rămâne dependentă de resursele fosile pentru viitorul previzibil: cărbune, petrol, gaze naturale. Even if the EU fails to change the energy mix in favor of renewables and to substantially reduce energy consumption it will still remain dependent on fossil resources - coal, oil, natural gas - for the foreseeable future. For this reason, it is of general interest to develop technologies that reduce the carbon dioxide emissions of combustion plants. CO2 capture and storage is a promising solution, but such technologies are not yet commercially tested.

The safety and security of nuclear energy. More than half of European Union countries use nuclear energy to produce electricity. About one third of the total of electricity produced Europe comes from such sources. The decision to use nuclear energy rests with individual Member State separately. But the EU, according to the rules established by the EURATOM Treaty, has a role in ensuring the use of nuclear energy in ways that do not endanger life or environment. Achieving high standards of nuclear safety and non-proliferation of nuclear weapons is the 8th line of action proposed by the European Commission.

Establishing a common international policy and its utterance in "in a single voice". Commission proposes several measures expanding globally by promoting them in the international dialogue. It also intends to create an energy security zone around the Member States as well as the development of strong partnerships with energy suppliers, based on mutual interest, predictability and

equal treatment. The financing conditions and participation in international projects will be improved, for example, by appointing coordinators for infrastructure projects of European interest. The European Union will intensify its efforts towards a clean, sustainable and cheap energy technology transfer to less developed countries.

Improve the understanding of energy issues. To achieve this goal it is expected that the organization of an Energy Observatory will study among other things, energy trends and investment needs of the European Union as a whole.

Conclusions

The European Commission's energy policy is to be revised two years after its adoption, concurrently with the publication of a report on the implementation and results achieved. Through the energy policy of the European Commission proposed they create a coherent framework for action not only to ensure the EU's energy future, but also to reduce the impact on environment, particularly, on climate change. Specific targets are set unilaterally in the Union. This is an example for the rest of the world states and Europe take the leading role in the fight for a clean and safe planet.

The general objective proposed is also effective on the safety of energy supply in the long term. Through achieving this goal Europe will reduce exposure to price volatility of fossil energy resources, will stimulate the development of domestic markets for electricity and gas and encourage technological development.

Three related objectives emerge from the the overall objective, the European Commission proposing a target:

- Increasing the share of renewables in the total energy mix to 20% in 2020;
- Improving energy efficiency by 20% by 2020;
- Increasing the share of biofuels in transport to 10% by 2020.

Based on contextual research it is possible to design and implement technical, economic and managerial restructuring activities in energy complexes.Therefore, the use and future structural transformation from technical, economic and managerial perspective of the energy sector in the European Union is an approach characterized by risk estimation and prediction that aims at measuring and dimensional reduction, of their content, respectively.

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THE REAL EXCHANGE RATE VOLATILITY COMOVEMENTS AND SPILLOVERS IN THAILAND'S INTERNATIONAL TRADE: A MULTIVARIATE GARCH APPROACH

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Abstract:

This paper examined the real exchange rate volatility comovements and spillovers among major currencies in Thailand's international trade against the Thai baht including the USA dollar (USD), the British pound (GBP), the Japanese yen (JPY) and the Malaysian ringgit (MYR). The data used in this study was the monthly data from 1985 to 2013. The three Multivariate GARCH models, namely the diagonal VECH, the diagonal BEKK and the CCC, were employed.

The empirical results overall for monthly data showed that the ARCH and GARCH estimates of the conditional variance between the real exchange rate returns were statistically significant in case of RGBP and RJPY. The conditional correlation between volatility of the real exchange rate returns was statistically significant in case of RGBP with RJPY as well.

Finally, we would choose the best model by considering the value of log-likelihood, AIC, SIC and HQ. We found that the best model in volatility analysis was the CCC model.

Keywords: The real exchange rate volatility, comovements and spillovers, the diagonal VECH, the diagonal BEKK, the CCC model

JEL Classification: G17, G12, G32

1. Introduction

The exchange rate is important for trading between countries, considered a business cost. Even though, Thailand has mainly partners in the export and import of goods and services such as ASEAN, EU, Japan and China. But Thailand also relies on money in dollars USD for international trade. Revenues from the export or expenditures from the import, paid in USD averaged 80% and the other currencies are next. We can consider from Table 1.

Table 1 The proportion of major currencies in export and import of Thailand in 2013

Currencies	USD	THB	JPY	EUR	GBP	SGD	MYR	OTHERS
The proportion in export	80%	8.20%	6.10%	2.80%	0.40%	0.30%	0.20%	2.00%
The proportion in import	80%	4.40%	10%	3.70%	0.30%	0.70%	0.60%	0.3%

Source of data: Bank of Thailand (BOT), 2013

In addition, the Thailand's exchange rate switches to a managed float exchange rate system since 1997. The Thai baht will move according to the market mechanism that is affected by the internal and external factors of the country. The change of exchange rate may affect international trade. Therefore, volatility management of exchange rate is necessary.

Now we look back on the exchange rate. It can be divided two types such as the nominal exchange rate and the real exchange rate. The nominal exchange rate is exchange rate seen in general. But for the real exchange rate, according to the definition, the real exchange rate can be defined in the long run as the nominal exchange rate (e) that is adjusted by the ratio of the foreign price level (P_f) to the domestic price level (P). It can be shown as:

$$\text{The Real Exchange Rate } (RER) = e\frac{P_f}{P} \qquad (1)$$

This study covers the conditional volatility and the conditional correlation of Thailand's international trade by taking changes in the real exchange rate into consideration. The reason is that the real exchange rate affects the Thailand's international trade more than the nominal exchange rate. And we choose four important exchange rates in the volatility analysis; the USA dollar (USD), the British pound (GBP), the Japanese yen (JPY) and the Malaysian ringgit (MYR)

We can explain more in the next section, which is related to the literature reviews, research methodology and empirical results.

2. Literature Reviews

A large number of studies find evidence in support of significant comovements in volatility and spillovers among asset prices. More detail can be found in Bae and Karolyi (1994), Kim and Rogers (1995), Kim (2003) and Christodoulakis (2007). However, few studies have so far investigated volatility comovements and spillover among the real exchange rates.

Bollerslev (1990) employed a multivariate GARCH framework to investigate European exchange rate volatility spillovers. He applied the Constant Conditional Correlation (CCC) to a set of five weekly European spot exchange rates against the US dollar, namely the Deutsche Mark, the French franc, the Italian lira, the Swiss franc and the British pound, He found significant comovements in volatility of these five exchange rates, and by comparing the pre and post European Monetary System (EMS) periods he found that the comovement were significantly greater in the later period.

Kearny and Patton (2000) offered an application of the BEKK model, proposed by Engle and Kloner (1995), to exchange rate volatility spillovers. This approach does not impose the restrictive assumption of constant conditional correlations through time and offers a very attractive formulation of volatility spillovers. In addition, it can distinguish between direct volatility spillovers or indirect spillovers. The currencies investigated by Kearney and Patton included the most important currencies within the EMS, that is the German mark, the French franc, the Italian lira, the British pound as well as the European Currency Unit all against the US dollar. Their analysis covered data from April 1979 through to March 1997. The authors found evidence of both direct and indirect volatility transmission within EMS in both daily and weekly data for the European Currency Unit (ECU), the German mark, the French franc, the Italian lira and the British pound. In addition, they provided evidence that the German mark held a dominant position in term of volatility transmission. The German mark was found to be relatively insulated from outside shocks while transmitting more volatility than the other currencies. Their results obtained using weekly data were less significant than those on daily data. This decrease in significant, derived from the temporal aggregation of the data from daily to weekly, is in the line with the conjecture that markets are more likely a transmit volatility in active phase rather than in calm ones.

Calvet *et al.* (2006) employed a Markov-Switching Multifractal (MSM) approach to assess volatility comovement of the German mark (Euro), the British pound and the Japanese yen against the US dollar. In addition to the MSM model, the authors applied the Constant Conditional Correlation (CCC) of Bollerslev (1990) and compared the results from the two models. They found that the MSM model outperformed the CCC.

The next section describes the research methodology used in this analysis.

3. Research Methodology

Multivariate GARCH Models

The basic idea to extend univariate GARCH models to multivariate GARCH models is that it is significant to predict the dependence in the comovement of the real exchange rate returns in a portfolio. To recognize this feature through a multivariate model would generate a more reliable model than separate univariate models.

In the first place, one should consider what specification of a multivariate GARCH model should be imposed. On the one hand, it should be flexible enough to state the dynamics of the conditional variances and covariances. On the other hand, as the number of parameters in a multivariate GARCH model increase rapidly along with the dimension of the model, the specification should be parsimonious to simplify the model estimation and also reach the purpose of easy

interpretation of the model parameters. However, parsimony may reduce the number of parameters, in which situation the relevant dynamics in the covariance matrix cannot be captured. So it is important to get balance between the parsimony and the flexibility when designing the multivariate GARCH model specification. Another feature that multivariate GARCH models must satisfy is that the covariance matrix should be positive definite.

Several different multivariate GARCH model formulations have been proposed in the literature, and the most popular of these are the diagonal VECH, the diagonal BEKK and CCC models. Each of these is discussed briefly in turn below; for a more detailed discussion, see Kroner and Ng (1998).

The diagonal VECH model

The first multivariate GARCH model was introduced by Bollerslev, Engle and Wooldridge in 1988, which is called VECH model. It is much general compared to the subsequent formulations. In the VECH model, every conditional variance and covariance is a function of all lagged conditional variances and covariances, as well as lagged squared returns and cross-products of returns. The model can be expressed below:

$$VECH(H_t) = c + \sum_{j=1}^{q} A_j VECH(\varepsilon_{t-j}\varepsilon'_{t-j}) + \sum_{j=1}^{p} B_j VECH(H_{t-j}), \quad (2)$$

where $VECH(H_t)$ is an operator that stacks the columns of the lower triangular part of its argument square matrix, H_t is the covariance matrix of the residuals, N presents the number of variables, t is the index of the t^{th} observation, c is an $\frac{N(N+1)}{2}\times 1$ vector, A_j and B_j are $\frac{N(N+1)}{2}\times\frac{N(N+1)}{2}$ parameter matrices and ε is an $N\times 1$ vector.

The condition for H_t is to be positive definite for all t is not restrictive. In addition, the number of parameters equals to $(p+q)\times\left(\frac{N(N+1}{2}\right)^2+\frac{N(N+1)}{2}$, which is large. Furthermore, it demands a large quantity of computation.

The diagonal VECH model, the restricted version of VECH, was also proposed by Bollerslev, et al (1988). It assumes the A_j and B_j in equation (2) are diagonal matrices, which makes it possible for H_t to be positive definite for all t. Also, the estimation process proceeds much smoothly compared to the complete VECH model. However, the diagonal VECH model with $(p+q+1)\times N\times\frac{(N+1)}{2}$ parameters is too restrictive since it does not take into account the interaction between different conditional variances and covariances.

The diagonal BEKK model

To ensure positive definiteness, a new parameterization of the conditional variance matrix H_t was defined by Baba, Engle, Kraft and Kroner (1990) and became known as the BEKK model, which is viewed as another restricted version of the VECH model. It achieves the positive definiteness of the conditional variance by formulating the model in a way that is property is implied by model structure.

The form of the BEKK model is as follows:

$$H_t = CC' + \sum_{j=1}^{q}\sum_{k=1}^{K} A'_{kj}\varepsilon_{t-j}\varepsilon'_{t-j}A_{kj} + \sum_{j=1}^{p}\sum_{k=1}^{K} B'_{kj}H_{t-j}B_{kj} \quad (3)$$

where A_{kj}, B_{kj} and C are $N\times N$ parameter matrices, and C is a lower triangular matrix. The purpose of decomposing the constant term into a product of two triangle matrices is to guarantee the

positive semi-definiteness of H_t. Whenever $K>1$, an identification problem would be generated for the reason that there are not only single parameterizations that can obtain the same representation of the model.

The first order BEKK model is:

$$H_t = CC' + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B \tag{4}$$

The BEKK model also has its diagonal form by assuming A_{kj}, B_{kj} matrices are diagonal. It is a restricted version of the diagonal VECH model. The most restricted version of the diagonal BEKK model is the scalar BEKK one with $A = aI$ and $B = bI$ where a and b are scalars.

Estimation of a BEKK model still bears large computations due to several matrix transpositions. The number of parameters of the complete BEKK model is $(p+q)KN^2 + \frac{N(N+1)}{2}$. Even in the diagonal one, the number of parameters soon reduces to $(p+q)KN + \frac{N(N+1)}{2}$, but it is still large. The BEKK form is not linear in parameters, which makes the convergence of the model difficult. However, the strong point lies in that the model structure automatically guarantees the positive definiteness of H_t. Under the overall consideration, it is typically assumed that $p=q=K=1$ in BEKK form's application.

The Constant Conditional Correlations (CCC) model

The CCC model was introduced by Bollerslev in 1990 to primarily model the condition covariance matrix indirectly by estimating the conditional correlation matrix. The conditional correlation is assumed to be constant while the conditional variances are varying.

Consider the CCC model of Bollerslev (1990):

$$y_t = E\langle y_t | F_{t-1}\rangle + \varepsilon_t, \quad \varepsilon_t = D_t\eta_t \tag{5}$$

$$\text{var}\langle \varepsilon_t | F_{t-1}\rangle = D_t\Gamma D_t$$

where $y_t = \left(y_{1t,\ldots,}y_{mt}\right)'$, $\eta_t = \left(\eta_{1t,\ldots,}\eta_{mt}\right)'$ is a sequence of independently and identically distributed (i.i.d) random vectors, F_t is the past information available at time t, $D_t = diag\left(h_t^{1/2},\ldots,h_m^{1/2}\right)$, m is the number of returns, and $t=1,\ldots,n,$. As $\Gamma = E\langle \eta_t\eta'_t | F_{t-1}\rangle = E\left(\eta_t\eta'_t\right)$, where $\Gamma = \{\rho_{ij}\}$ for $i,j=1,\ldots m,$ the constant conditional correlation matrix of the unconditional shocks, η_t, is equivalent to the constant conditional covariance matrix of the conditional shocks, ε_t, from (5), $\varepsilon_t\varepsilon'_t = D_t\eta_t\eta'_{t-1}D_t$, $D_t = \left(diag\ Q_t\right)^{1/2}$, and $E\langle \varepsilon_t\varepsilon'_{t-1} | F_{t-1}\rangle = Q_t = D_t\Gamma D_t$, where Q_t is the conditional covariance matrix.

The CCC model assumes that the conditional variance for each return $h_{it}, i=1,\ldots,m$, follows a univariate GARCH process, that is:

$$h_t = \omega_t + \sum_{j=1}^{r}\alpha_{ij}\varepsilon^2_{i,t-j} + \sum_{j=1}^{s}\beta_{ij}h_{i,t-j} \quad , \tag{6}$$

where α_{ij} represents the ARCH effect, or short run persistence of shocks to return i, β_{ij} represents the GARCH effect, and $\sum_{j=1}^{r}\alpha_{ij} + \sum_{j=1}^{s}\beta_{ij}$ denotes the long run persistence.

Model estimation for multivariate GARCH

Under the assumption of conditional normality, the parameters of the multivariate GARCH models of any of the above specifications can be estimated by maximizing the log-likelihood function.

$$\ell(\theta) = -\frac{TN}{2}\log 2\pi - \frac{1}{2}\sum_{t=1}^{T}(\log|H_t| + \varepsilon_t' H_t^{-1}\varepsilon_t) \quad (7)$$

where θ denotes all the unknown parameters to be estimated, N is the number of the real exchange rates and T is the number of observations and all other notation is as above. The maximum-likelihood estimates for θ is asymptotically normal, and thus traditional procedures for statistical inference are applicable.

3. The purpose of this study

The purpose is to analyze the real exchange rate volatility comovement and spillovers among major currencies in Thailand's international trade against the Thai baht including the USA dollar (USD), the British pound (GBP), the Japanese yen (JPY) and the Malaysian ringgit (MYR) by using multivariate GARCH, namely the diagonal VECH, the diagonal BEKK and CCC model and choose the best way for such analysis.

4. Data

The data used in this study is the monthly data from 1985 to 2013. We will get 348 observations. The data is derived from the Bank of Thailand (BOT). Moreover, data analysis can be carried out using EVIEWS 8. The real exchange rate return is defined as:

$$R_t = \log\left(\frac{RER_t}{RER_{t-1}}\right) \quad (8)$$

where RER_t is the real exchange rate at time t and RER_{t-1} is the real exchange rate at time t-1. The R_t of equation (8) will be used in observing the volatility of the real exchange rate between the selected currencies over the period 1985 to 2013. We can create the variables of the return on the real exchange rate as follows:

The real exchange rate return of the USA dollar = RUSD, The real exchange rate return of the British pound = RGBP, The real exchange rate return of the Japanese yen = RJPY and The real exchange rate return of the Malaysian ringgit = RMYR

In addition, we can show the movement of the monthly real exchange rate returns according to Figure 1.

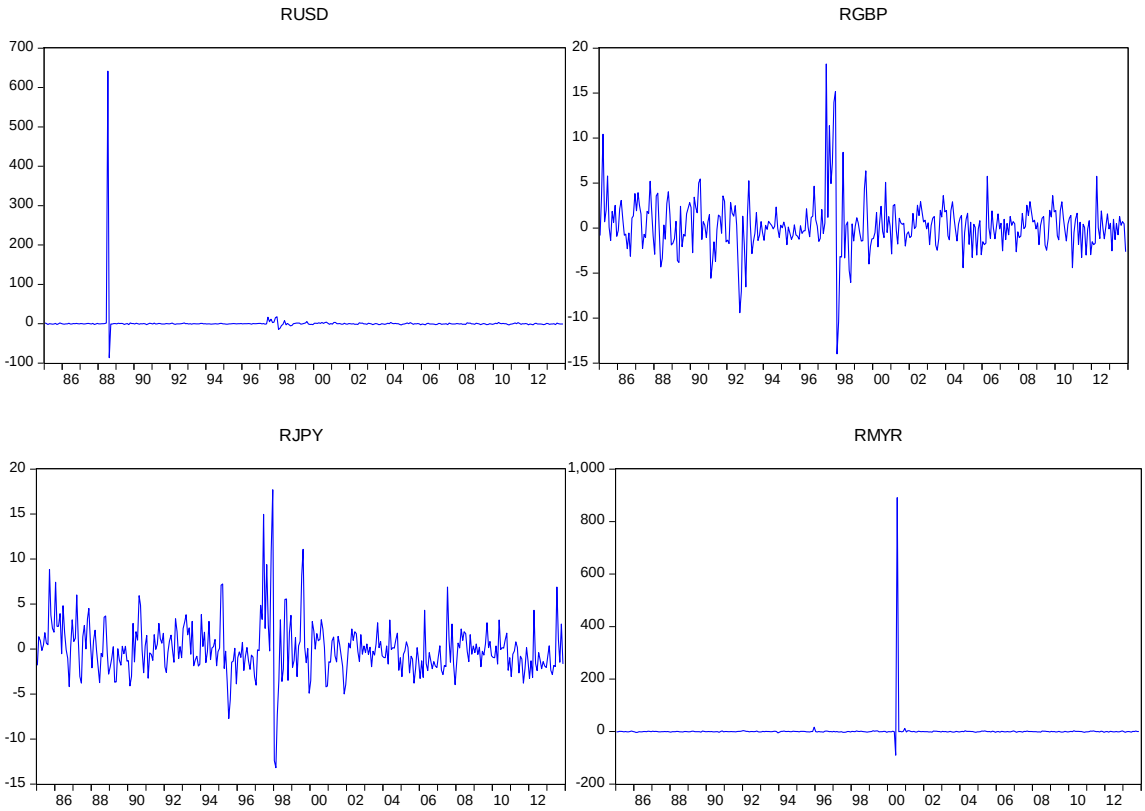

Figure 1 The monthly real exchange rate returns

The descriptive statistics are given in Table 2. The monthly real exchange rate returns of Malaysian ringgit (RMYR) display the greatest variability with the mean of 2.817%, a maximum of 891.292%, and a minimum of -90.195%. Furthermore, the skewness, the kurtosis and the Jarque-Bera Lagrange multiplier statistics of all the real exchange rate returns are statistically significant, thereby implying that the distribution is not normal.

Table 2 Descriptive statistics

RETURNS	RUSD	RGBP	RJPY	RMYR
Mean	2.068	0.332	0.167	2.817
Median	-0.131	0.250	-0.087	-0.181
Maximum	641.585	18.232	17.700	891.292
Minimum	-86.529	-13.982	-13.180	-90.195
Std. Dev.	39.141	3.170	3.260	54.075
Skewness	15.904	1.013	0.943	16.198
Kurtosis	261.129	11.055	9.006	266.978
Jarque-Bera	775,069.600	790.681	454.203	810,498.100

5. Unit Root Tests

Standard econometric practice in the analysis of financial time series data begins with an examination of unit roots. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are used to test for all the real exchange rate returns under the null hypothesis of a unit root against the alternative hypothesis of stationarity. The results from unit root tests are presented in Table 3. The

tests yield negative values in all cases for levels, such that the individual returns series reject the null hypothesis at the 1% significance level, so that all returns are stationary.

Table 3 Unit Root Tests

Returns	Augmented Dickey-Fuller Test				Phillips-Perron Test			
	Constant		Constant and Trend		Constant		Constant and Trend	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
RUSD	-18.823***	-11.724***	-18.874***	-11.702***	-18.846***	-324.708***	-18.926***	-324.342***
RGBP	-12.423***	-10.479***	-12.439***	-10.455***	-12.395***	-169.040***	-12.412***	-168.585***
RJPY	-11.664***	-9.738***	-11.823***	-9.723***	-11.582***	-91.888***	-11.564***	-91.614***
RMYR	-18.301***	-12.856***	-18.292***	-12.832***	-18.301***	-236.845***	-18.293***	-237.264***

6. Empirical Results

The diagonal VECH estimates of the conditional correlation between the volatilities of the real exchange rate returns base on estimating the univariate GARCH (1,1) model for each the real exchange rate are given in Table 4. The estimates of the diagonal VECH parameters that θ_1 and θ_2 are statistically significant in only case of $\rho_{(RGBP\_RJPY)}$. This indicates that the short run persistence of shocks on the dynamic conditional correlations is at 0.182 (θ_1) for RGBP with RJPY, while the long run persistence of shocks to the conditional correlations is 0.811 ($\theta_1 + \theta_2$) for RGBP with RJPY.

The diagonal BEKK estimates of the conditional correlation between the volatilities of the real exchange rate returns are given in Table 5. The estimates of the diagonal BEKK parameters that θ_1 is statistically significant in case of $\rho_{(RGBP\_RJPY)}$, $\rho_{(RGBP\_RMYR)}$ and $\rho_{(RJPY\_RMYR)}$. This indicates that the short run persistence of shocks on the dynamic condition correlations are at 0.178 for RGBP with RJPY, at 0.332 for RGBP with RMYR and at 0.405 for RJPY with RMYR, while θ_2 is statistically significant in case of $\rho_{(RUSD\_RGBP)}$, $\rho_{(RUSD\_RJPY)}$ and $\rho_{(RGBP\_RJPY)}$. This indicates that the long run persistence of shocks to the conditional correlations is 0.813 ($\theta_1 + \theta_2$) for only RGBP with RJPY.

Finally, in Table 6 presents the estimates for CCC model, with $p = q = r = s = 1$. The ARCH and GARCH estimates of the conditional variance between the real exchange rate returns are statistically significant in case of RGBP and RJPY. The ARCH (α) estimates are generally small (less than 0.2), and the GARCH (β) estimates are generally high (more than 0.6). Therefore, the long run persistence ($\alpha + \beta$) for RGBP and RJPY, is at 0.808 and 0.814, respectively. This indicates a near long memory process. In addition, since $\alpha + \beta < 1$, RGBP and RJPY satisfy the second moment and log-moment condition, which is a sufficient condition for the QMLE (quasi-maximum likelihood) to be consistent and asymptotically normal. CCC estimates of the constant conditional correlation between RGBP and RJPY with 0.504. This indicates that the standardized shock on the constant conditional correlation for RGBP with RJPY is 0.504.

Furthermore, we will choose the best model next by considering the value of log-likelihood, AIC, SIC and HQ. From the Table 4, 5 and 6, we found that the CCC model is highest log-likelihood equal -4033.825. AIC, SIC and HQ are lowest, equal 29.496, 29.786 and 29.613, respectively. Thus, it can be concluded that we should choose the CCC model in volatility analysis of the real exchange rate returns.

However, we can show the movement of the conditional covariance and the conditional correlation of the real exchange rate returns in each model according to Figure 2, 3, 4, 5 and 6, respectively.

7. Multivariate GARCH diagnostic tests

The multivariate GARCH models consist of the diagonal VECH, the diagonal BEKK and the CCC model. We can diagnostic check on the system residuals to determine efficiency of estimator according to the Table 7. We found that system residuals have no autocorrelations up to lag 12 and are not normally distributed. Therefore, it can be concluded that the estimators of multivariate GARCH model are efficient.

Conclusion

This paper estimated three popular multivariate GARCH models, namely the diagonal VECH, the diagonal BEKK and CCC model, for the real exchange rate returns of USA dollar (RUSD), British pound (RGBP), Japanese yen (RJPY) and Malaysian ringgit (RMYR) against the Thai baht. The empirical results overall for monthly data showed that the ARCH and GARCH estimates of the conditional variance between the real exchange rate returns are statistically significant in case of RGBP and RJPY. The conditional correlation between volatility of the real exchange rate returns is statistically significant in case of RGBP with RJPY as well.

Finally, we will choose the best model by considering the value of log-likelihood, AIC, SIC and HQ. We found that the best model in volatility analysis is the CCC model. Such results can be useful as the management the volatility of the real exchange rates for Thailand's international trade.

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Table 4 The diagonal VECH model estimates

	RUSD	RGBP	RJPY	RMYR	$\rho_{(RUSD\_RGBP)}$	$\rho_{(RUSD\_RJPY)}$	$\rho_{(RUSD\_RMYR)}$	$\rho_{(RGBP\_RJPY)}$	$\rho_{(RGBP\_RMYR)}$	$\rho_{(RJPY\_RMYR)}$
Constant (Mean)	2.060 (52.948)	0.333 (0.504)	0.159 (0.324)	2.848 (43.027)	-	-	-	-	-	-
ω (Constant)	136.060 (104.805)	1.523** (0.635)	1.599*** (0.588)	1852.262 (4247.799)	-	-	-	-	-	-
α	0.0005 (0.005)	0.147*** (0.047)	0.230*** (0.067)	0.740 (1.814)	-	-	-	-	-	-
β	0.914*** (0.068)	0.659*** (0.087)	0.606*** (0.098)	-0.0005 (2.263)	-	-	-	-	-	-
$\alpha+\beta$	0.9145	0.806	0.836	0.7395	-	-	-	-	-	-
θ_0 (Constant)	-	-	-	-	0.697 (13.099)	0.561 (14.186)	-1.359 (28385.59)	0.914*** (0.068)	-0.582 (271.874)	0.493 (112.347)
θ_1	-	-	-	-	0.050 (0.486)	0.044 (0.809)	-0.017 (48.358)	0.182*** (0.044)	0.322 (4.438)	0.360 (3.909)
θ_2	-	-	-	-	0.923 (0.699)	0.873 (1.295)	0.108 (8480.000)	0.629*** (0.072)	-0.058 (7.424)	0.320 (2.794)
$\theta_1+\theta_2$					0.973	0.917	0.091	0.811	0.264	0.680
Log likelihood	-4037.334									
AIC	29.609									
SIC	30.056									
HQ	29.789									

Note: standard error in parenthesis, *** denote significance at the 1% level, **denote significance at the 5% level

Table 5 The diagonal BEKK model estimates

	RUSD	RGBP	RJPY	RMYR	ρ (RUSD_RGBP)	ρ (RUSD_RJPY)	ρ (RUSD_RMYR)	ρ (RGBP_RJPY)	ρ (RGBP_RMYR)	ρ (RJPY_RMYR)
Constant (Mean)	2.012 (51.554)	0.319 (0.285)	0.119 (0.292)	2.856 (33.560)	-	-	-	-	-	-
ω (Constant)	136.089 (103.965)	1.530*** (0.365)	1.638*** (0.481)	1852.503*** (391.507)	-	-	-	-	-	-
α^2	2.813e-06	0.146***	0.217***	0.754***	-	-	-	-	-	-
β^2	0.914***	0.661***	0.610***	9.941e-07	-	-	-	-	-	-
$\alpha^2+\beta^2$	0.914	0.807	0.827	0.734	-	-	-	-	-	-
θ_0 (Constant)	-	-	-	-	0.804 (22.486)	0.263 (28.497)	-1.350 (25805.00)	0.879*** (0.252)	-0.644 (104.123)	0.545 (144.038)
θ_1	-	-	-	-	0.00006	0.0007	0.001	0.178***	0.332***	0.405***
θ_2	-	-	-	-	0.777***	0.747***	0.0009	0.635***	0.0008	0.0007
$\theta_1+\theta_2$					0.777	0.7477	0.0019	0.813	0.3328	0.4057
Log likelihood	-4036.844									
AIC	29.518									
SIC	29.808									
HQ	29.634									

Note: standard error in parenthesis, *** denote significance at the 1% level

Table 6 - CCC model estimates

	RUSD	RGBP	RJPY	RMYR	ρ (RUSD_RGBP)	ρ (RUSD_RJPY)	ρ (RUSD_RMYR)	ρ (RGBP_RJPY)	ρ (RGBP_RMYR)	ρ (RJPY_RMYR)
Constant (Mean)	1.668 (34.535)	0.266 (0.363)	0.066 (0.246)	2.640 (30.353)	-	-	-	-	-	-
ω (Constant)	135.946 (155.605)	1.541*** (0.547)	1.671*** (0.584)	1852.171*** (403.403)	-	-	-	-	-	-
α	-0.001 (0.002)	0.145** (0.059)	0.189*** (0.065)	0.775 (1.290)	-	-	-	-	-	-
β	0.914*** (0.068)	0.663*** (0.090)	0.625*** (0.106)	-0.003 (0.023)	-	-	-	-	-	-
$\alpha+\beta$	0.913	0.808	0.814	0.772	-	-	-	-	-	-
Constant conditional correlation					0.042 (1.039)	0.020 (0.880)	0.063 (7.243)	0.504*** (0.086)	-0.080 (1.451)	-0.045 (1.132)
Log likelihood	-4033.825									
AIC	29.496									
SIC	29.786									
HQ	29.613									

Note: standard error in parenthesis, *** denote significance at the 1% level, **denote significance at the 5% level

Table 7 Multivariate GARCH diagnostic tests

TEST	LAG	VALUE	PROBABILITY
System Residual Tests for Autocorrelations H_0=no residual autocorrelation (Q-Stat)	1	61.892	0.000
	2	68.342	0.0002
	3	73.194	0.011
	4	80.344	0.081
	5	86.762	0.283
	6	94.250	0.531
	7	108.850	0.566
	8	118.523	0.714
	9	137.420	0.638
	10	156.607	0.561
	11	171.000	0.592
	12	187.392	0.580
System Residual Normality Tests H_0 = Multivariate normal			
-Skewness (Chi-sq)		111867.7	0.000
-Kurtosis (Chi-sq)		15747737	0.000
-Jarque-Bera		15859605	0.000

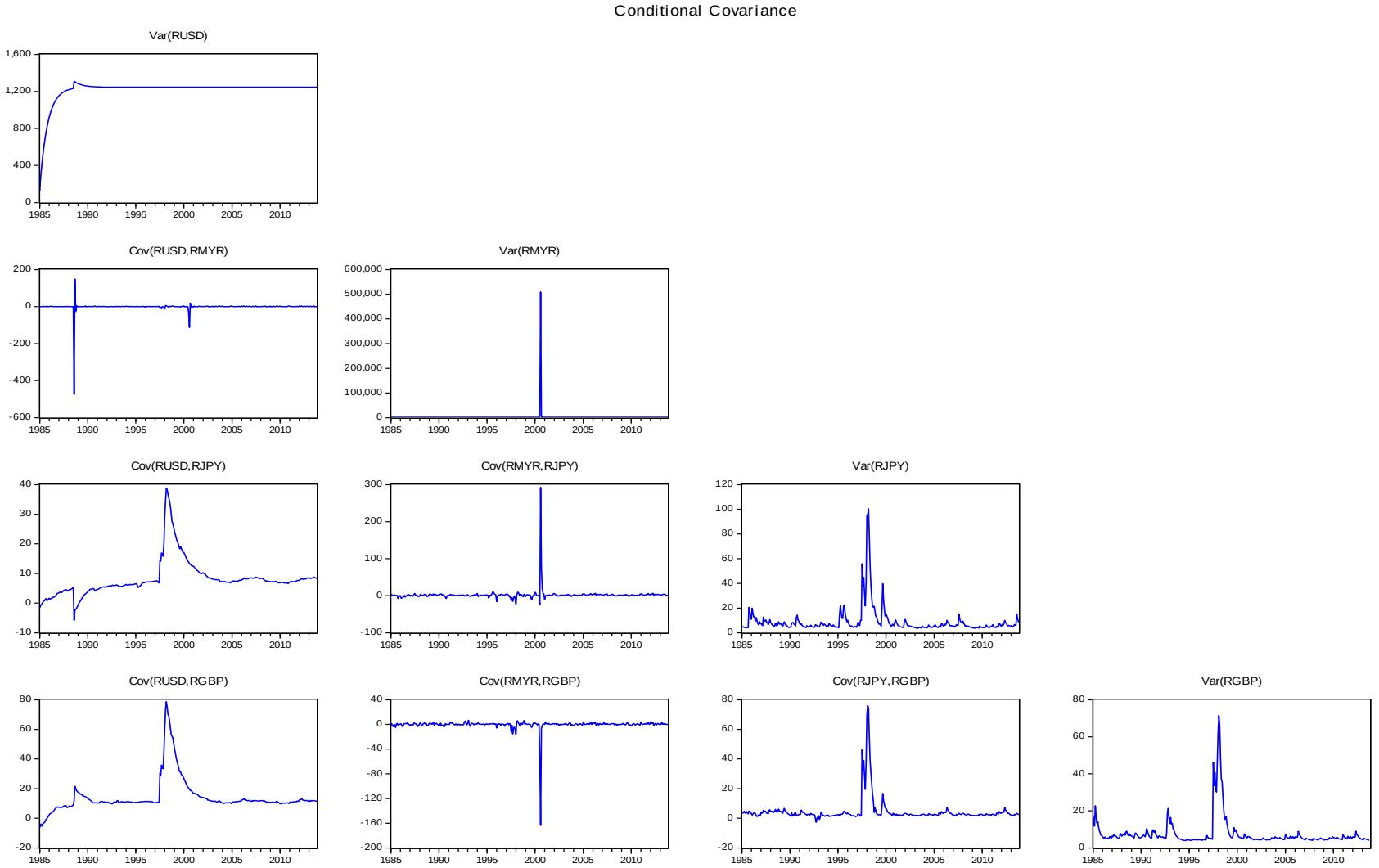

Figure 2 Conditional Covariance (the diagonal VECH estimates)

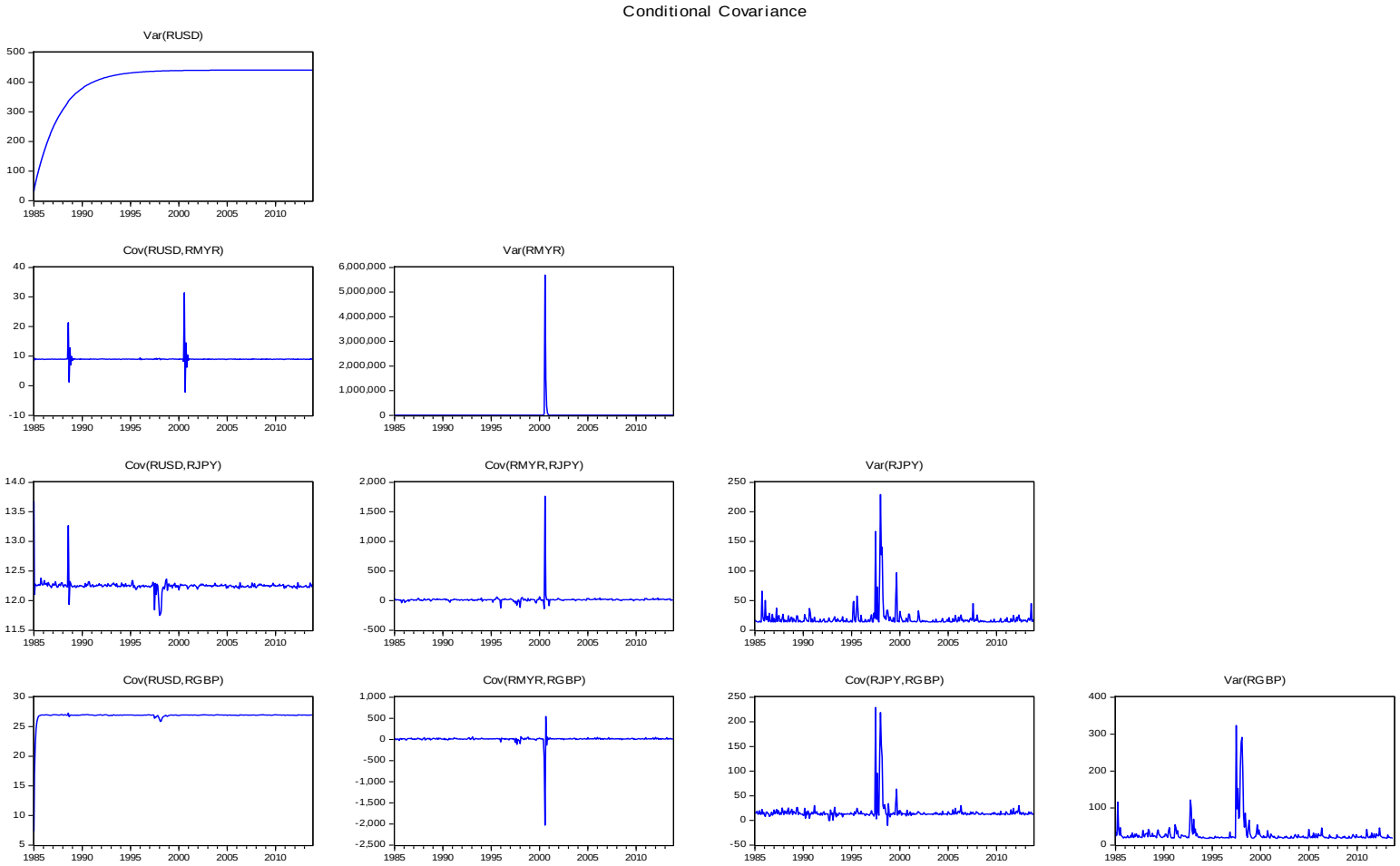

Figure 3 Conditional Covariance (the diagonal BEKK estimates)

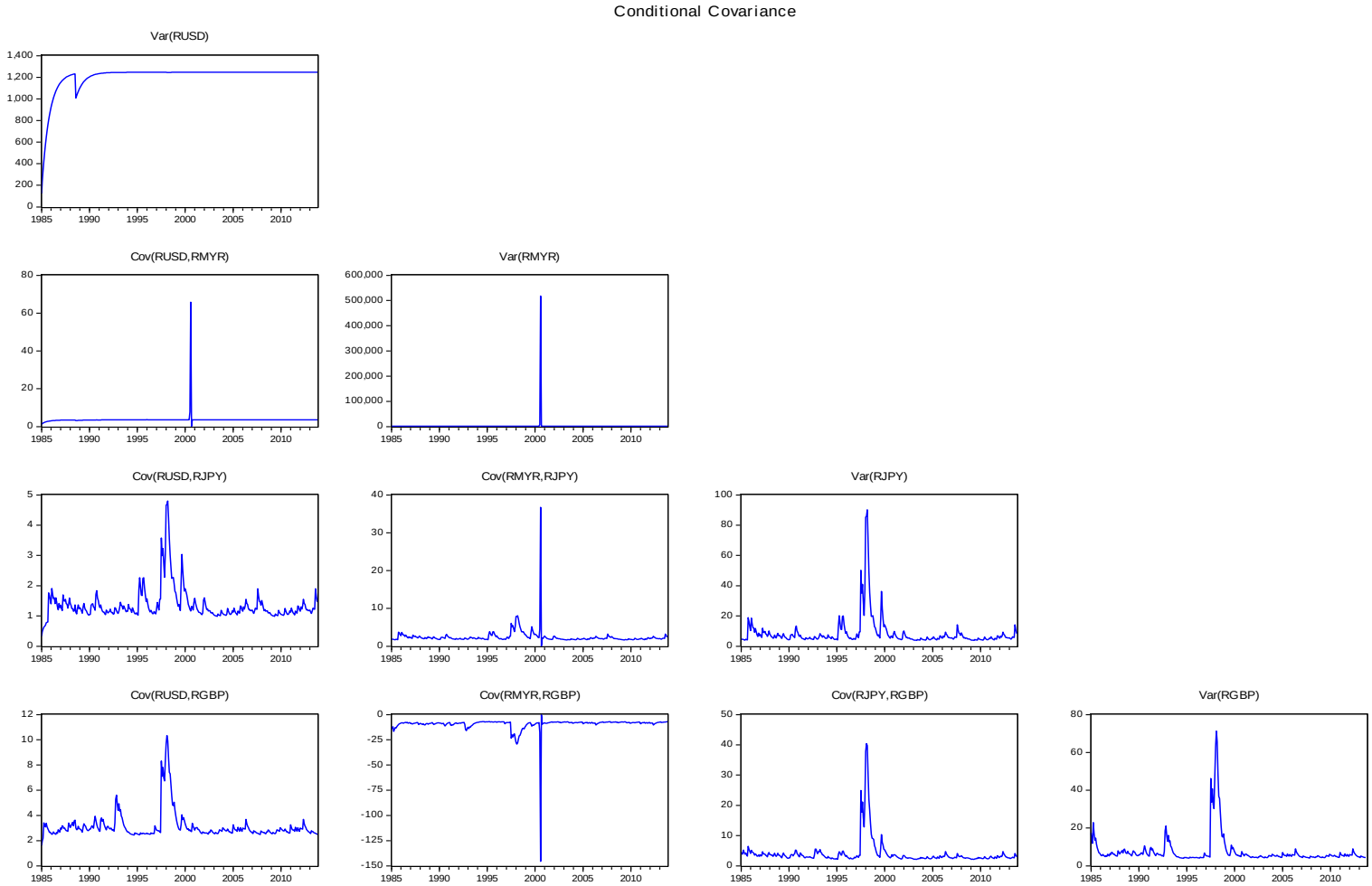

Figure 4 Conditional Covariance (the CCC estimates)

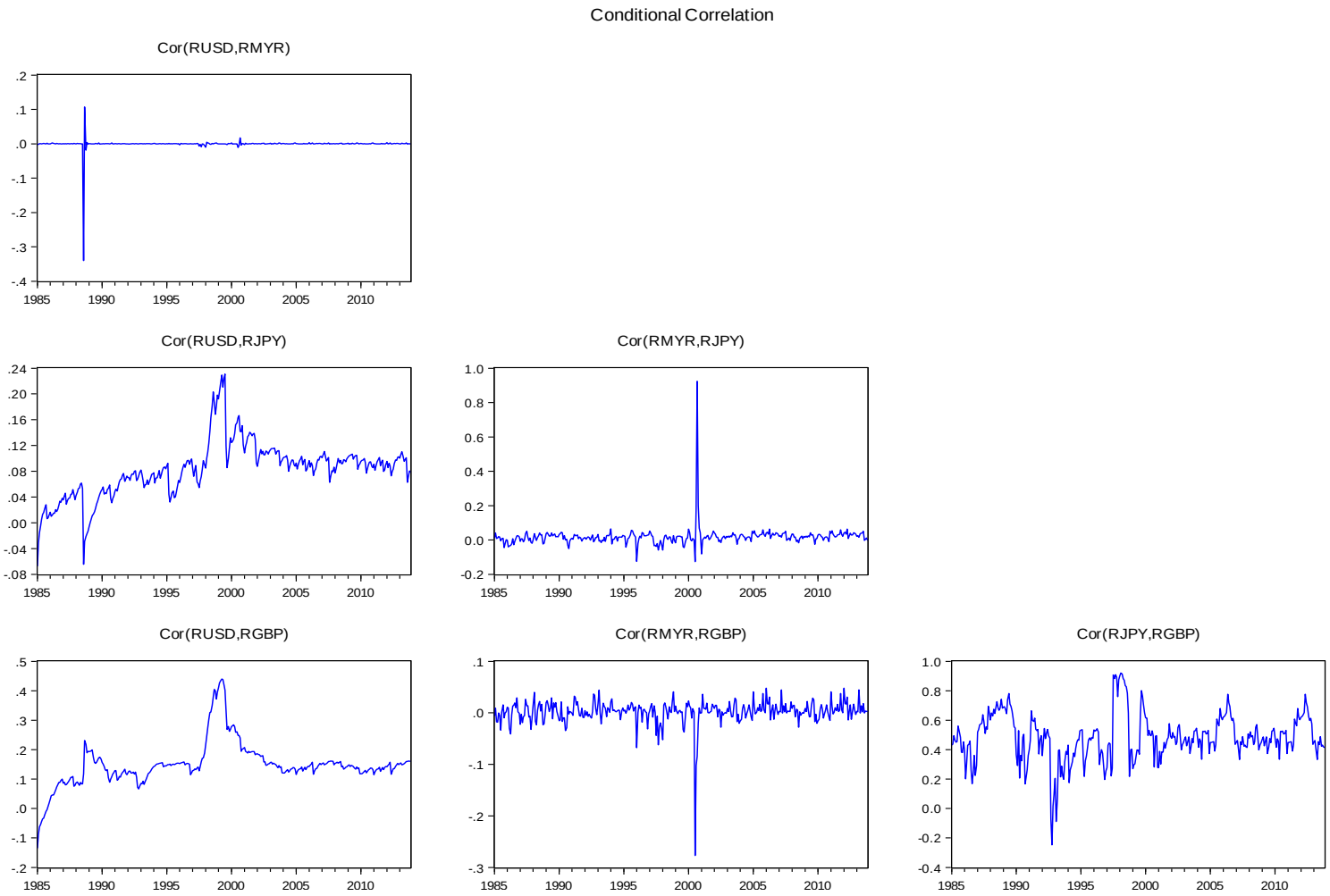

Figure 5 Conditional Correlation (the diagonal VECH estimates)

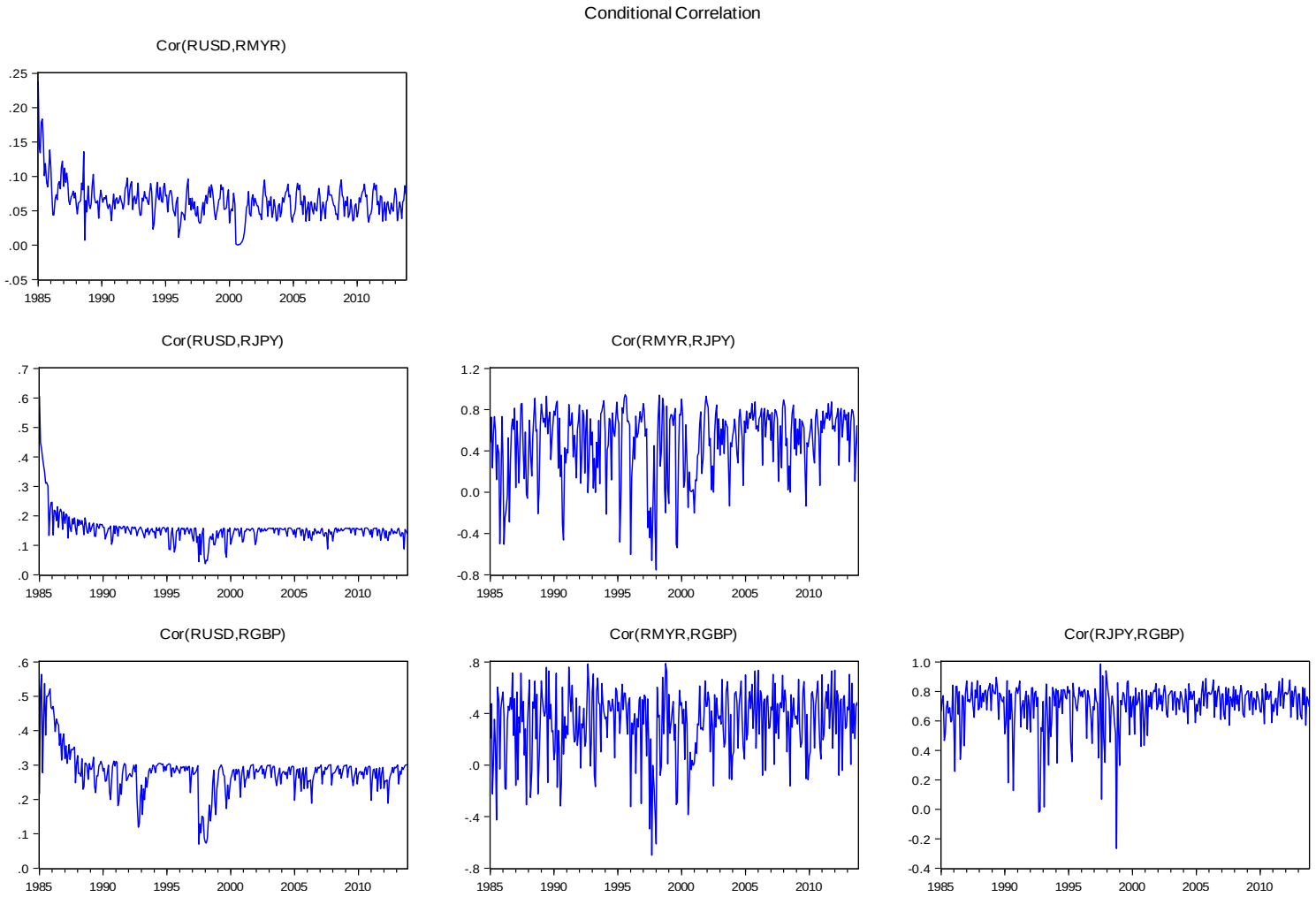

Figure 6 Conditional Correlation (the diagonal BEKK estimates

MODELLING THE DEMAND FOR NEW INVESTMENT CREDITS TO THE NON-FINANCIAL COMPANIES IN THE SLOVAK REPUBLIC

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Abstract:

This article deals with modelling the demand for new investment credits to the non-financial companies in Slovakia. The main aim is to analyze what indicators determine the demand for new investment credits using Autoregressive distributed lag modelling approach to cointegration analysis. The time period under consideration lasts from January 2009 to September 2013. Applied econometric analysis has confirmed the existence of the long-run relationship between the examined variables. We have shown that the index of industrial production, cost of loans and inflation rate are important determinants of the investment credit to the non-financial companies in Slovakia. The employed ARDL approach to cointegration enabled us to examine the long-run and short-run relationships among the variables of interest. The signs of the coefficients indicate that the estimated function is a demand function for the investment credit to the non-financial corporations. Both the CUSUM and CUSUMQ tests confirm the stability of the estimated long-run coefficients of the demand function.

Keywords: new investment credits, non-financial institutions, demand for investment credits, bounds test, ARDL approach to cointegration

JEL Classification: G21; G31; C22

1. Introduction

Credit developments carry significant information about both economic and financial activity. First of all, changes in credit provide signals about the availability and demand for funds supporting (or deterring) the investment and spending decisions of the private non-financial sector. This is particularly the case where bank lending is one of the major sources of non-financial corporations financing. Credit developments may thus contain useful information for forecasting an economic activity and monetary developments. In addition, from a monetary policy perspective, the credit market potentially plays a propagating role in the process of transmitting changes in monetary policy to the real side of the economy. Loans are also the major component of banks' asset side of their balance sheet and hence they represent a significant counterpart to the monetary aggregates. As a result, corporate lending is an important measure to consider for the regular assessment of the monetary policy stance. Detailed knowledge about the various structural factors determining corporate loan developments is therefore crucial for understanding monetary developments and, ultimately, for the setting of monetary policy.

Most previous studies have either modelled credit to the private sector as a whole (Hofmann, 2001; Hulsewig, 2003; Calza *et al.*, 2003; Gambacorta and Rossi, 2007) or business lending for individual euro area countries (Bridgen and Mizen, 1999 and 2004; Kakes, 2000). In the case of Slovakia the analysis of the determinants for household credits is studied e.g. by Vokorkosová and Peller (2013). Furthermore, in our analysis, we exploit a dataset of credits to the non-financial companies in the Slovak Republic.

2. Review of the literature

Modelling the credit demand is currently an object of interest in many studies. Various authors have used different techniques to specify the real demand for credit. Some of them analyze the credit market using the total volume of granted credits by monetary financial institutions (MFI) in a country to all sectors in the economy as a dependent variable. Others focus on chosen segments of credit market such as mortgage, investment or consumer credits granted to private sector or to households. Identification strategy of significant factors influencing demand for credits depends on the data which have been applied by authors, e.g. identification based on aggregate date or micro-level data.

According to the most studies the economic activity variable (e.g. real GDP or industrial production index as a proxy for GDP), financing cost (e.g. interest rates or bank lending rates) and inflation rate are considered to be the main determinants affecting credit demand. It does not seem to be consensus in the literature about what impact has the economic growth on credit demand. Some empirical findings point to a positive relation (Bernanke, Blinder, 1988) and some of them to a negative relation (Friedman *et al.*, 1993). It is also difficult to estimate relation between credit demand and inflation rate in advance. Some empirical studies indicate a positive relation (Calza, 2003) and some of them a negative relation (Cuthbertson, 1985). The negative relationship between the demand for credits and their cost appears to be more consensual.

Bernanke and Blinder (1988) present a simple formal model for illustrating the bank lending channel which is a variant of the IS-LM model. In this model they suggest that the loan demand equation takes the following form:

$$L^d = \underset{-}{L}(\rho, \underset{+}{i}, \underset{+}{y}) \quad (1)$$

where L^d represents the loan demand, ρ the interest rate on loans, i the interest rate on bonds and y denotes GDP.

Kashyap and Stein (1995) investigate bank lending behavior using the individual bank data. In their model assuming that there is a single, homogeneous economy-wide loan market, demand for credits should be a function of the loan rate r, as well as general economic condition denoting by Y. Thus, a linear representation of aggregate credit demand is:

$$L^d = Y - kr \quad (2)$$

Ehrmann (2001) examines bank lending based on a simple version of the Bernanke and Blinder's model (1988). His demand for loan L^d is given by equation:

$$L^d = \phi_1 y + \phi_2 p - \phi_3 i_l \quad (3)$$

where y refers to the aggregate real output, p to the price level, i_l to the interest rate on loans and ϕ_1, ϕ_2, ϕ_3 are positive coefficients.

Calza *et al.* (2001) emphasizes that "the analysis of the demand for loans to the private sector in the euro area is limited to a relatively small set of explanatory variables representing general economic activity and the cost of loans." He estimates the empirical model based on the long-run relationship specified in semi log-linear form which can be written as follow:

$$LOANS = \alpha + \beta_1 GDP - \beta_2 ST - \beta_3 LT \quad (4)$$

where: LOANS and GDI stand for logarithms of loans to the private sector and GDI both in real terms, ST and LT represent the real short-term and long-term interest rates respectively.

His econometrical investigation shows that in the cointegration equation, the coefficients of real short-term and long-term interest rates have negative signs, which confirms that the employed model is describing a demand phenomenon. On the other side, plus sign of the GDP coefficient indicates positive relationship between granted loans and economic activity. In 2003

they extend their examination of the demand determinants for loans and include inflation rate as the next factor influencing credit demand. The long-run relationship equation is defined in following form:

$$(loans - p)_t = \beta_0 + \beta_1 y_t - \beta_2 R_t + \beta_3 \pi_t \quad (5)$$

where $loans, p$ and y denote logs of nominal loans to private sector, the GDP deflator and real GDP, R represents the nominal composite lending rate and π stands for inflation rate. The estimation results indicate negative relation between loans and nominal lending rate. Moreover, positive signs of real GDP and inflation rate have a positive effect on the overall financial condition of private sector. Higher economic growth and productivity can lead to a larger number of investment projects, which are funded by credits and, hence, demand for loans rises.

Except the most included factors influencing credit demand, e.g. Hofmann (2001) considers also the real estate prices, Cottarelli *et al.* (2005) explore financial liberalization index, accounting standards, entry restrictions to the banking sector, German origin of the legal system, public debt, Boissay *et al.* (2006) examine Euribor as the independent variable.

In the Slovak credit market the household credits is payed the most attention in the theoretical and empirical literature. Vokorokosová and Peller (2013) investigate the determinants of household credits in Slovakia in the period 1995 Q1 to 2008 Q4. They find the existence of the long-run relationship among the variables of interest.

Our paper is devoted to extending existing studies exploring the demand for credits. Most studies employ the total volume of credits granted to the private sector. By contrast, we focus on the analysis of demand for new investment credits to non-financial companies and employ the volume of new investment credits to non-financial companies as a dependent variable

3. Data

The analysis in this study is based on monthly data extracted from database of the National bank of Slovakia and the Statistical office of the Slovak republic. The time period under consideration lasts from January 2009 to September 2013. The time series employed in our study and their notations used to present the variables are following:

RLNC - total volume of real new investment credits to non-financial companies in logarithm form;
IR - average year interest rate on new investment credits (%);
IIP - index of industrial production;
HICP - harmonized index of consumer prices (index).

Basic descriptive statistics and graphical analysis of the mentioned variables are depicted in the Table 1 and the Figure 1.

Table 1 Descriptive statistics

	Number of observations	Mean	Standard Deviation	Variance	Median	Minimum	Maximum
RLNC	57	12.70	52.31	2736.84	-1.35	-74.01	135.29
IR	57	3.89	0.56	0.31	3.93	2.23	4.95
IIP	57	101.97	10.36	107.41	105.10	74.80	113.70
HICP	57	116.60	4.60	21.19	116.69	111.05	123.27

Source: Author´s calculations

As Figure 1 presents, the growth of the new investment credits to non-financial companies indicated frequent changes from month to month. Apart from some periods the investment credits to non-financial companies were marked by a slight positive month to month growth. The interest rate for the new investment credits was declining from the 4.37% at the beginning (2009 January)

to 2.23% in 2013 August. As for the economic activity proxied by the index of industrial production, we can see that apart from the beginning period (2009) it marked a positive growth. So there is a link between the economic development and the credit growth. When the economy rises, the consumption increases hence the non-financial companies are forced to meet the higher demand for their products. Because of that they increase the demand for working capacities and investments which are financed mainly through the bank credits. (Hofmann, 2001)

So the development of economic indicators belongs to the discussed topics in many studies, especially in the time of financial and economic crisis. The development of credits has become the object of interest in studies of e.g. Beka (2006), Beka, Čársky (2006), Polouček (2010), Vodová (2013), Vokorokosová and Peller (2013).

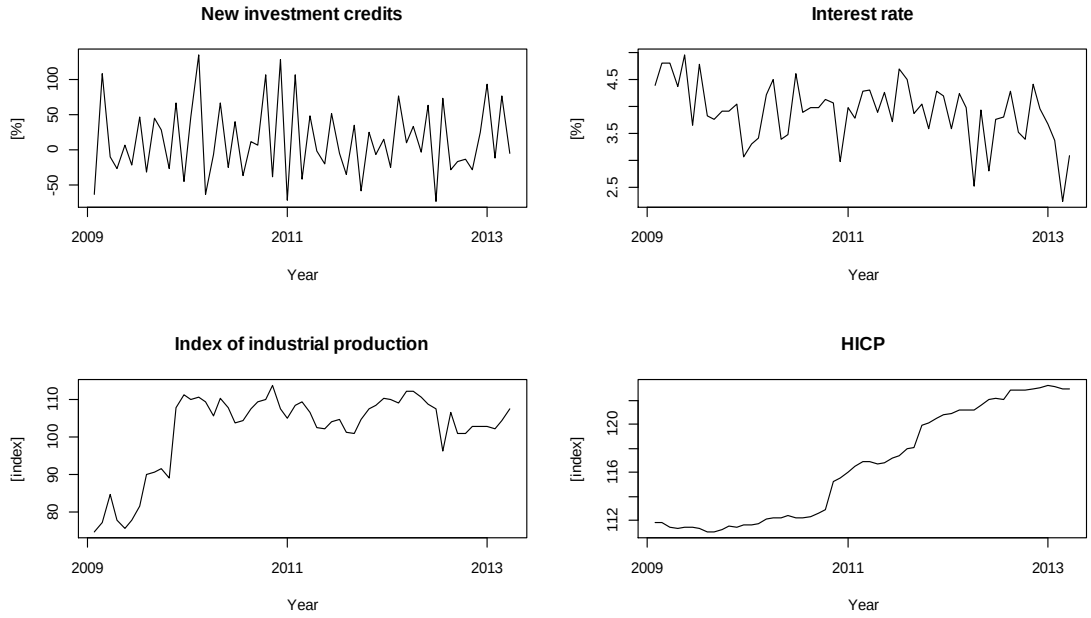

Figure 1 Graphical analysis of model variables

Source: Author´s calculations using data of the National bank of Slovakia and the Statistical office of the Slovak Republic

We explore the period of time when economic growth and financial markets were influenced by global financial and economic crisis. From the beginning of 2009, when the Slovak republic joined the eurozone, economic situation in Slovakia was getting worse. Many investments were stopped. The development of new investment credits stagnated because of uncertainty of the future economic condition. After stimulating the economic growth and new investment impulses the situation in Slovakia was getting better and investment credits increased, but their dynamics decelerated. Even monetary easing and declining of interest rates for investment credits did not encourage higher growth of new investment credits.

4. Methodology

The demand for the investment credit to non-financial companies *RLNC* is determined by the index of industrial production *IIP* that is a proxy for the economic activity in the country, inflation measured as an *HICP* index and the interest rate *IR* applied on the investment credits. Therefore the demand for the investment credits takes the following log-linear form:

$$r\ln c_t = \alpha + \beta_1 ir_t + \beta_2 hicp_t + \beta_3 iip_t + \varepsilon_t \quad (6)$$

where: $r\ln c_t$ represents the investment credits in real terms (log), ir_t the interest rate applied on the investment credits, $hicp_t$ the inflation measured as an index and iip_t index of industrial production, ε_t the error term.

To empirically analyze the long-run relationships and dynamic interactions among the variables of interest we employ the autoregressive distributed lag (ARDL) cointegration procedure introduced by Pesaran *et al.* (1996).

The ARDL approach to cointegration procedure is adopted for three reasons. Firstly, the bounds test procedure is simple. As opposed to other cointegration techniques such as Johansen and Juselius (1990), it allows the cointegration relationship to be estimated by OLS once the lag order of the model is identified. Secondly, the bounds testing procedure does not require the pre-testing of the variables included in the model for unit roots. It is applicable irrespective whether the variables are purely I(0), purely I(1) or mutually cointegrated. Thirdly the test is more efficient in small or finite sample data sizes as it is the case in this study. But the procedure will crash in the presence of I(2) series.

Bounds testing procedure: Following the Pesaran and Pesaran (1997), Pesaran and Shin (1999) and Pesaran and Smith (2001), the error-correction version of ARDL model can be written as follows:

$$\Delta r\ln c_t = \beta_0 + \sum_{t=1}^{p}\delta_1\Delta r\ln c_{t-1} + \sum_{t=0}^{q1}\delta_2\Delta ir_{t-1} + \sum_{t=0}^{q2}\delta_3\Delta iip_{t-1} + \sum_{t=0}^{q3}\delta_4\Delta hicp_{t-1} + \beta_1 r\ln c_{t-1} + \beta_2 ir_{t-1} + \beta_3 iip_{t-1} + \beta_4 hicpi_{t-1} + \varepsilon_t \quad (7)$$

where: Δ denotes the first difference operator, β_0 is an intercept, coefficients (δ_1, δ_2, δ_3, δ_4) measure the short-run dynamics of the model whereas β, represent the long-run dynamics of the model.

The first step in the ARDL bounds testing approach is to estimate equation (7) by ordinary least squares (OLS) in order to test for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables. So we test the null hypothesis that all β coefficients are jointly equal to 0 against the alternative that they are not equal to 0.

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

$$H_1: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$$

Pesaran *et al.* (1996) provide two sets of asymptotic critical values. One set assumes that all variables are I(0) and the other assumes they are all I(1). If the computed F-statistic falls above the upper bound critical value, then the null of no cointegration is rejected. If it falls below the lower critical value the null cannot be rejected. Finally if the calculated F-value falls within the bounds, inference is inconclusive. If the cointegration is confirmed we estimate the long-run coefficients of the credit demand function and the associated ARDL error correction models.

Unit root tests: Before we procede with the ARDL bounds test, we test for the stationarity of all variables to determine their order of integration and make sure that none of the variables is of I(2). In this study we use ADF, PP and KPSS unit root tests in order to check the stationarity of the variables.

Table 2 Augmented Dickey-Fuller unit root test results

VARIABLE	ADF TEST			
	Intercept		Intercept and trend	
	t-statistic	**p-value**	**t-statistic**	**p-value**
rlnc	-2,7198	0,0772	-2,6921	0,2439
Δrlnc	-14,1015	0,0000	-13,9648	0,0000
ir	-5,6357	0,0000	-6,2656	0,0000

VARIABLE	ADF TEST			
	Intercept		Intercept and trend	
Δir	-12,6903	0,0000	-6,2425	0,0000
hicpi	0,2462	0,9732	-2,3597	0,3960
Δhicpi	-6,3698	0,0000	-6,3577	0,0000
iip	-2,7771	0,0680	-2,4958	0,3291
Δiip	-8,2565	0,0000	-8,4001	0,0000

Notes: The null of the unit root is rejected if the p-value is lower than the 5% level. Δ is a difference operator, Lag length is selected automatically based on Schwarz Info Criterion.

Table 3 Phillips-Perron unit root test results

VARIABLE	PP test			
	Intercept		**Intercept and trend**	
	t-statistics	**p-value**	**t-statistics**	**p-value**
rlnc	-5,4424	0,0000	-5,3967	0,0002
Δrlnc	-14,1015	0,0000	-13,9648	0,0000
ir	-5,5893	0,0000	-6,2522	0,0000
Δir	-28,8968	0,0001	-27,7871	0,0001
hicpi	0,0805	0,9614	-2,4446	0,3536
Δhicpi	-6,4503	0,0000	-6,4445	0,0000
iip	-2,7819	0,0673	-2,3946	0,3783
Δiip	-8,3157	0,0000	-8,6128	0,0000

Notes: The null of the unit root is rejected if the p-value is lower than the 5% level. Δ is a difference operator.

Table 4 KPSS unit root test results

VARIABLE	KPSS test			
5%	**Intercept**		**Intercept and trend**	
	LM-statistics	**Critic value at 5%**	**LM-statistics**	**Critic value at 5%**
rlnc	0,1628	0,4630	0,1632	0,1460
Δrlnc	0,1086	0,4630	0,0914	0,1460
ir	0,4655	0,4630	0,0975	0,1460
Δir	0,3027	0,4630	0,2924	0,1460
hicpi	0,8780	0,4630	0,1595	0,1460

Δhicpi	0,2241	0,4630	0,1743	0,1460
iip	0,4639	0,4630	0,1919	0,1460
Δiip	0,2749	0,4630	0,0807	0,1460

Notes: The null of stationarity is rejected if the LM statistic is higher than the critical value at 5% level, Δ is a difference operator.

The results regarding the order of integration based on different unit root criteria such as ADF, PP and KPSS are summarized in the Table 5.

Table 5 Unit root test results

	ADF test		PP test		KPSS test	
	Intercept	**Intercept and Trend**	**Intercept**	**Intercept and Trend**	**Intercept**	**Intercept and Trend**
rlnc	I(1)	I(1)	I(0)	I(0)	I(0)	I(1)
ir	I(0)	I(0)	I(0)	I(0)	I(1)	I(0)
hicpi	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
iip	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)

Source: Author´s work in Eviews 7

According to the unit root tests none of the variables is of I(2) and the dependent variable is of I(1) so the appropriate technique to cointegration is the ARDL approach.

5. Results

Bounds tests for cointegration: In the first step of the ARDL analysis we tested for the presence of the long-run relationship among the variables by estimating an unrestricted VAR model in the form of equation (7). Firstly we estimated an OLS regression for the first differences part of the equation (7) and then test for the joint significance of the parameters of the lagged levels variables when added to the first regression

In testing the null of no cointegration we must decide about the order of lags on the first differenced variables, because as the Bahmani-Oskooee and Bohl (2000) have shown, the results of this first step are sensitive to the order of VAR. To confirm this and in regard to the number of observations available we impose 1, 3, 6 and 9 lags on the first difference of each variable. The computed F-statistic for order of lag is reported in the table (6). As can be seen, the computed F-statistic is inconclusive for lag 1 at 95% level and for lag 3 at 90% level, but for lag 9 it is significant at 99% level. The results seem to provide preliminary evidence for the existence of the long-run relationship (especially when the higher order of lag is selected).

These results indicate that in the formulating the equation (6) we must retain the lagged levels variables.

Table 6 F-statistics for testing the existence of a long-run relationship among variables

Order of lag	F-statistics
1	3,291
3	2,517
6	2,682
9	10,761 ***

Notes: The relevant critical value bounds are given in Narayan (2004). They are for k=3; 4,118-5,200 at 99% significance level; 2,962-3,910 at 95% significance level and 2,508-3,356 at 90% significance

level. * Denotes that the F-statistic falls above 90% upper bound, ** denotes above 95% bound and *** above 99% bound.

In the second stage, we continue by estimating the ARDL model using an appropriate lag selection criterion such as AIC, SBC and R^2.The AIC and SBC criterions provide the same ARDL (2, 0, 0, 0) model (see the results in the Table 7), but according to the R^2 criterion the best model is ARDL (2, 3, 2, 3), see Appendix.

Table 7 ARDL (2, 0, 0, 0) based on AIC and SBC criterion (Dependent Variable is RLNC)

REGRESSORS	COEFFICIENT	T-RATIO [PROB.]
RLNC (-1)	0,11491	0,9016 [0,372]
RLNC (-2)	0,35885	2,9655 [0,005]
IR	-0,20800	-2,1366 [0,038]
IIP	0,014202	2,1370 [0,038]
HICPI	-0,022233	3,0493 [0,073]
C	5,6357	3,0493 [0,004]

Notes: R^2 = 0.41; F-stat = 6.6525 [0,000]; SBC = -30.7623, Serial correlation (LM) = 14.5468 [0,267]; Ramsey´s Reset Test = 0.49349 [0,482]; Heteroscedasticity = 1.8188 [0,177]; Normality (LM) = 1.5822 [0,453]

The estimated ARDL (2, 0, 0, 0) model based on AIC and SBC criterions takes the following form:

$$r\ln c = 5{,}63 + 0{,}11 r\ln c_{t-1} + 0{,}36 r\ln c_{t-2} - 0{,}21 ir + 0{,}014 iip - 0{,}02 hicpi + \varepsilon_t \qquad (8)$$

The regression for the underlying ARDL (2, 0, 0, 0) and ARDL (2, 3, 2, 3) models fits at R^2 = 0.41 and R^2 = 0.54 respectively, and passes the diagnostic tests against the serial correlation, functional form misspecification and non-normal errors. The stability of these models is examined by CUSUM and CUSUMQ tests proposed by Brown *et al.* (1975). The results of these tests for the ARDL (2, 0, 0, 0) are shown in the Figure 2 and 3 for the ARDL (2, 3, 2, 3) in the appendix. The results of CUSUM and CUSUMQ tests stay within the critical bounds of 5% significance level (portrayed by two straight lines) so the null hypothesis that all coefficients in the model are stable cannot be rejected. The results indicate that there is a stable and significant relationship among the variables under the consideration, and there is not any significant structural instability in the model.

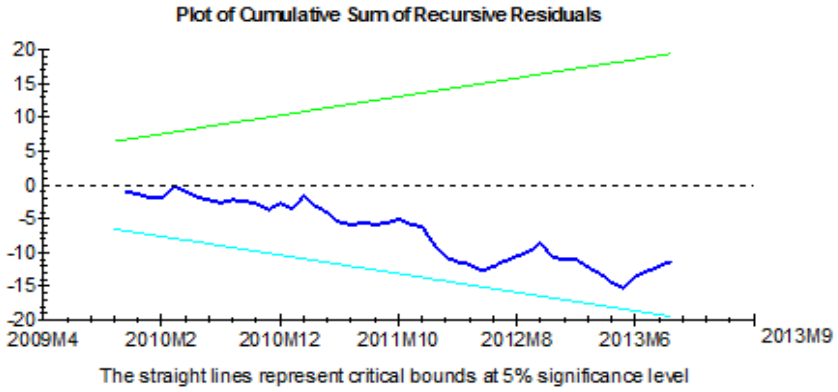

Figure 2 Plot of cumulative sum of recursive residuals
Source: Own calculations in Microfit 4.0

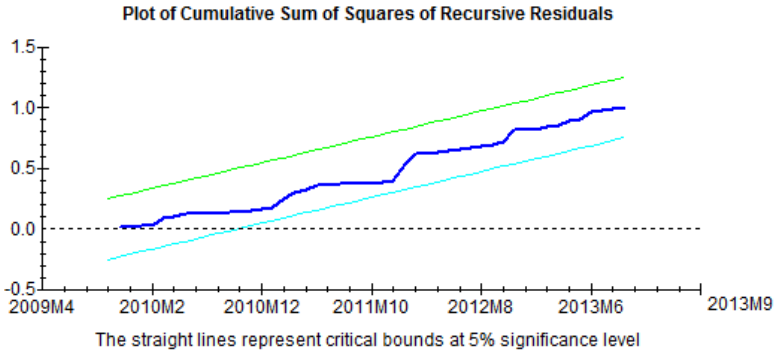

Figure 3 Plot of Cumulative Sum of Squares of Recursive Residuals

Source: Own calculations in Microfit 4.0

After we established the stability of the model and that the long-run relationship existed, we estimated the coefficients of the long-run relationship using the ARDL approach. The results of the long-run coefficients are presented in the Table (8).

Table 8 Estimated long-run coefficients using ARDL approach

	ARDL (2, 0, 0, 0)		ARDL (2, 3, 2, 3)	
Regressor	**Coefficient**	**T-ratio [Prob.]**	**Coefficient**	**T-ratio [Prob.]**
IR	-0,39525	-1,7905 [0,080] *	0,086984	0,22533[0,823]
IIP	0,026988	2,2285 [0,031] **	0,044394	2,4603[0,018]**
HICPI	-0,042248	-1,8258[0,074] *	-0,046187	-2,1461[0,038]**
C	10,7095	3,6404[0,001]***	7,5965	2,0142[0,051]*

Notes: ARDL (2, 0, 0, 0) based on the SBC and AIC, ARDL (2, 3, 2, 3) based on the R^2. Dependent variable is rlnc. * denotes 10% significance level and ** denotes 5% significance level and *** denotes 1% significance level.

The estimated coefficients of the long-run relationship obtained from the models based on the AIC and SBC criterions are the same and they are very similar to the coefficients obtained from the model based on the adjusted R^2 criterion. Except for the coefficient of the interest rate in the ARDL (2, 3, 2, 3) model which is not significant and has an unexpected positive sign.

The estimated long-run model based on ARDL (2, 0, 0, 0) has the following log-linear form:

$$r\ln c = 10{,}71 - 0{,}395ir + 0{,}027iip - 0{,}042hicpi + \varepsilon_t \qquad (9)$$

The results of the estimated long-run coefficients show that the index of the industrial production that is a proxy for an economic activity has a significant positive impact on the real credit to non-financial companies in the long-run according to all three models. A unit increase in the value of the index leads to approximately 2.7% or 4.4% increase in the real investment credits to non-financial companies, all things being equal. The results are in accordance with the findings in Hofman (2001) and Calza (2001)[5] who instead of the *iip* used the real *GDP* as independent

[5] The long-run income elasticity estimated by Calza *et al.* (2001), is 1,34 for the euro area;,1,48 in Calza *et al.* (2003); 1,76 for the Netherlands by Kakes (2000); 1,11 for Germany in Hülsewig *et al.* (2001); and values ranging betweeen 1,1 and 1,4 for most euro area countries in Hoffman (2001)

variable as a proxy for the economic activity. They also found the positive relation between credit and real GDP. The difference between the value of the *iip* coefficient in our study and the coefficients of *GDP* in other studies that is a bit lower than ours may be caused by the fact that we use the *iip* variable as a proxy for the economic activity while Calza (2001, 2003) uses *GDP* variable. Also we focus only on the investment credits to non-financial companies while Calza *et al.* (2001, 2003) deals with the total loans to private sector in the euro area. Our findings of this positive relation between these two variables in the case of Slovakia may support the argument that a strong economic growth in the long-run may lead to a higher demand for the investment credits from the non-financial companies to fund their investment decisions. As regards the long-run coefficient of the interest rate, it has an expected significant negative sign. From the estimated value of the *ir* coefficient it seems that in the long-run the investment credit is affected mostly by the changes in the interest rate than by the changes in other variables. The rise of the interest rate by 1 percentage point leads to approximately 39 % decrease in the volume of the real investment credits. This indicates that the cost of loans proxied by the nominal interest rate seems to be the most important determinant of the investment credits demand in the long-run. In our study we found a support for the existence of a negative relationship between the real investment credits and inflation because the coefficient of inflation is negative and significant[6]. A unit increase/(decrease) in the *HICP* index value leads to a 4.2% decrease/(increase) in the investment credits.

After estimating the long-run model, the estimates of the short-run dynamic coefficients selected by the AIC, SBC and R^2 are presented in the Tables 9 and 10. The adjusted, R^2 are 0.53 and 0.63 for these models respectively, suggesting that such error correction models fit the data reasonably well. The coefficients of the error correction terms in ARDL (2, 0, 0, 0) and ARDL (2, 3, 2, 3) model are both negative and highly significant. This reinforces our findings of cointegration as provided by the F-test.

Table 9 Error correction representation for selected ARDL (2, 0, 0, 0) model based on AIC and SBC

Regressor	Coefficient	T-ratio [Prob.]
Δ rlnc (-1)	-0,35885	-2,9655 [0,005] ***
Δ IR	-0,20800	-2,1366 [0,038] **
ΔIIP	0,014202	2,1370 [0,038] **
ΔHICPI	-0,022233	-1,8336 [0,073] *
ΔC	5,6357	3,0493 [0,004] ***
ecm (-1)	-0,52624	-3,5763 [0,001] ***

Notes: *ecm* = rlnc + 0,395ir – 0,0267iip + 0,0422hicpi – 10.7095C. Dependent variable is Δ rlnc, R^2=0.53, R-Bar-Squared = 0.48390, F-stat = 10.9386 [0,000], SBC = -30.7623, DW-statistic = 1.9854, SER = 0.3635, RSS = 6,3422; * denotes 10% significance level, ** denotes 5% significance level and *** 1% significance level

The estimated short-run model will be in the following form:

$$\Delta r\ln c = 5{,}64 - 0{,}36\Delta r\ln c_{t-1} - 0{,}21\Delta ir + 0{,}014\Delta iip - 0{,}022\Delta hicpi - 0{,}53ecm_{t-1} + \varepsilon_t \quad (10)$$

Where *ecm* is the error correction term which is given as:

$$ecm = \text{rlnc} + 0{,}395\text{ir} - 0{,}0267\text{iip} + 0{,}0422\text{hicpi} - 10{,}7095\text{C} \quad (11)$$

[6] The sign of the long-run coefficient of inflation cannot be determined apriori. There are argumets in support of a positive relationship (Howells and Hussein, 1999), but also the arguments in support of negative relationship between the two variables. (Cuthbertson, 1985)

The coefficient of the lagged error correction term reveals how quickly/slowly variables return to the equilibrium and it must be significant and negative for establishing cointegration. The absolute value of the coefficient of the error correction term indicates the speed of adjustment to restore equilibrium and negative sign shows convergence in the short-run dynamic model. The estimated *ecm* coefficient in our model has expected negative and significant sign of -0.53. The value of this coefficient implies a fairly high speed of adjustment to equilibrium after a shock from the previous period. This means that approximately 53% of disequilibria from the previous month´s shock converge to the long-run equilibrium in the next month.

As can be seen from the table (9) the growth rate of the real credit to non-financial companies in the short-run is affected mainly by the one lagged real credit variable which coefficient is highly significant and negative. What means that the one percent rises in the real credit in previous month will cause approximately 0.35 percent decline in the real credit next month. The real investment credit to non-financial companies is in the short-run also negatively affected by the interest rate and inflation and positively by the index of industrial production.

Conclusions

This study employed the bounds test (ARDL) approach to cointegration to examine the long-run and short-run relationships between the real investment credit to non-financial companies, the interest rate, the index of industrial production and the inflation rate. The main aim of the study is to estimate the demand for the real investment credit to non-financial companies and find out the indicators that have an impact on the demand for the credit to non-financial companies in Slovakia. By applying the cointegration technique we were able to find out that the variables of interest put in the demand function (6) are bound together in the long-run. The estimated error correction term was also highly significant and negative confirming the existence of the long-run relationship among the variables of interest. Both CUSUM and CUSUMQ tests confirm the stability of the long-run coefficients of the investment credit demand function. The results also indicate that the economic activity, cost of loans and inflation rate are important determinants of credit demand to non-financial companies in Slovakia. This implies that the growing economic activity will enhance the investment credit demand from non-financial companies while the rise of the cost of loans and inflation will reduce the investment credit demand in Slovakia.

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APPENDICES

Table 10 ARDL (2, 3, 2, 3) based on Adjusted R^2 (Dependent variable is RLNC)

REGRESSORS	COEFFICIENT	T-RATIO [PROB.]
RLNC (-1)	0,1862800	1,3014 [0,201]
RLNC (-2)	0,2464800	1.7094 [0.095]
IR	-0,2115000	-2,0811 [0,044]
IR(-1)	0,0093275	0,092744 [0,927]
IR(-2)	0,0493130	0,45742 [0,650]
IR(-3)	0,2022000	1,8689 [0,069]
IIP	0,0125940	0,93849[0,354]
IIP(-1)	-0,0172960	-1,1143[0,272]
IIP(-2)	0,0298840	2,3680[0,023]
HICPI	-0,1319800	-0,98966[0,328]
HICPI(-1)	0,2046700	1,0545[0,298]
HICPI(-2)	-0,3385200	-1,8175[0,077]
HICPI(-3)	0,2396200	1,9541[0,058]
C	4,3091000	1,5134 [0,138]

Notes: R^2 = 0.54, F - statF(13,40) = 3,6164[0,001], SBC = -39,9496, Serial correlation (LM) = 16,6810 [0,162], Ramsey´s Reset Test = 5,8668[0,015], Heteroscedasticity = 0,043707[0,834], Normality (LM) = 2,0411 [0,360

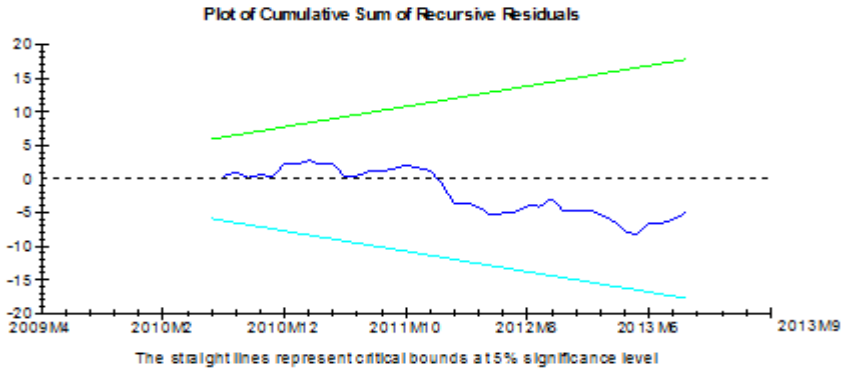

Figure 4 - Plot of Cumulative Sum of Recursive Residuals of ARDL (2, 3, 2, 3)

Source: Own calculations in Microfit 4.0

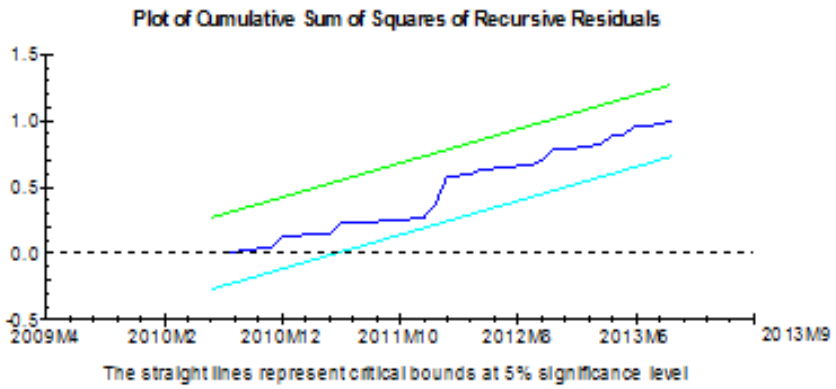

Figure 5 Plot of Cumulative Sum of Squares of Recursive Residuals of ARDL (2, 3, 2, 3)

Source: Own calculations in Microfit 4.0

ETHICS PERCEPTION IN BUSINESS AND SOCIAL PRACTICE IN THE CZECH REPUBLIC

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Abstract:

Business ethics, as a part of so called applied ethics, has been dynamically gaining on importance. Pushing the idea of applying ethics in the Czech business environment has started in the mid-90s of 20th century. Since that time the business ethics has made a huge progress and its Czech representatives and promoters have done a significant amount of work in this area. On the other hand, it is necessary to objectively admit, that there are still many managers, businessmen, students and people who have doubts about the legitimacy of business ethics and they consider it as unreal and illusory in the market environment. Therefore, main objective of this paper is to contribute to the knowledge, understanding, current status, level of perception's awareness of ethics and morality in business and social spheres based on both theoretical analysis and resource bases, and own empirical research.

Keywords: business ethics, applied ethics, corporate social responsibility, Czech society, pilot survey, qualitative analysis.

JEL Classification: M140

1. Introduction

Much of the growing importance of business ethics was caused by the membership of Czech Republic in the European Union, which very intensively supports ethical behavior and corporate governance of European enterprises with the aim to increase their competitiveness in a global measure. The initiator of promoting ethical behavior can be also the representatives of business sphere. Entrepreneurs' growing interest about ethical and social audits, implementation of ethical codex and other methods and tools of business ethics has various causes: pressure of foreign partners, requirement for foreign investment, changes in customer's attitudes, company's culture of foreign parent company, requirement of quality and stable employees, requirement for long-term business relations, pressure of supranational institutions and state and total pressure of society and public opinion (Bowie, 2013; Andriof, McIntosh, 2001; Kline, 2010; Schminke, 2010; Kunz, 2012; Trevino, Nelson, 2011).

If the main aim of entrepreneurship is to maximize profits then it is impossible not to encounter in practice the irresponsibility, performance orientation and motivation, increase need of money and consumption etc. We meet with ethics resp. with its disobeying practically every day. Large-scale media and mass media are informing us daily about law violations, but also about the facts and situations which are not clearly stated in law but they are generally known and violating these rules/laws is considered unethical and immoral.

Many managers and business owners are asking themselves whether there is any sense in dealing with ethical and moral aspects of business. It is generally said that you either behave consistently ethically and morally, but in this case you do not have much chance of success at the market, or you are successful, efficient, and competitive, simply you are earning money, but ethics is a luxury for you, it is a luxury good. Ethics, morality and success in business do not mix. This is then related to overall increase in corruption, economic crime and other social and socio-pathological phenomena. However, now in a time of falling economic results of enterprises and overall companies' deterioration, enterprises and companies are more interested in ethical aspects, tracking the causes and consequences of its absence not only in interpersonal relationships, but

especially in the business and commercial sphere. The importance of applying ethics in business and management is discussed very often, different views are presented as to why and how important is ethics in business, why ethics is a necessary prerequisite for the future development in all areas of social existence. The importance of business and management ethics is becoming more urgent and necessary as the globalization's process is coming to its peak. Here, we are dealing with overcoming up to now respected opinions and searching for ways to form new interpersonal relationships and creating more dignified business environment. Tendencies, trends and topicality of this problematic are suggested by the fact that many various ethical conferences, seminars, trainings, symposia etc. are being organized. At the same time they discover and promote approaches which state that especially linking business ethics and enterprises' social responsibility belongs among one of the competitive advantage on the market and represents the image of corporate culture (Bailey, Burch, 2005; Caroll, 2008; Blowfield, Murray, 2008; Duarte, Diniz, 2013).

Currently we can, with certainty, characterize several basic foundations (Kuldová, 2012, Collins, 2012):

- Many institutions and organizations that support the implementation of business ethics in the Czech Republic were established, they promote the idea of ethical behavior. They compile rankings of ethical companies, present particular examples on how to do business ethically, they execute research and gather concrete contributions of ethical behavior.
- Consulting companies which help the enterprises to apply concrete tools and methods of business ethics organize seminars and provide training in the area of business ethics.
- Cooperation of private and non-profit sector has intensified. The amount of concrete social and environmental project is continuously growing.
- Conferences, meetings of representatives from state, private companies, non-profit sectors and academics are being held; the aim is to support and promote development of business ethics in Czech Republic.
- Many researches, in the area of business ethics and company's corporate governance, which evaluate current state and point out trends and development direction, were executed in the Czech Republic.
- Teaching business ethics takes place at most of Czech universities.
- There are more and more companies that actively apply ethical principles of business and permanently sustainable development.
- More Czech customers are interested in ethical and responsible behavior of companies whose products they are buying.

This pilot survey follows and in fact complements current, already executed investigations in the field of business ethics and social practice. We work on the assumption that it is not possible to comprehensively and methodologically cover the problem only based on a single study or partial empirical research. Therefore, it is necessary to perceive the results (findings) as complementary. The structure and content of the research is based on the work of Čaník, Řezbová, Zavrel (2006), Putnová, Seknička (2007), Dytrt *et al.* (2011), Remišová (2011), Kuldová (2012), Kunz (2012), etc.

2. Problem formulation

Executed research, data processing and overall interpretation represent a qualitative approach. The sense of applying qualitative research is, in our case, to uncover and understand phenomena legitimacy, which cannot be uncovered by quantitative research. By the qualitative research approach we are getting closer to the essence of researched phenomena. Qualitative research has a much bigger ability to reveal legitimacy, and actual links of researched reality.

Under the term qualitative research we understand any research whose results are not achieved by statistic procedures, or other types of quantification (Trevino, Nelson, 2011; Ritchie, Lewis, 2003). In social sciences the term qualitative research refers to a research which is aimed at how individuals and groups see, understand and interpret the world. According to other criteria the

qualitative research can be referred to as a research which does not utilize statistical methods and techniques.

Due to the content type, objectives and overall purpose of the empirical investigation the following technique was selected – questions about attitudes (questionnaire).

For results' interpretation was used so called adjusted relative frequency, which means that percentage of respondents who marked relevant answer from total amount of given answers for particular question. It is very difficult to say how would the respondents answered if they did not register the question and therefore did not continue with answering.

As it was already mentioned, the questions that could not have been evaluated quantitatively are interpreted verbally. During the evaluation logical methods of scientific work were used, including exploration method based on semantic operationalization (abstraction, concretization, generalization, analysis, synthesis, induction and deduction).

307 respondents participated in the empirical pilot research (survey). Basic condition for participation in the survey was permanent employment of the respondent (economically active). Because of the researches' problem objective the respondents' experience with ethical aspects in working environment is fundamental. Individual questionnaires were delivered personally through instructed assistants. This research sample surveyed 129 men (42%) and 178 women (58%).

The educational structure of respondents: in standardized empirical research the educational structure of researched sample belongs among fundamental history data. Thus inductively is drawn the a priori relationship between the respondent's education and inherent values by the credibility of data provided. This structure shows that only 3.6% of respondents have primary education, 30.3% secondary education and more than 66% of respondents have a university education, which should be perceived as positive.

The distribution of respondents by region: It is more than understandable, given the place of the personal distribution of questionnaires, that half of the respondents are from the Moravian-Silesian Region. However, the percentage of respondents from other regions is by no means insignificant. For methodologically ideal case (statistically representative sample) it would be necessary to ensure sufficient number of respondents in all regions, so that it would be possible to create an overall picture of the study population. It would also be interesting to see the relationship between individual representation in the regions and their testimonies. However, in this study this was not the aim.

3. Problem solution

Based on the empirical survey (questionnaire survey) respondents were asked a total of 25 research questions that tried as much as possible to explore given issue. Research questions were divided into two thematic areas. First set of questions identified common ethical aspects associated with business operations. Second set of questions surveyed the ethical aspects of business in the respondents' own department.

3.1. Ethical Aspects of Business in General

Question No. 1. Do you think it is important to consider ethics in business?

The vast majority of respondents 95% agree that it is important to consider ethics in business. Other research also confirms that the interest (especially from stakeholders) to ensure that the businesses behave and act ethically is eminent. Likewise it can be assumed that vast majority of the population would claim that it is important to deal with ethical aspects of business, nevertheless the overall level (practice) shows completely different facts.

Question No. 2. Do you think that businesses in the Czech Republic behave ethically?

The results show that more than 60% of respondents believe that businesses in the Czech Republic behave rather unethically. Only 18% of respondents claim that firms behave rather ethically. 14% unequivocally say that businesses in the Czech Republic do not behave ethically. 5% of respondents are not able to assess the situation. Only two percent say that business conduct is ethical.

Question No. 3. What do you think about the situation of ethics in business in the Czech Republic?

The question was formulated in terms whether the situation of ethical climate in business in Czech Republic is improving or worsening or remaining the same. 18% say that the situation is still the same, it does not develop. It is also interesting that 14% of respondents feel that the situation of ethics in business is getting better. 10% of respondents cannot evaluate this situation and only two percent of respondents do not care, they are not interested at all in the issues of business ethics.

Question No. 4. According to your opinion what is the situation in the Czech Republic in terms of compliance with business ethics in comparison with other countries (European Union)?

Here, of course, it can be assumed that respondents can credibly and adequately assess the situation of business ethics in comparison with other countries. Nevertheless, even this information provides some relevant facts. More than half of the respondents perceived the situation in comparison with foreign countries as rather worse. 15% of respondents believe that this situation is certainly worse. 13% consider this level as comparable and the same number of respondents could not adequately assess this problem. Further, none of the respondents chose (on the scale) the possibility that the ethics situation in comparison with foreign countries is definitely better. However, 4% of respondents reported that the ethics situation in the Czech Republic seems to them rather better than abroad. Of course, this fact would have to be more developed and it would be necessary to find out why the respondents have this opinion, more precisely based on what.

Question No. 5. Which companies in your opinion often behave ethically?

57% of respondents think that the level of ethical climate is better in multinational companies and organizations, which basically corresponds directly with the results of Question 4. 21% of respondents are not able to assess the situation. 13% think that state enterprises with public participation are more likely to behave ethically. 9% say that ethical behavior is more common in private companies and enterprises.

Question No. 6. Do you think that ethical behavior in business has some importance (benefits)?

65% of respondents say unequivocally that ethics in business activities is important. More than a quarter of the people surveyed have some doubts about the importance of ethics in business, but they still think it is needed. Five percent of respondents are not able to assess the importance and the value of ethics in business. 3% percent of the people surveyed have a doubt about the importance and benefit of ethics in business. Only one percent stated that ethics in business has no meaning or benefit. However, even this one percent is significant due to the examined problematic and thematic interest.

Question No. 7. What do you think derives from ethical business? (max. 5 options)

Here, the respondents reported specific benefits associated with ethics in business. For better clarity and focus it was possible to only state maximum five reasons. Among the major reasons belong: company reputation, strengthening corporate culture, keeping skilled employees, competitiveness. Other less significant reasons are: increasing product quality, sales growth and profit growth. Interestingly, the respondents did not mention as the main reasons for ethical business: reducing risks in the company, reduce costs, increase employees' work efficiency, etc. The results correspond with the results of previous surveys and other research.

Question No. 8. Do you agree with the opinion that ethical behavior is beneficial for company in a long term?

More than half of respondents 54% state, that ethical behavior is definitely beneficial for company in a long term. 35% of respondents are not directly convinced about this fact. 6% of respondents state that even in the long term perspective the ethical behavior is not beneficial for

company. Two percent of respondents are not able to assess this situation. In case of low percentage representation of negatively perceived opinions these responses are significant. It cannot be proven how the answers would look like if the question was given for a short time horizon.

Question No. 9. What are the biggest ethical problems in the Czech Republic? (max. 5 options)

Here again, respondents had the opportunity to present up to five most serious ethical problems in business today. It was more than likely that respondents would indicate currently the most acute ethical issues. Here, clearly and understandably "reigns" the problem of corruption and bribery (86%). Then follows: unfair treatment of employees, unfair sales and marketing practices, financial fraud, non-commercial conditions or poor quality products and services.

Question No. 10. What do you consider as the main factors of successful business in the Czech Republic? (max. 5 options)

The respondents consider as the greatest factor (condition) of successful business in the Czech the quality of the product. However, it is interesting that in the previous question 9 poor quality products and services represent only 21%. Furthermore, it is about prestige and reputation of the company, innovation, clear corporate strategy, network of contacts and friends or corporate culture. Ethics in business as a factor of increasing success in business is seen only by 18% respondents. The possibility to write their own factors for success in business was utilized by only two respondents, their answers were: production flexibility and quality marketing strategy. Although the percentage is not very significant, it provides very interesting and practical opinions and suggestions.

Question No. 11. Based on your opinion in what area (sector) is unethical behavior taking place most often?

Based on respondents it is clear, and it is quite understandable and logical that the unethical behavior is taking place in profitable sector. Nonprofit sector is based on respondents participating in unethical company's behavior by more than 17%. Eight percent of respondents do not know or they are not able to assess this situation. The results are more than comprehensible because the environment where all of the company's activities are aimed at profit's creation and achieving expected "bottom line" the unethical behavior will be taking place more often. Everywhere where "you dealing with money" the people have a tendency to behave differently than in situations in which the people have a free choice of decision and where you cannot lose anything.

Question No. 12. Based on your opinion in what area (sector) is the unethical behavior taking place most often?

It is the same question as the previous one, however in this case it is asking for the ratio of unethical behavior or companies, organizations or institutions from the point of view of its ratio on its management. More than half of respondents state that unethical behavior is taking place more often in organizations with state participation 57%. On the contrary, 24% of respondents are convinced that especially private sector is the place with the biggest ethical problems. 11% states that the highest level of unethical behavior is in the public sphere. The rest of the respondents 8% cannot evaluate this situation.

Question No. 13. In what industry (sector) do you think is the highest level of corruption? (max. 5 options).

The highest level of corruption is obviously seen in the political sphere 78% since it is a sphere which represents the largest share of all decision-making and management processes within the state apparatus. Politics and its representatives have a major impact on the fundamental level of morality in society. Another problem sectors are: construction 65%, health services 50%, transportation 43% and industry 42%, etc. Due to our problematic it cannot be overlooked that 12% of the respondents see corruption also in professional sport. Given the characteristics,

importance, factors and the role of professional sport in society, which we discussed in detail in the theoretical part, these results are quite understandable.

Question No. 14. Which feasible change would improve the ethics of the business in the Czech Republic?

More than half of the respondents claim that a fundamental change to increase the overall ethical and moral climate in the Czech Republic must be made in a people's way of thinking. Further, a lower percentage changes seen are: consistent law enforcement (14%), compliance with existing standards and regulations (12%) and consistent control (9%). Other less significant changes seen are: amending, supplementing existing laws or changing people. Even the results of this survey somewhat correspond to the results of other studies.

3.2. Ethical Aspects of Business Activity at Individuaů´s Workplace

Question No. 15. How many employees does the company where you work have?

By asking this anamnestic question we are examining and in fact confirming the relation between the number of employees and the rate of ethics in an organization. Generally it is stated that the more employees organization have the more unethical practices are taking place. It is given especially by organizational structure, certain level of personnel complexity and anonymity, several levels of delegating authority, fulfilling working and functional roles etc. The highest number of employees (30%), work in an organization, which has up to 10employees. 22% of respondents work in an organization with 11 to 50 employees. Because of place of questionnaire's distribution (Moravian-Silesian region) it is understandable that more than 16% of respondents work in an organization that has more than 500 employees; they are most probably industrial companies. Further, 13% respondents work in an organization with 51 to 200 employees and 12% work in organization with 201 to 500 employees. Only 7% of employees work (do business) individually.

Question No. 16. How can you describe your company?

This question is finding out the origin of organization's ownership. Main aim of this question was to find the connection between ethics level in organization and its origin. In the context of question 4 we can assume that with growing level of foreign capital the ethics level is higher. However, this cannot be proven without further analysis. In our case 61% of respondents work in an organization with purely Czech capital. 30% work in an organization which is a part of a multinational corporation and 9% in a company with foreign investor.

Question No. 17. Do you consider the behavior of your business to be ethical?

It is interesting that more than half of the respondents 51% considered the behavior of firms, organizations in which they work rather ethical. 30% of respondents believe that they are working in a company that is clearly behaving ethically. 12% of respondents admitted that the company in which they work, behaves rather unethically. 6% percent is convinced that their company certainly does not behave ethically. One percent of respondents are unable to assess the situation, they do not know.

Question No. 18. Are values and rules of conduct clearly defined in your company?

45% of respondents say that their company has clearly and transparently determined values, rules of conduct and behavior. 28% of respondents state that the organization has probably these values and rules stated somewhere. Similarly, 17% of respondents say that the organization for which they work does not have clearly defined values and rules of behavior. 8% is sure that their organization does not have these rules.

Question No. 19. Do any internal ethical regulations exist in your company?

This question confirms predetermined hypothetical assumption that respondents perceive the presence of written and clearly defined rules of conduct and unwritten, informally abided forms of behavior and communication as contradictory. Although in a previous question almost

half of respondents stated that organization in which they work have clearly determined values and rules of conduct; one quarter thinks that that they probably have these rules but almost 60% report that their organizations have only unwritten code of ethics and one fourth of respondents is not sure. 15% of respondents are aware of the fact that they do not have any formal ethical rules or standards. Aforementioned Code of Ethics is registered by only less than two percent of respondents.

Question No. 20. Do penalties/punishments for violating ethical rules exist in your company?

The logic is that if an organization does not have any formal ethical rules or clearly stated values of behavior, it cannot require obedience of these rules nor it can punish possible violation of these rules. Less than 40% of respondents stated that their organization has an existing punishment for violating ethical rules. 33% are not sure and 28% say that they do not execute such penalties/punishments. It can be assumed that if the employees do not have any official rules, standards or set values of ethical conduct, they will rather comply with general, internal, informal ways of communication and habits.

Question No. 21. Has your company ever dealt with violation of the Code (rules) by penalties or punishments?

Here you can get a number of possible interpretations. 43% of respondents stated that they were not aware about any penalties or punishments given by the organization to the violators of the Code. 32% respondents state that their company has never handled such a violation. Only 18% of respondents stated that their company has dealt with the violations of Code by some penalties or punishments. The respondents had the opportunity to mention specific measure(s) which were used in their company. Proposed solutions for violating the Code, the respondents reported only two options: dismissal 4% and fine 3%.

Question No. 22. Have you ever been a direct witness to situation in which your colleague behaved unethically?

We admit that this question might be perceived by respondents as very sensitive. However, we noticed that 38% of the respondents witnessed unethical behavior of their colleagues. Almost 60% of respondents did not encounter such problem. Due to the presented theoretical relationship and background it cannot be overlooked that 3% of respondents do not know what it means to act unethically. This fact confirms so far presented opinions that citizens really do not know what exactly ethical and unethical behavior is.

Question No. 23. If you were a witness to this or you would find out about this, what would you do?

This question directly responds to the positive answer of the respondents for question 23. Almost 70% of respondents say that if they witnessed or found out about colleague's unethical behavior they would have pointed it out to him/her. Only 10% of respondents would notify their supervisor. 21% of respondents would not bother with this issue at all. The question is what behavior and based on what would be more appropriate; how to react, how to respond, what behavior is expected by the colleagues and what by supervisors, and most importantly what does the person expect from himself/herself.

Question No. 24. In your opinion, how should be potential unethical behavior of employee handled?

Here, respondents could choose from a variety of possible solutions for unethical behavior in the organization. Interviewees answered very cunningly in most cases, almost 64% said that the solution of impropriety should be chosen according to the nature and gravity of the offense. You cannot punish various unethical behaviors by one universal way. Less than 13% of respondents would solve unethical conduct of an employee by talking to them about it. Only 8% of respondents would solve this issue by financial penalties. However, practice shows that especially financial penalty is the strongest stimulus in behavior change, especially in Czech national environment.

Question No. 25. Have you ever come across the CSR concept (Corporate social responsibility of companies)?

This last question was supposed to find out general knowledge about realized corporate social responsibility concept of companies and organizations; this concept is a specific practical application of ethics in entrepreneurial and managerial activities. Although CSR concept is not any novelty even in Czech environment, more than half of respondents 56% do not know what CSR concept means. On the contrary 34% state that they know what it is and only 10% of respondents state that it is a part of strategic approach of their organization.

3.3. Findings

Based on qualitative analysis of empirical survey data the following partial findings were found:

Almost absolute majority of respondents claim that *it is very important* and *significant* to deal with ethics in business and managerial activity. Equally the respondents claim that ethics in business *has* its legitimate *contributions*. The respondents are also convinced that ethical behavior is *worth* for companies in a long-term horizon. It is more than positive, that respondents evaluate the task, significance and function of ethics in common practice is such way, nevertheless it often remains in the "sympathies" to the ethics. Other, not completely academic, however apposite expression would be that everyone only talks and discusses the ethics although no one does anything that would improve this situation at least a bit.

The respondents consider the behavior of business subject in the CR as *rather* unethical. It is also alarming that the respondents perceive this situation in future as worsening. It is very difficult to say what has caused this situation. Certainly some role is played by the current level of political corruption and instability, continuously progressing state of economic recession, total worsening of interpersonal relationships etc. this impression is also confirmed especially in the confrontation with foreign, not only business environment which has been evaluated by the respondents on a higher level. In this case we could consider how the respondents would react and what they would probably say in case of heretic question: *„By what concrete activities, attitudes or behavior have you contributed to the increase of ethics at your workplace or outside?, or „What would you, yourself do in order to make the whole picture of ethics in the society better?"*

The respondents claim that the situation in the context of ethics in business continues to deteriorate and that business subject in the CR are behaving *rather* unethically. Within the evaluation and assessment of organization's ethics in which the respondents work they are less critical. They claim that especially their firm is behaving ethically. Certain contradictoriness of these expressions can be assigned to the anonymity of answers. The respondent has a tendency to express his/her opinion on general, social question more honestly. In the context of evaluating their close and concrete surroundings the respondents seem to be more tolerant.

In the context of ethics in the companies and organizations it was found that the ethical and moral level is higher in the environment of *international or supranational corporations*. As it was already mentioned the level of ethical climate in foreign companies is generally perceived at a higher level. This is apart from others given by certain long-term social, political, economic and cultural development.

Over a sixty percent of respondents work in organization with solely Czech capital. This with the fact that there is a higher ethics in a foreign company has some predicative value. From this fact we can derive that if the respondents worked in organizations with mostly foreign capital (investors) we would assume higher level of ethics, more precisely higher perception of ethics and ethics evaluation.

In series of questions we found that unethical behavior occurs more in the *profitable* and *state* subjects. As state enterprise we consider organization where the state is at least a co-owner. The private and state spheres are meeting here. In this environment the respondents perceive the highest rate of unethical behavior.

Potential benefits of ethical behavior of firms and organizations completely correspond with other, previously executed researches and studies. According to respondents, among essential reasons for implementing ethics into business are: *company's reputation, strengthening company's*

culture, sustaining competent employees and competitiveness. Among other, less significant reasons are: *increasing product's quality, sales growth or profit growth*. To what extent are these reasons legitimate and important for company's efficient operation remains a question. It is certain that mentioned reasons are directly connected to the total value system of society.

Among the fundamental ethical problems not only in business environment but in the whole society the respondents perceive: *corruption and bribery*. This is (considering various social environments) the most spread social-pathologic phenomena. Other registered problems include: *dishonest treatment of employees, unfair business and marketing practices, financial frauds, not abiding business conditions or low quality goods and services.*

The highest level of corruption is evidently perceived in the sphere of *politics* (78%). Other problematic sectors include: *construction (65%), health care (50%), transportation (43%) and industry (42%) etc*. This corresponds with a current corruption perception index (CPI) with the rating 4.4. The rate of this index ranks Czech Republic within EU countries and other developed countries at the bottom of the trend.

Due to our problematic it is not insignificant that more than 12 % of respondents perceive corruption in a *professional sport.* Due to the facts mentioned in theoretical part of this work these results are quite understandable. It is certain that in comparison with the corruption, bribery level and other unethical behaviors, the sector of professional sport is perceived by the respondents as less significant. However, this can be caused by personal lower level of interest about this problematic. Nevertheless, in the area of professional sport we can find as serious and spread manifestation of unethical behavior and corruption as in other more significant sectors.

More than half of respondents claim that a significant change to increase total ethical and moral climate in the CR include the *way of people's thinking and politics* (57%). This up to a certain level depends on a political culture. The way the representatives of politic life behave the same way we, the citizen behave. Further, less perceived change is: *strict law enforcement, obedience of current norms and rules or consistent control.* What is very interesting is the fact that increasing ethics in Czech society is, not according to the results, a question of time (continuous development of society change) but a fundamental and radical change is desirable.

According to respondents *product's quality* is considered as the highest factor (condition) of successful business in the CR. Further it is: *company's prestige, innovations, clear company's strategies, network of contacts and acquaintances or company's culture.* The research's result only confirms the need, significance and a sense for increasing company's culture in firms and enterprises. This corresponds with a urgent need for the implementation of various ethical tools into the business sphere. Ethics in business itself as a factor of increasing the business success is perceived only by 18% of respondents.

Ethical rules, values or better said presence of ethical codex are *rather an exception* in the analyzed firms. A possible sanction for breaking something that really does not exist is very difficult. The research indirectly confirmed the dependence between the company size and existence of ethical codex. With large companies (approx. above 300 employees) we can more often assume the presence of internal ethical documents. Equally the connection between ethical codex and the company's origin is confirmed. The more foreign capital is present the higher is the existence of ethical codex.

Entrepreneurial subjects in the CR solve the violation of ethical rules and norms with difficulties. Respondents, themselves admit in many cases that they are not aware of any case where their employer, supervisor, management solved some violation of ethical codex in the past. This can be caused by the fact that there are not any ethical wrongdoings or this problematic is not taken into account. Only in exceptional cases the unethical behavior was punished by *a fine or even dismissal*. We confirm only the fact that business subjects and other organizations in CR do not know how to proceed when ethical rules are violated. This problematic is especially complicated if concrete ethical rules are not determined.

Another, also serious finding is that more than half of the respondents do not know, do not have an idea what CSR concept (Corporate social responsibility) represents. Concurrently this concept is typical examples of applying ethics into business and managerial work.

3.4. Recommendation for practice

Based on the results of own research and according to previously realized and in content similar research it can be stated that from various reasons we are still encountering large level of unpreparedness of company's and organization's management for certain innovation in ethic environment. Based on long-term observation of own practice, personal contacts and contacts with other academics it can be stated that main reasons for lack of interest in ethics in business from the management point of view are:

- There is an insufficient, general knowledge about content, meaning, sense and place of ethics in economics, business and managerial work. This fact was also confirmed not only by this empirical study but also by other research studies.
- Company's management is afraid of implementing ethics into company's culture. They cannot imagine what is connected with implementing ethics into business (advantages, benefits but also costs and expenditures). They are resisting uncertain, not examined forms of innovations and changes.
- By implementing ethics into business, in fact, we are violating working but also life style of management (well- known practices of leading and managing). It is necessary to completely change, adjust existing way of communication, organization and management.

Management is risking the disapproval and impatience with the results of ethical tools implementation into company culture from the view of shareholders. Management is worried that they will not be able to mobilize and positively stimulate employees for a needed cooperation. Management very often encourages creative abilities of their subordinates and they overestimate organizational meaning of their own routine work. All work meetings, classical business meetings or workshops are led more in order to divide work tasks and activities. Management is mostly concentrated on observing effects, processes and outputs which can be quantified. It is very difficult to calculate, show and summarize the level of moral, polite and correct behavior. Ethics and morale are not a part of aggregate macroeconomic model which has its own exact, mathematical basis (maybe unfortunately).

Implementing ethics into business requires complex and systematic approach, but the problem is to create it and personally ensure it. In the practice, there is an approach based on resolution such as: "…so from now on we will behave ethically and morally! "definitely does not exist.

Management lives under the assumptions that everything about what they have to make a decision, they also understand; it is very often happening even in super effective organizations where this is considered as the most important phenomenon. Only "enlightened" management can publicly admit that they are not specialists for all areas pertaining to the functioning and operation of the company.

The management is not personally convinced that ethical behavior is going to pay off. This is completely logical and understanding approach, meaning that each cost (investment) of company is spent in order to receive later profit or return from it.

Management, in its ethical behavior, is not supported by a general public. Nevertheless, if the feedback, public support, transparent need and willingness of company to be a part of ethical environment are missing, then the business subject does not have any interest in these changes.

In order to increase the level of ethical climate in companies and organizations it is necessary that the management (if interested):

- takes responsibility for processes of developing company's ethics, culture, business negotiation ethics and behavior of whole organization,
- uses consultancy and external company's services for ensuring company's policies and programs development,
- is more responsible for implementing ethical principles and standards into entrepreneurial activities of company,
- systematically monitors ethical state of company,
- is responsible for creating internal documents (code of ethics), directives and principles of business ethics,

- is responsible for ethical behavior training for employees,
- is the contact person in case of ethical problems and dilemmas,
- investigates in the context of violating ethics, complaints and sanctions,
- accepts and solves remarks of company's management and employees in the area of ethics,
- updates implemented company's ethical documents,
- plans, organizes, manages and controls projects in the area of ethics and social corporate responsibility,
- controls the compliance between company's values, objectives and strategy with projects in the area of ethics and CSR,
- ensures measurement, evaluation and reporting of organization's ethical state,
- is communication, organizational, operational link among employees, stakeholders and company's management in the area of ethics and CSR,
- integrates ethical aspects to other subsidiaries after merger or acquisition.

Conclusion

From the executed empirical investigation we have found partial, specific findings:

- Almost absolute majority of respondents say that it is *very important and significant* to deal with ethics in business and management activities. Similarly, the respondents contended that ethics in business *has its justifiable benefits*. They also believe that ethical behavior will *pay off* to the companies and organization in the long term horizon. It is more than positive that respondents evaluate the role and the importance of ethics in social practice; however, it still remains more or less as the "sympathy" for ethics. Another, not entirely academic, but an apt expression is that everybody talks and discusses about ethics and its importance but nobody really does anything about it, more precisely nobody does anything that would at least partially improve this situation.
- Respondents consider the behavior of enterprises in the Czech Republic *rather unethical*. It is also very worrying that respondents perceive this situation in the future as *deteriorating*. It is difficult to say what has caused this situation. Certainly, the level of current political corruption and instability, ongoing economic recession, overall deterioration of interpersonal relationships etc. contributed to this problem. This impression is also confirmed especially in the comparison with foreign countries; it is not only the business environment that the respondents evaluated at much higher level. Here comes into consideration the fact, how would the respondents react or what they would most probably mention in case of "heretical" question, such as: "By what specific activities, attitudes or behavior did they contribute to increase ethical behavior at their workplace or elsewhere?, or "What did you (yourself) do to make whole picture of ethics in society different, better?".
- Respondents claim that the situation in the context of ethics in business continues to deteriorate, and the Czech Republic's businesses are behaving *rather unethically*. The evaluation and assessment of the level of ethics in organization, in which the respondents work, are less critical. They claim that their own company is behaving ethically. A certain inconsistency of these observations can be attributed to a certain level of anonymous answers. Respondents have the tendency to answer general, social questions more sincerely. Within the context of assessing their surrounding and specific environment the respondents are more tolerant.

In the context of ethics in companies and organizations, it was found that the ethical and moral level is *higher in international or multinational corporations*. As already mentioned, the degree of ethical climate in foreign companies is generally perceived at higher level. This is among other things due to a certain long-term social, political, economic and cultural development.

Over sixty percent of respondents work in an organization with purely Czech capital, this with the respect to the fact that higher level of ethics is perceived in foreign companies. From this information we can derive that if the respondents worked in an organization with mostly foreign capital (investor) we could assume higher level of ethics, resp. perception of level and ethic's evaluation.

From the series of questions it was found out that there is a higher occurrence of unethical behavior in *profitable and state organizations.* By state company we understand organization in

which the state is at least co-owner. The private and state sectors are colliding here. In this environment the respondents perceive the highest level of unethical behavior.

Potential benefits of ethical behavior of companies and organizations fully correspond with other, previously carried out research and studies. Among the major reasons for the introduction of ethics in business, according to respondents is: *company reputation, strengthening corporate culture, keeping skilled employees, competitiveness.* Other less significant reasons are: increasing product quality, sales growth and profit growth. How much are these reasons justified and important for effective company's operation remains a question.

Among the major ethical problems not only in the business environment, but in society as a whole, respondents perceive: *corruption and bribery*. This belongs (with respect to various social environments) to the most common socio- pathological phenomenon. Further problems were also registered: unfair treatment of employees, unfair sales and marketing practices, financial fraud, failure to comply with terms and conditions or poor quality of products and services.

The highest level of corruption is obviously seen in the *political sphere* 78%. Others troubled sectors include: construction 65%, health services 50%, transportation 43% and industry 42%, etc. this basically corresponds to the current Corruption Perception Index (CPI) with a rating of 4.4. The rate of this index ranks the Czech Republic in the EU and other developed countries at the bottom of the trend.

More than half of the respondents claim that a fundamental change to increase the overall ethical and moral climate in the Czech Republic is in the *way of thinking, politics, and people* 57%. This is largely associated with the political culture in general. So, the way the leaders present their image of ethical and moral patters of political life, the same way we, the citizens follow this pattern. Next, a lower percentage in changes is: *rigorous enforcement of law, respect for existing norms and laws and consistent control.* Interestingly, the improvement in ethics in Czech society is not, based on the results, a question of time (continual development of social changes) but necessary, fundamental, radical change is required.

As the greatest factor (condition) of successful business in the Czech respondents consider the *quality of the product*. Interesting is that in the previous question No. 9 poor quality products and services are with only 21%. Furthermore, it is about *prestige and reputation of the company, innovation, clear corporate strategy, network of contacts and friends or corporate culture*. The survey results only confirm the need, importance and sense of increasing company cultures in companies and organizations. This corresponds with necessary need to implement various ethical tools into business sphere. Actual *business ethics* as a factor of increasing success in business sees only 18% of respondents.

Ethic rules, values or better the presence of ethical codex are *rather an exception* in the analyzed companies. Potential sanctions and penalties for breaching something which basically does not exist is very difficult. Research indirectly confirmed dependence between company's size and code of ethics. In large companies (approx. more than 300 employees) the presence of internal ethics document can be assumed more often. At the same time, the relation between code of ethics and company's origin is proven. The more the foreign capital is present the higher is the probability of ethical codex existence.

Business entities in the Czech Republic deal with violations of ethical rules and standards with difficulties. Respondents, themselves admit in most cases that they are not aware that their employer, supervisor, or management had ever dealt with ethical code violation. This may be due to the fact that de facto none ethical wrongdoing occurred or the issue is not specifically addressed. Only in exceptional cases unethical behavior was punished by a penalty, or even dismissal. This confirms the fact that some businesses, but also other organizations in the Czech Republic do not know how to proceed when ethical rules are disobeyed. This problematic is especially complicated if specific ethical directives are not implemented.

Next, also very important findings are that more than half of the respondents do not know, what CSR concept (Corporate social responsibility) means or what it represents. But in fact this concept is a typical example of ethics' application into business and managerial work. Based on the survey and its results it is evident that a radical change in terms of improving the ethical climate and moral awareness or corporate management is necessary. The situation is urgent.

Managers should lead their companies in current market conditions to prosperity. This obviously will not happen without problems which they have to solve responsibly, they have to decide about them and they have to be held responsible for their decisions. Objective, responsible and ethical managerial decisions are complicated. Defined rules (phases) for ethical decision making within the organization can help the managers in their decision making (Čaník, Řezbová, 2006; Putnová, 2007).

Applying ethics into business is not a fashionable trend although it can seem like this. It is some kind of "revitalization" of correct, transparent and responsible business which should become necessary condition for success – to become competitive. Managerial ethics increases business' transparency and it helps to overcome uncertainty in decision making about strategic goals in the context of economic and social phenomenon. Mentioned problematic of consumption does not have to be a fundamental social problem if it is "managed" in the context of economic responsibility.

In the context of other surveys we have to, unfortunately, admit that interest of management in implementing ethics into business is rather formal and it has never been high. It is necessary to realize that ethics and morality, more precisely its level is not an issue only for that particular company or institution but it reflects total level of ethical climate of society. It is abundantly clear and understandable that the goal of every company/enterprise is to satisfy the market requirements, fulfill economic objectives in the context of further development or sometimes even survive in the market, efficiently use existing capacity and anticipated sources of new investment and de facto continuous process of innovation support as a means of competitiveness. It is assumed that all this is happening in the context of ethics, morality and good governance procedures. But the reality is somewhat different. Many cases can be found and documented where strictly adhered ethics in business and managerial work "got" the company into bankruptcy, the competitive failure. It is not possible to be so short-sighted that we did not realize that the academic environment provides a place; space and time to deal with ethics, morality, conscience and other noble themes. There is a space to explore and investigate. The market environment is competitive fight where businesses battle for survival is definitely not the ideal environment for ethical "experiments ".

Nevertheless, we cannot accept the American slogan "Whatever is good business is good ethics." And yet we still believe that it is possible to "do" business fairly, honestly, solidly and still effectively. Due to the very theme and content of the work it is in principle more than undignified, degrading and desperate, that we have to deal and solve the question of ethics and morality. It should be a natural thing!

There is a clear connection between the problematic of knowledge of management, companies, organizations and total level of morale in the society. Otherwise said, company's management but also their employees are a part of complete reflection of morale profile of a given company. From this point of view the analysis of ethics in business is fundamental.

Company's management responsibility creates some added value in the life of whole society. It increases not only the total level of a domestic company's good name, but in current, globalized, geo-economic place and also the position in international context. It cannot be ignored or underestimated if the companies realize their social role, significance and in what rate do they participate on total increase of national wealth. Logical connection among wealth, company's prosperity and wealth and prosperity of society is evident. Nevertheless, it should not be done for any price. In ethics and morality the liberal statement: laissez-faire cannot be applied. As a success in business we should not consider only production prices increase and company's cost decrease. If we talk about responsible and wanted results from business, then we think about all organization's activities which do not reduce their duties in case of satisfying the stakeholder's interests.

Ethics and its meaning in business and managerial work have been discussed for quite a long time; in our country as well as in many other developed economies. The meaning of ethics, resp. the interest in it is growing. This is especially due to the development of science, technology and information technology, which in the context of globalization presumes development of

international cooperation. This development and building mutual relations is not possible without systematic ethical base.

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ECONOMIC ASPECTS OF WORKING TIME FLEXIBILITY IN SLOVAKIA

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Abstract:

The paper presents the results of the research held on flexibilization of labour and promoting reconciliation of work and family life in Slovakia. Data collection was done by questionnaire survey on a sample of over 400 respondents (parents of minor children) in the Central Slovakia (Banska Bystrica region). Data were analysed by data mining methods (frequency and cross tables, decision trees) in SPSS. We tested the dependence of responses to questions about flexibility of working time and contractual arrangement from economic indicator of work (occupational), sector of economic activity, ownership (public and private owned companies) and their impact on working conditions. The aim of the paper is to identify critical factors of influence on working time organization from the first named group of factors of influence (work, production process organization, sector of economic activity and occupation specifications) with intention to support implementation of positive working time flexibility in Slovakia and another post-socialist countries of Central and Eastern Europe facing problems in this area.

Keywords: working time flexibility, factors of influence at sectorial, occupational and company level, decision trees.

JEL Classification: J22, C38

1. Introduction

Economic factors (at sectorial, occupational, company level) cannot be considered in isolation. At the same time with economic characteristics of production process it must be taken into account the influence of socio-demographic structure of workers on working condition, especially working time organization. Both above-mentioned groups of factors (on the employers-site and on the workers-site) that determine working time organization at company level are influenced by national and sector characteristics (legislation, culture, norms formal and informal, collective bargaining etc.), too.

On the basis of own research results and on the basis on data analysis from Eurostat, European Foundation of Working and Living Conditions (Eurofound) in Dublin and from Institute for the Study of Labour (IZA) in Bonn we make conclusions about key factors of influence on working time flexibility from economic area (at company, sector of economic activity and occupation level) to improve practical implementation of positive working time flexibility in Slovakia and other countries of the Central and Eastern Europe.

In the second part we describe the assumption of the research of problematic working time flexibility at company level.

2. Determinants of working time flexibility at company level

At beginning of the paper we explain some basic concepts of working time flexibility within the purview of the production process, sector of economic activity specifics or professions/occupations specifics (managerial, technical or administrative staff; white-collar and blue-collar staff; managers, professionals, technicians and associate professionals, clerks, service workers and shop and market sales workers, skilled manual workers, elementary occupations, armed forces). We distinguish between working time flexibility and employment or contractual arrangements flexibility (indefinite/open-ended or fixed-term employment contracts, non-employment contract, self-employment/freelancers, agency contracts etc.).

Working time flexibility means all forms of working time schedules except traditional standard fixed-time working day. It is more or little regular or irregular, long and short varying

working hours over a day, week, month or even an entire year (for example flexible daily starting and finishing times, working time accounts (called time banking also) with accumulation of paid time off in hours, days or longer periods (sabbatical or early retirement), compressed workweeks (number of working hours cumulated in fewer working days), annualised hours (averaging of working hours over extended periods of time) (Messenger, 2011).

Work duration, scheduling, discretion and short-term flexibility over working time consider Van Houten, G. *et al.* (2014) as four dimensions of working time quality. We focus on internal numerical flexibility (so called working time flexibility) according typology by Atkinson (1984) or Atkinson and Meager (1986) (Wallace, 2003). We use designation company or establishment for employers´ organization, because we mean different scale of employers – from business companies to non-profit or public sector establishments.

We observe mutual dependence of impact between character of production process and work and between working time organization. The term "correlates" were used in the Survey about working time flexibility of European Foundation for Improvement of Working and Living Conditions (Chung, H. *et al.* 2007) and we agree on correlation between different company profiles and the types of working time organization.

Valeyre, A. *et al.* (2009) identify following work organisation types: 'discretionary learning', 'lean production', 'Taylorist', and 'traditional' or 'simple structure' forms of work organization. According to authors the forms of work organisation depend on sector of economic activity or occupational category. For instance, discretionary learning forms of work organisation are highly developed in the services sectors, while lean production and Taylorist forms are most frequent in the manufacturing industries. In terms of occupational category, 'traditional' or 'simple structure' forms of work organisation are particularly characteristic among service and sales workers as well as unskilled workers, while discretionary learning forms are more prevalent among senior managers, professionals and technicians. The demographic characteristics of workers are also important: for example, discretionary learning forms are more frequent among older workers, while Taylorist forms mainly concern younger workers. At the same time, lean production forms are characterised by an overrepresentation of men, while traditional or simple structure forms are characterised by a higher presence of women.

Another characteristics of production process, that affect the organization of working time, are operating/office hours (Delsen, L. *et al.* 2009), regularity and uniformity of workload, seasonality of production process, autonomy of work, task rotations, multitasking, multiskilling, business cycle, fluctuations in demand for production/services of company.

Working time organization (part-time work, overtime work, night work, weekend work, shift work, Saturday work, Sunday work) and its flexibility at the enterprise level is determined not only by business objectives (production proces characteristics, variations in workload within working day – irregular working hours, part-time work, flexible working hours) but also by company practices (ownership company/establishment (public vs. private), company culture, formal and informal arrangements about working condition and working time organization. On the other hand working time organization is affected by workers' needs and preferences (in the sphere of work, family and private life, civic engagement) that are diverse across companies. Company-oriented flexibility emphasises practices that focus on the company´s operational needs and/or the preferences of its customers (overtime, non-standard work schedules (Messenger, 2011). Type of working time flexibility that meets the operational needs of companies represent for example overtime, flexibility oriented towards workers needs is represented by flexi-time schemes with some degree of control over their work schedules. Clear boundaries can not be identified between employers-oriented and workers-oriented flexibility. Moreover workers-oriented flexibility contributes to the company productivity and competitiveness and to the societal and macroeconomic prosperity - concept of „decent work".

The Decent Work concept was formulated by the ILO's constituents – governments and employers and workers – as a means to identify the Organization's major priorities. It is based on the understanding that work is a source of personal dignity, family stability, peace in the community, democracies that deliver for people, and economic growth that expands opportunities for productive jobs and company development. Decent Work reflects priorities on the social,

economic and political agenda of countries and the international system. In a relatively short time this concept has forged an international consensus among governments, employers, workers and civil society that productive employment and Decent Work are key elements to achieving a fair globalization, reducing poverty and achieving equitable, inclusive, and sustainable development (http://www.ilo.org/global/about-the-ilo/decent-work-agenda/lang--de/index.htm).

Chung *et al.* (2007) makes following typology of working time flexibility:

- Worker-oriented high flexibility;
- Company-oriented high flexibility;
- Intermediate flexibility based on the life course/day-to-day/overtime;
- Low flexibility.

Tangian (2007) says about prevailing role of national determinants over professional or social specificities as contributing to the average working conditions. The differences between countries may reflect how institutional and cultural differences affect the ability of establishments to respond to the various needs of people for working time flexibility. Another explanation of the differences between countries may be that institutional and cultural differences determine which features of working time flexibility are reasonable for a company to implement (Chung, H. *et al.* 2007). National and institutional factors are represented by national labour market regulation and institution, especially focused on employment protection legislation (Gareis and Korte, 2002), in: Chung, H. *et al.* 2007).

Flexibility can be assessed at many levels, notably passing from the macro to the micro level, i.e. from the national to the individual level. Furthermore different studies are concentrated on the flexibility from the company point of view or from the workers' point of view, to fulfil the aim of one factor of flexibility. Our contribution is concentrated on flexibility at the level of the company and its determinants. Even at this level we can identify whole complex of factors and different interests and subjects. Either business objectives (production process character, fluctuations of demand, workload irregularity) or company culture, the negotiation climate within the company (trade unions density, collective bargaining, works councils) are an important explanatory factor in the analysis of a company's organisation of working time (see Figure 1). Significantly the professional or sectorial profiles affect applications of flexibility schedules at company level. Working time flexibility is affected from all below mentioned levels, which have in addition objective predetermined or subjective/individually created/unique character.

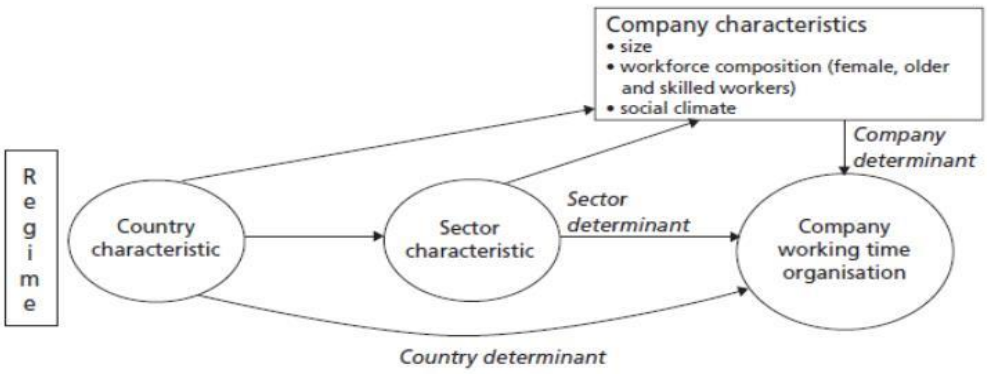

Figure 1 - Determinants of company-level working time organisation.

Source: Chung, H. *et al.* 2007, p. 12

In the Fifth European Working Condition Survey are used following indicators to comparison between sectors: 1. Education and work classification (occupations – manager, professional, technician and associate professional, clerical support worker, service and sales worker, skilled agricultural, forestry and fishery workers, craft and related trades workers, plant and machine operators and assemblers, elementary occupations (manual). 2. Working hours. 3. Workers representation by trade unions or works councils. 4. Job autonomy (ability to choose or change the order of tasks, methods of work and speed or rate of work. The report (included data

from 33 sectors of economic activity) captures the diversity between sectors in terms of working conditions and job quality. Likewise it considers sector perspective as highly relevant to the improvement of working conditions. Many interventions to improve working conditions are organised and implemented at this level. We mentioned differences within sectors, too. Those are across groups of workers within the sector (Van Houten, G. *et al.* 2014).

Overview of irregular and atypical working hours by sectors of economic activity brings the Fifth European Working Conditions Survey in overview report "Working conditions and job quality: Comparing sectors in Europe" (Van Houten, *et al.* 2014). Agriculture stands out regarding irregular working hours. Atypical hours are particularly prevalent in food and beverage services, agriculture, accommodation, the arts, entertainment and recreation sector. Financial services, the metal industry, and legal and accounting activities are among the sectors with the smallest shares of workers reporting atypical working hours. The study provides a comparison of the organization of work (teamwork and team autonomy, multitasking and multiskilling, etc.

For more information see identification of sectorial profiles on working conditions, trends and differences between country clusters by Jettinghoff, K. and Houtman, I. (2009). The authors of the study note, that in the level of the company the working time schedules are affected by those specific profiles of sector and parallel by the socio-demographic factors (structure of workers – gender, age, education, employment status). It explains differences in working conditions within sector, too.

In 2004–2005 the European Foundation for the Improvement of Living and Working Conditions launched a large-scale survey in companies in 21 European countries to tackle pressing data deficit: the Establishment Survey on Working Time (Chung, *et al.* 2007). The study seeks to explore and explain the main determinants of the different systems for organising working time in the workplace. More specifically, the research aims first to identify a typology and its correlates of different company 'profiles' in terms of the types of working time arrangements and work–life balance policies in place. The study analyses which of the company characteristics determine the flexibility profile of a company. Main objective of the survey was to construct and validate an overarching typology of such practices and arrangements in European companies in order to examine its cross-national variation, determine its main correlates and explore whether distinct flexible working time profiles can be seen to have different performance outcomes. The study covers public and private establishments from virtually all sectors of economic activity, with the exception of 'agriculture', 'forestry', 'private households' and 'extraterritorial organisations'. In these sectors, the number of companies employing 10 or more workers is negligible in the countries surveyed.

Flexibility profile of an organisation is related to its known characteristics, such as its line of business, the size and composition of its workforce and its geographical location. Due to the different sector characteristics, services sectors (NACE G–O) are usually seen to need and provide more flexibility than industry sectors (NACE C–F). The public type of ownership is also considered to have more arrangements for work–life balance needs of workers than the private type. Although larger establishments have more scope for introducing different types of flexibility, smaller establishments require various options to adapt to changes. While bigger establishments have formalised arrangements, smaller establishments have informal arrangements which might be more efficient in providing various working time flexibility options. The share of women and older workers as well as the skill composition within the workforce may be additional aspects that need to be examined, state Chung, H. *et al.* (2007). The authors conclude that not only country, but also sector, size and workforce composition are deciding factors in whether an establishment uses a certain working time arrangement or not. In addition, as is the case in relation to early retirement, the economic or employment situation of the companies may also be another factor that might affect the organisation of working time. A further element which is examined in this research is the social climate within establishments.

Multivariate analysis of the typology of working time flexibility realised by Chung, H. *et al.* (2007) confirmed the following results: Services sector has higher numbers of the high-flexibility types of companies, both worker and company oriented. This sector also has some degree of the life course and day-to-day types of moderately flexible companies. Conversely, the

industry sector shows a higher proportion of companies with less flexibility, namely the overtime and low-flexibility type of companies. This may have to do with the fact that establishments in the services sector, which have less standardised work processes, have more opportunities to reorganise their working times. The distribution of flexibility types between the services and industry sectors could also be due to the fact that some forms of working time flexibility – such as unusual working and opening hours – are needed in the services sector to suit customer needs (Chung, H. *et al.* 2007).

The comparison of the private and public sectors displays, the public sector companies appear to be more concerned to meet workers' needs in facilitating work–life balance options, by providing more flexible working time arrangements for their workers.

The marginal effects for the sector of economic activity show that flexibility profiles also vary considerably between sectors. The manufacturing industries and the mining and quarrying sector are the reference categories for this set of indicators. The construction sector can be characterised by an overrepresentation of the low-flexibility type of companies. The typical worker-oriented high-flexibility sectors include public administration, financial intermediation, real estate, renting and business activities, electricity, gas and water supply and other community, social and personal services. Health and social work stands out as the company-oriented high-flexibility sector, with a higher probability of 20 percentage points of companies being of this type than in the manufacturing industries and mining and quarrying. However, the transport, storage and communication sector and the hotels and restaurants sector also show a relatively large percentage of this type of company. The life course oriented moderately flexible types of companies are overrepresented in the education sector. The day-to- day flexibility type accounts for the lowest amount of all establishments. Therefore, the variation across sectors is also lower than for the other types of companies. Nevertheless, the day-to-day flexibility type of company is overrepresented in the hotels and restaurants sector, and in the other community, social and personal services sector. The type of companies for which working time flexibility mainly concerns overtime is most frequently found in the manufacturing industries and the transport, storage and communication sector. Overall, more organisations with a higher-flexibility profile operate in the services sector, while more companies with a lower-flexibility profile are in industry (Chung, H. *et al.* 2007).

According to company size, high-flexibility (both in terms of those that are more focused on company needs and those that are more focused on workers' needs) types is greater among larger establishments, numbers of low-flexibility companies are substantially larger in the smaller company categories. Companies that are part of multi-site organisations more often belong to one of the two most flexible types of establishments.

The relationship between workload variations and the type of working time flexibility is also interesting. Establishments that experience variations of workload – whether these are short-run or long-run fluctuations – are more likely to have a company-oriented high-flexibility profile and less likely to have a low-flexibility profile. The effect vanishes, however, if it concerns long-term fluctuations that are not predictable. If short-term variations are unpredictable, then raise the probability of being a company with overtime arrangements.

Over mentioned characteristics is business/production process-oriented. Following characteristics is workers-structure oriented. Flexibility options that are geared more towards the needs of workers exist to a greater extent in companies with a large proportion of skilled workers, while company-oriented flexibility and low flexibility are more common in companies in which the percentage of skilled workers is low. Arrangements perform better in attracting and maintaining a skilled workforce. The age composition of the workforce has little relation to the flexibility profile of the establishment. Companies with a larger percentage of young workers are, however, significantly more likely to have a company-oriented high-flexibility profile and less likely to be low-flexibility organisations (Chung, H. *et al.* 2007).

Measurable indicators of working time flexibility from the data analysis from Eurostat, European Foundation of Working and Living Conditions (Eurofound) in Dublin (see Van Houten, G. *et al.* 2014; Chung, H. *et al.* 2007) and from Institute for the Study of Labour (IZA) in Bonn (Eichhorst, W. *et al.* 2013) were compared to our own research results.

3. Comparative analysis of working time flexibility by sectors of economic activity and occupation groups in European Union

In the next part we compare and analyse degree of working time flexibility by sectors and occupation group in European countries (especially for group of EU-27 and EU-15) using statistics from databases of Eurostat. There were no significant differences in working time flexibility for different groups of professions (managers, professionals, technicians and associate professionals, clerks, service workers and shop and market sales workers, skilled manual workers, elementary occupations, armed forces).

From the Table 1 is obvious that evidently greater flexibility of working time is characteristic for so called white-collar workers (both performing managerial, creative work, as well as officials). On the contrary, the lowest degree of flexibility in working time reached manual workers and elementary occupations. A comparison of data on working time flexibility of the EU-27 with a group of 15 EU did not find significant differences. The most significant differences between the group of EU-27 and EU-15 were recorded in fixed working hours, and in all groups of professions (more flexibility we have found in the EU-15 and by the first two categories of professions).

Table 1 - Employees with variable working hours by occupation (total number and % of employees by type variability) in EU-27

ISCO88/YNLFS	Total number	Fixed start and end of a working day	Staggered working hours, banded start and end	Working time banking with possibility only to take hours off	Working time banking with possibility to take full days off (besides taking hours off)	Start and end of working day varying by individual agreement	Determines own work schedule (no formal boundaries)	Other
Total	169 182,7	64,62%	7,10%	4,18%	5,81%	6,33%	3,90%	2,17%
Managers, professionals, technicians and associate professionals	60 560,9	53,55%	8,74%	5,99%	8,90%	6,81%	7,51%	2,47%
Clerks	21 839,3	63,55%	7,15%	5,72%	8,94%	4,42%	2,43%	1,26%
Service workers and shop and market sales workers	24 036,0	69,96%	6,98%	2,28%	2,30%	8,16%	1,66%	2,56%
Skilled manual workers	42 788,7	74,27%	5,62%	2,90%	3,58%	5,20%	1,37%	1,86%
Elementary occupations	18 110,8	73,16%	5,35%	1,90%	1,73%	7,42%	2,76%	2,32%
Armed forces	1 364,6	70,17%	7,01%	:	4,05%	5,02%	:	4,12%

Source: Eurostat Database of Employment and Unemployment (Labour Force Survey) http://epp.eurostat.ec.europa.eu/portal/page/portal/employment_unemployment_lfs/data/database

Explanatory notes: Last available data exist from the year 2004. Special value - : (not available)

Flexibility of working time due to types in countries of the European Union (E- 27) is in the Table 2. Denmark, Sweden and Norway are in terms of flexibility of working time on the first place position in the EU-27 countries, followed by the other EU countries. At the end of the scale are Cyprus and Romania. According to the latest available data (2004) Slovakia achieved average ranking with almost 80% of employees with fixed working hours and almost 15.5% of employees with flexible working time arrangements.

Table 3 contains data on the flexibility of working time in the EU-27 by sector. Obviously the greatest flexibility of working hours is in the service industry. It exceeds several times the flexibility of working hours in industry and manufacturing (by the number of workers with flexible working hours). The smallest flexibilities of working time are in agriculture and fishing. Differences between groups of countries EU-27 and EU-15 are minimal (less than in the case of comparisons according to above showed comparison by occupation groups).

Table 2 - Employees with variable working hours (total number and % of employees by type variability) in EU 27

	A	B	C	D	E	F	G	sum C:G	sum E+G
GEO/YNLFS	Total number	Fixed start and end of a working day	Staggered working hours, banded start and end	Working time banking with possibility only to take hours off	Working time banking with possibility to take full days off (besides taking hours off)	Start and end of working day varying by individual agreement	Determines own work schedule (no formal boundaries)	Sum of differnt types of variable (without fixed) working times	Sum of most variable working time (with possibility to take full days off)
European Union (27 countries)	169 182,7	64,62%	7,10%	4,18%	5,81%	6,33%	3,90%	27,33%	9,71%
European Union (15 countries)	137 911,5	60,47%	7,19%	4,72%	6,83%	6,82%	4,48%	30,04%	11,31%
Euro area (18 countries)	111 852,2	62,39%	7,33%	5,21%	6,00%	6,24%	3,42%	28,19%	9,42%
Euro area (17 countries)	110 993,9	62,26%	7,35%	5,24%	6,04%	6,22%	3,42%	28,28%	9,46%
Euro area (13 countries)	108 215,4	61,76%	7,41%	5,28%	6,16%	6,30%	3,47%	28,62%	9,64%
Belgium	3 529,7	65,73%	7,39%	3,73%	3,70%	6,53%	3,63%	24,98%	7,33%
Bulgaria	2 478,9	89,19%	1,94%	0,85%	1,39%	4,44%	1,03%	9,64%	2,42%
Czech Republic	3 851,3	77,42%	4,14%	7,37%	2,92%	3,92%	0,90%	19,25%	3,82%
Denmark	2 476,9	37,54%	6,63%	0,96%	18,00%	24,39%	11,47%	61,46%	29,48%
Germany (until 1990 former territory of the FRG)	30 984,2	38,25%	4,09%	14,76%	15,68%	3,87%	1,70%	40,09%	17,37%
Estonia	518,1	83,25%	5,96%	1,47%	2,47%	3,38%	3,15%	16,43%	5,62%
Ireland	1 495,9	68,71%	8,13%	2,04%	1,70%	3,02%	1,58%	16,47%	3,28%
Greece	2 735,8	80,19%	6,70%	0,96%	0,81%	2,74%	0,86%	12,07%	1,67%
Spain	14 560,2	82,90%	3,77%	0,96%	0,22%	5,57%	1,24%	11,76%	1,45%
France	21 736,1	69,75%	2,91%	0,97%	2,34%	13,34%	9,07%	28,63%	11,41%
Italy	16 084,0	66,28%	21,48%	0,42%	0,97%	5,16%	1,87%	29,90%	2,83%
Cyprus	254,5	89,63%	4,32%	:	:	1,14%	0,98%	6,44%	:
Latvia	858,3	79,91%	4,31%	:	:	8,11%	3,90%	16,32%	:
Lithuania	1 152,4	82,37%	13,42%	:	0,89%	1,48%	0,72%	16,50%	1,61%
Luxembourg	172,8	61,52%	14,70%	10,47%	1,22%	5,09%	3,18%	34,66%	4,40%
Hungary	3 316,7	80,62%	8,21%	1,08%	1,28%	2,11%	3,24%	15,91%	4,52%
Malta	126,9	81,80%	7,09%	:	:	2,76%	2,36%	12,21%	:
Netherlands	7 018,9	68,37%	9,24%	2,18%	4,21%	2,10%	2,02%	19,75%	6,24%
Austria	3 263,9	62,94%	3,53%	5,59%	8,71%	9,98%	7,50%	35,32%	16,21%
Poland	9 983,2	82,19%	8,44%	0,47%	1,37%	5,61%	0,94%	16,83%	2,31%
Portugal	3 755,9	80,04%	9,29%	0,67%	0,60%	2,30%	1,69%	14,55%	2,29%
Romania	6 056,5	89,24%	4,67%	1,01%	0,57%	3,38%	0,98%	10,62%	1,56%
Slovenia	795,5	69,99%	21,72%	0,70%	0,64%	3,31%	1,52%	27,89%	2,16%
Slovakia	1 879,0	79,88%	4,36%	5,25%	1,28%	3,65%	0,88%	15,42%	2,17%
Finland	2 082,5	49,41%	11,72%	7,04%	15,85%	6,21%	6,45%	47,27%	22,30%
Sweden	3 822,8	38,69%	30,02%	5,72%	15,61%	2,48%	5,18%	59,02%	20,80%
United Kingdom	24 191,8	60,77%	3,12%	2,32%	7,07%	7,93%	8,08%	28,52%	15,14%
Iceland	130,6	74,96%	15,47%	1,15%	6,28%	:	:	22,89%	:
Norway	2 092,5	48,67%	7,96%	2,11%	23,95%	10,84%	4,12%	48,98%	28,07%
Switzerland	3 282,9	54,37%	3,66%	2,93%	20,74%	:	8,62%	35,95%	29,36%

Source: Eurostat Database of Employment and Unemployment (Labour Force Survey) http://epp.eurostat.ec.europa.eu/portal/page/portal/employment_unemployment_lfs/data/database

Explanatory notes: Last available data exist from the year 2004. Special value - : (not available)

Table 3 - Employees with variable working hours by economic activity (total number and % of employees by type variability) in EU-27

YNLFS/NACE_R1	Total - all NACE activities	Agriculture; fishing	Industry (except manufacturing)	Manufacturing	Services
No answer	9 954,2	1,46%	8,40%	20,12%	69,79%
Total	169 182,7	1,93%	8,68%	21,23%	67,90%
Fixed start and end of a working day	109 321,6	1,89%	9,57%	22,79%	65,51%
Staggered working hours, banded start and end	12 020,1	2,35%	7,27%	18,08%	72,04%
Working time banking with possibility only to take hours off	7 078,7	1,29%	6,61%	24,20%	67,78%
Working time banking with possibility to take full days off (besides taking hours off)	9 833,6	0,71%	5,60%	22,92%	70,62%
Start and end of working day varying by individual agreement	10 706,9	3,10%	7,73%	12,38%	76,56%
Determines own work schedule (no formal boundaries)	6 593,6	2,06%	6,86%	16,61%	74,13%
Other	3 673,9	3,79%	6,08%	12,16%	76,64%

Source: Eurostat Database of Employment and Unemployment (Labour Force Survey) http://appsso.eurostat.ec.europa.eu/nui/submitViewTableAction.do

Explanatory note: Last available data exist from the year 2004.

In the fourth part we present results of our research.

4. Results of primary research of working time flexibility and its determinants in Slovakia

DATA

The respondents of our research were parents of minor children (under 12 years). Category of parents with the youngest child under 3 years represented 21.7%, parents with a youngest child 4-6 years 21.3% and parents of school-age children (7 – 12 years) accounted for the remaining largest group of respondents. The research sample consisted of men (14.6%) and women (85.4%). In the age the highest proportion (36.4%) is in category of 35-39 year olds, followed by the age group 40-44 year olds (21.9%) and category of 30-34 year olds (17.6 %).The respondents aged 45-49 years too (6.3%) and 50-59 years (2.5%) also answered.

Secondary education has got 45% of respondents and university education 48.2% of them. In the private sector worked 40.5% of respondents and 28.1% in the public sector (for the remaining 20.9% of respondents we could not identify the sector). Majority of respondents (70.1%) were mental working, the remaining 14.8% of respondents were physically working. In economic status prevailed among respondents employee (73.9%), another 10.3% were self-employed, and the same proportion were persons on parental leave. Respondents were also viewed according to the economic status of partner.

The professions of respondents were very various. Therefore, we could not analyse working flexibility specification according profession or career position, but it would be interesting to analyse respondents' answers of certain selected professions or career position groups.

METHODS

The aim of our research was to find the most significant associations between working time arrangement as output and economic variables as input variables (predictors). For its achievement we use decision trees implemented in statistical system IBM SPSS version 19 (IBM SPSS Decision Trees 19, 2010). The decision tree creates a tree-based classification model. It classifies into groups or predicts values of a dependent (target) variable based on values of independent (predictor) variables. The procedure can be used for:

- *Segmentation*. Identify persons who are likely to be members of a particular group.
- *Stratification*. Assign cases into one of several categories, such as: high, medium, and low-risk.
- *Prediction*. Create rules and use them to predict future events, such as the probability that someone will default on a loan.
- *Data reduction and variable screening*. Select a useful subset of predictors from a large set of variables for use in building a formal parametric model.

- *Interaction identification.* Identify relationships that belong to specific subgroups and specify them in a formal parametric model.
- *Category merging and discretizing continuous variables*. Recode group predictor categories and continuous variables with minimal loss of information.

The decision tree methods available in SPSS are:

- CHAID. Chi-squared Automatic Interaction Detection. At each step, CHAID chooses the independent (predictor) variable that has the strongest interaction with the dependent variable. Categories of each predictor are merged if they are not significantly different with respect to the dependent variable (Kass, 1980).
- CRT. Classification and Regression Trees. CRT splits the data into segments that are as homogeneous as possible with respect to the dependent variable. A terminal node in which all cases have the same value for the dependent variable is a homogeneous, "pure" node (Breiman *et al.* 1984).
- QUEST. Quick, Unbiased, Efficient Statistical Tree. A method that is fast and avoids other methods' bias in favour of predictors with many categories. QUEST can be specified only if the dependent variable is nominal (Loh – Shih, 1997).
  In our case the CRT model produced best results with default parameters (only prior probabilities where set to equal to increase the number of correct classifications in case of flexible time arrangements). If we want to take into account the employer viewpoint for comparison of working time arrangements then we should use some benchmarking method like balanced scorecard (Gavurová 2011, 2012; Šoltés, Gavurová, 2013).

RESULTS

Our tree diagram (depicted in the Figure 2) shows that using the CRT model, the economic status is the best predictor of working time arrangement. Right terminal node contains 50 cases of maternal leave respondents, of household respondents and of self-employed persons. The proportion of flexible time arrangement in the node is 60.0%. In the left node the proportion of flexible time arrangement is 30.2%, which is significantly lower than the proportion in the right node. The left node has got 348 cases of persons with other economic activities: unemployed, employed and parental leave. For these cases the next best predictor is the sector. More flexible working conditions in self-employment profession can be explained by character of work (like below by mental working workers), it is mostly managerial, administrative and creative work (compare Eichhorst, 2013). People at maternity or parental leave filled flexibility of working time schedules in their last job.

If the sector is public or missing (left terminal node, n = 149) then proportion of flexible time arrangement is 39.6%. The respondents working in private or ambiguous sectors (right node, n = 199) has got proportion of flexible time arrangement 23.1%. For them CRT model includes paid work during parental leave as another predictor. In the left terminal node the proportion of flexible time arrangement is 33.8% (paid work during parental leave and blank (missing) cases, n = 71). Comparable results about differences between flexibility of working time in private and public sector companies are also in international research studies (Eichhorst, 2013; Chung, Kerkhofs, Ester, 2007). Reasons are not only character of production process and of operating hours, regularity of work without fluctuations, but also density of trade unions and coverage by collective arrangements. Predominant flexibility of working time for persons/mothers especially working during parental leave can be explained by following. They are mostly high skilled workers, for who is typical independent/autonomous creative work, which allows for a high degree of positive (workers-oriented) working time flexibility. At the same time, their employers are interested in the earliest return of these persons in the labor market (to prevent loss of skills) and therefore generate flexible working conditions for them.

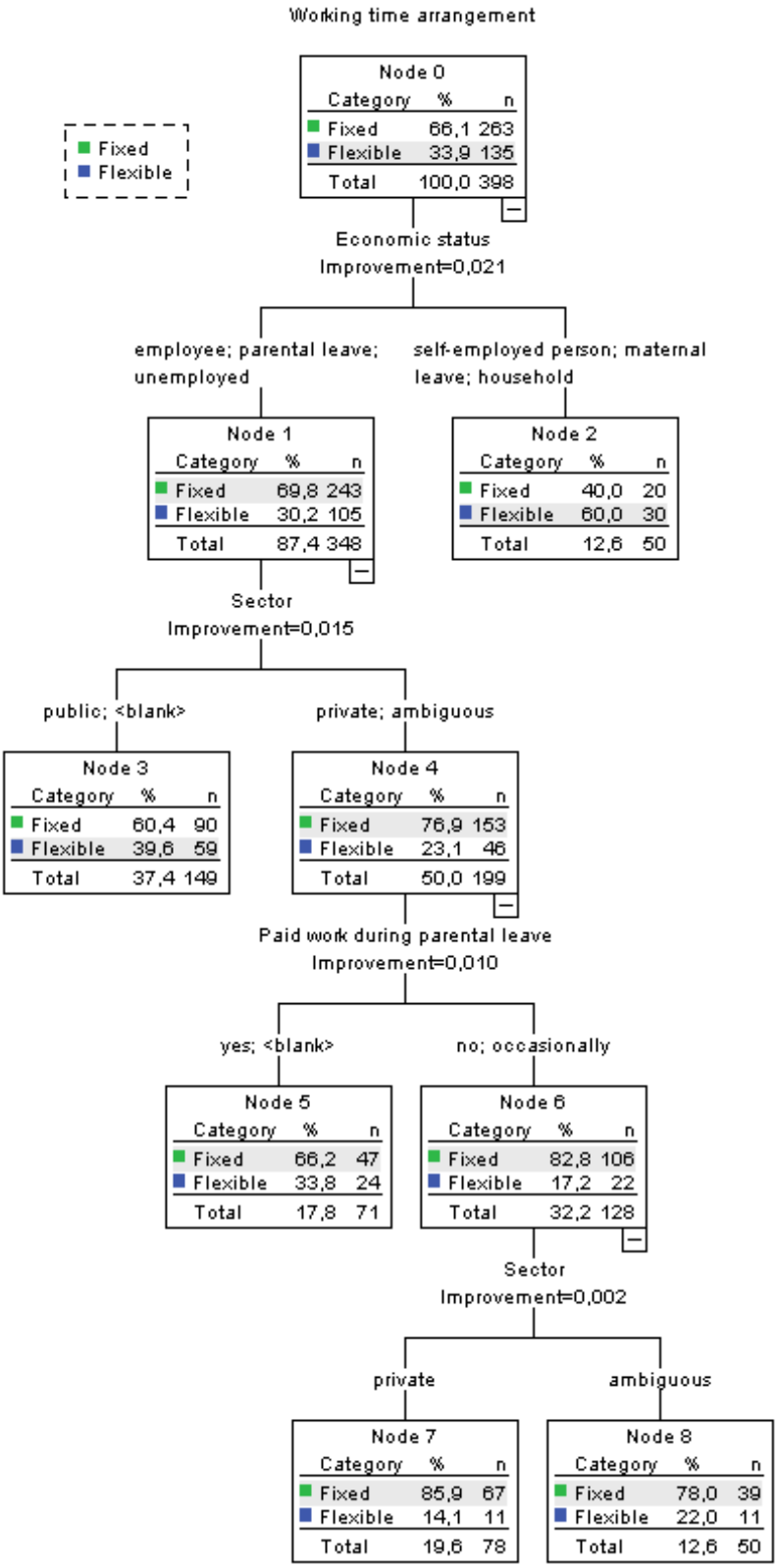

Figure 2 - Classification tree diagram for working time arrangement with economic predictors

The right node (n = 128) with the proportion 17.2% is finally divided again by sector. If the sector is private then proportion is 14.1% (left terminal node, n = 78). If the sector is ambiguous then proportion of its flexible time arrangement is 22.0% (right terminal node, n = 50).

The classification (Table 4) shows that the CRT model classifies only 60.8% of the respondents correctly in spite of surrogate predictors usage. It is caused mainly by missing values in following variables: the sector (10.6% of missing values and 20.9% of ambiguous cases which are questionable) and work type (15.1% of missing values) and also by involution of only economic variables in our tree model.

Table 4 - Classification matrix of CRT model of the working time arrangement

OBSERVED	PREDICTED		
	Fixed	Flexible	Percent Correct
Fixed	153	110	58,20%
Flexible	46	89	65,90%
Overall Percentage	50,00%	50,00%	60,80%

Importance (relative and absolute) of all five economic predictors involved in CRT model is depicted in Figure 3. We can see that the most important economic predictor due to working time arrangement is the economic status of the respondent. The next one is sector with slightly smaller relative importance (76%). Then follow paid work during parental leave (43%) and sector (29%). The last predictor – economic status of respondents' partner is negligible though formally significant (1%).

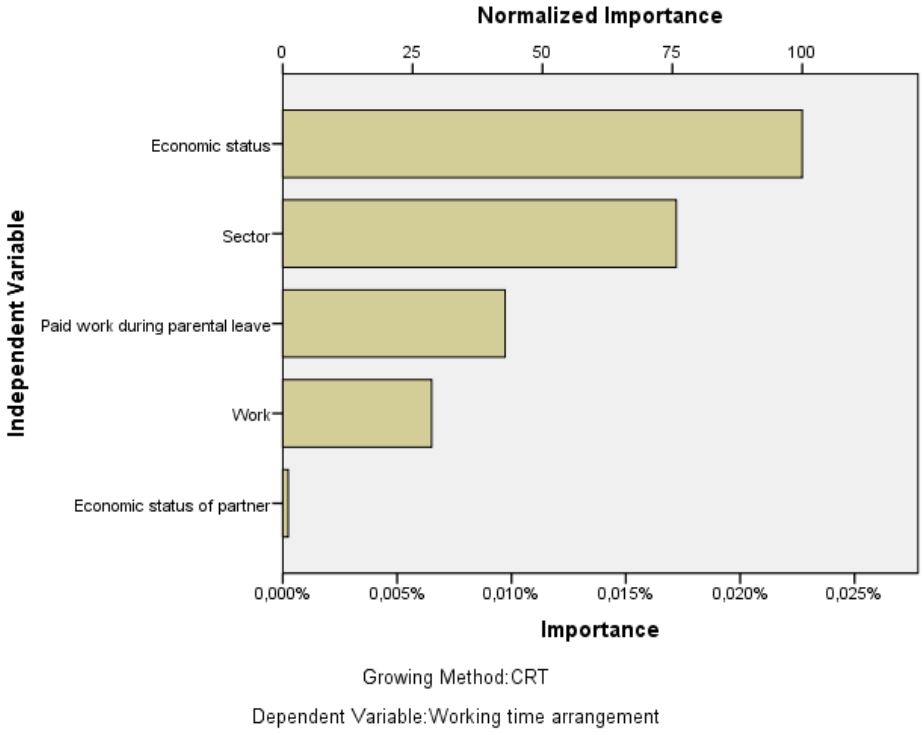

Figure 3 – Importance of economic predictors involved in CRT model of working time arrangement

Now we can make some conclusions.

Conclusion

The aim of our paper was to identify critical factors of influence on working time organization from the first named group of factors of influence (work, production process organization, sector of economic activity and occupation specifications). Not only business objectives (production process character, fluctuations of demand, workload irregularity), but also company's culture, the negotiation climate within the company (trade unions density, collective bargaining, works councils) are an important explanatory factors in the analysis of a company's organisation of working time, as well as professional or sectorial profiles affect significantly applications of flexibility schedules at company level. The group of economic factors cannot be considered in isolation. With economic characteristics of production process it must be taken into account influence of socio-demographic structure of workers on working condition, especially working time organization. The differences between countries may reflect how institutional and cultural differences affect application of working time flexibility in practice. Slovakia and countries of the Central and Eastern Europe are countries with lower levels of working time flexibility, particularly of positive (workers-oriented) flexibility of working time schedules. Reasons are not only objective (determined by nature of production process, sectorial or occupational specifications), but also subjective behaviour at level of individual employer (business culture, by willingness to negotiation about working conditions improvement) and workers structure (by skills, age, occupations and by their individual preferences and needs). Evidently, all these factors have influence on resulting flexibility of working time schedules. We specify key factors of influence at company level with the intention to support implementation of positive working time flexibility in practice of Slovak companies and in companies in other post-socialist countries of the Central and Eastern Europe facing problems in this area.

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THE EFFICIENCY OF SLOVAK UNIVERSITIES: A DATA ENVELOPMENT ANALYSIS[7]

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Abstract:

We run Data Envelopment Analysis to study technical efficiency of faculties in the Slovak Republic. Our dataset come from Academic Ranking and Rating Agency. Inputs for our analysis are Education, Attractiveness of study and Doctoral studies. Output variables in our study are Research and Grants. Our finding shows that there exist serious differences in effectiveness of faculties. The most serious imbalances are within Economic Sciences group, Technical Sciences group, Theological Sciences and Group of Arts. On the other hand, the most balanced situation is within the Natural Sciences group, Medical Sciences Group and Agricultural Sciences Group.

Keywords: Data Envelopment Analysis, Slovak universities, efficiency of faculties.

JEL Classification: C14, I21

1. Introduction

Efficiency of schools is a crucial factor that can lead an educational system towards economic efficiency. In this paper, we look closer on the technical efficiency of universities in Slovak Republic using Data Envelopment Analysis. The issue of efficiency of universities is quite complex, because of the fact, that higher education is, apart of certain exceptions, public good, thus one cannot orient in pursuance of market price. In Slovakia, private and public universities coexist. Both of them have different goals. Whereas public universities aim to carry on own research and development, private universities are aiming on profit maximization. Despite of the fact, that Slovak Republic is a relatively small country, we can find here 20 public universities, 3 state colleges, 13 private colleges and 4 foreign universities. In this paper we present data envelopment analysis, which works with 24 universities, 109 faculties, among which 103 are public ones and 6 are private faculties. Our dataset comes from independent Slovak civil association Academic Ranking and Rating Agency report for 2013. Our study use as input variables: Education, Attractiveness of study and Doctoral studies. Output variables in our study are Research and Grants.

The aim of the study is to examine the efficiency of faculties based on their scientific specialization. Paper is organized as follows: in next part literature review is proposed. Afterwards materials and methods are described precisely. Subsequently, results of the analysis are presented. Final part of the paper is devoted to discussion and conclusion.

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2. Literature review

Abbott and Doucouliagos found that regardless of the output-input mix, Australian universities as a whole recorded high level of efficiency relative to each other. Nazarko *et al.* use subsidies as the input and the number of students and scientific grants are treated as the output. Authors showed that the majority of the universities in Poland possess reserves in technical and allocative efficiency. Bayraktar *et al.* run Data Envelopment Analysis to measure the relative efficiency of quality management practices in Turkish public and private universities. Authors showed that private universities with higher levels of quality management efficiency on stakeholder-focus indicators achieved better performance in terms of fulfilling the expectations of their stakeholders. Sav run an analysis on a dataset consisting of 331 public universities in USA. Author found that tuition dependency promotes inefficiency while increased government funding yields efficiency gains. Another finding of the study is that investment income appears to have a slight negative effect, albeit statistically weak. Results of the study reveal that public university efficiencies have improved over time. Agasisti and Dal Bianco run Data Envelopment Analysis on 58 Italian public universities. Authors found that the majority of universities perform well for various input and output specifications. Afonso and Santos run Data Envelopment Analysis on Portuguese Public Universities. In this study inputs are the number of teachers and universities' spending while the outputs are the undergraduate success rate and on the number of doctoral dissertations. Authors identified well performing universities and those which do not perform well. Agasisti and Johnes use Data Envelopment Analysis to compute the technical efficiency of Italian and English higher education institutions. Authors´ results show that institutions in England are more efficient than those in Italy when comparing jointly their performances. Authors also look at the evolution of technical efficiency scores over a four-year period, and find that Italian universities are improving their technical efficiency while English universities are obtaining stable scores. Agasisti and Pérez-Esparrells employ Data Envelopment Analysis to analyze efficiency of Italian and Spanish universities. Authors found that Italian universities are relatively more efficient than those in Spain. Afonso and Aubyn showed on a dataset consisting of OECD countries, that efficiency in education is in some cases linked to efficiency in the health sector. Breu and Raab measure relative efficiency of the top 25 universities in the United States. Authors find that the most prestigious universities always generate the highest level of satisfaction among students. The authors suggest that university expenditures should be aimed more at increasing levels of efficiency, rather than to improve the perceived quality. Jeck and Sudzina run Data Envelopment Analysis on a dataset consisting of 96 faculties in the Slovak Republic. Authors use teaching staff as input variable and number of graduates, publications in Current Contents Connect® and number of patents as output variables. The authors found that one half of faculties in the Slovak Republic are effective. Authors found no differences in efficiency caused by the location of faculties. Authors also argue that 21 faculties do not reach economies of scale, thus are too big. Some other studies related to state of Slovak educational system can be found in following publications (Gavurová, 2011), (Bednarova, *et al.* 2014), (Pudło, Gavurová, 2012) (Pudło, Gavurová, 2013) and (Hudec, 2003). This study provides many abundant ideas for next researches and for using of complementary methods to measure efficiency, effectiveness and economy. The future in the use of effectiveness methods will require more views in the evaluation of economic phenomena and thus the evaluation of outcomes of several methods (Gavurová, 2011), Gavurová, 2012), (Šoltés, Gavurová, 2013), (Szabo, Šoltés, Herman, 2013) and (Užík, Šoltés, 2009).

3. Materials and methods

Data Envelopment Analysis is one of the mostly used methods to assess the technical efficiency of entities. Its basic idea consists in enveloping positions of the monitored entities with a line called efficiency frontier. All entities not present at this line are considered as inefficient. This method does work under the condition that at least two entities must be compared and at least one of them is always effective. Effective one lies on the efficiency frontier. Others may be inefficient and inefficiency is then measured as the distance from the efficiency frontier. DEA includes several types of models, the most used models are:

- DEA BCC (Banker, Charnes, Cooper) - assumes that the studied units, also called DMU - Decision Making Units (DMU), have variable returns to scale. Also efficiency frontier has convex or concave shape.
- DEA CCR (Charnes, Cooper, Rhodes) - DMU monitored in accordance with this model have constant returns to scale. All efficient DMU therefore lie on a straight line.
- Additive DEA model - previous models can be further divided into input and output models. Input models change just inputs and outputs are unchanged, in order to achieve efficiency, output models works vice versa. The additive model combines the input and output models and therefore, calculates how to change specific inputs and outputs simultaneously.

For our analysis we use the BCC model that is input and output oriented, which assumes variable returns to scale. In our analysis, every faculty is understood as an independent Decision Making Unit.

The datased for our analysis is the latest issue of the report of an independent Slovak civil association, Academic Ranking and Rating Agency, which objective is to assess the quality of Slovak higher education institutions. The mission of Academic Ranking and Rating Agency is to stimulate positive changes in Slovak higher education (Academic Ranking and Rating Agency, 2013). As analysis inputs we chose Education (I1), Attractiveness of study (I2) and Doctoral studies (I3). Output variables in our study are Research (O1) and Grants (O2).

Input variables

• Education (I1)

- the number of teachers per hundred full time students and part-time students in 2012;
- the number of professors and associate professors per one hundred full-time and part-time students in 2012;
- the proportion of professors, associate professors and teachers with PhD. degree within the total number of teachers in 2012;
- the proportion of professors and associate professors within the number of all teachers in 2012.

• Attractiveness of study (I2)

- the ratio of the number of registered candidates to the planned number of positions in 2012;
- the ratio of the number of enrolled students to the number of accepted students in 2012;
- the proportion of foreign students in the total number of full-time students in 2012;
- the proportion of students sent to foreign exchange programe within ERASMUS and SAIA mobility in the total number of full-time students in the academic year 2010/2011;
- the proportion of unemployed graduates in the total number of graduates - the average in 2010-2012;

• Doctoral studies (I3)

- the ratio of the average number of PhD graduates in 2010-2012 to the average number of all students in the first year of doctoral study for the years 2007-2009;
- the proportion of the total faculty scientific production for the years 2010-2012 per one PhD student;
- the proportion of the total citations of faculty scientific production for the years 2010-2012 per one PhD student;
- the ratio of the average number of full-time PhD graduates for the years 2010-2012 to the number of professors and associate professors;
- the ratio of the number of full-time PhD students to the number of full time Bachelor students and a Master's degree in 2012.

Output variables

• Research (O1)

- the number of publications in international databases Web of Knowledge for the years 2003-2012 for the creative worker (plus publications from the database CRPA for selected groups of faculties);

- the number of citations of publications in international databases Web of Knowledge for the years 2003-2012 for the creative worker (plus citations to publications from the database CRPA for selected groups of faculties);
- the average number of citations per publication in international databases Web of Knowledge for the years 2003-2012 (plus database CRPA for selected groups of faculties).

• Grants (O2)

- the amount of funds from domestic grants for creative worker in 2012;
- the amount of funding from external grants for creative worker in 2012;
- the amount of grant funds from all the mentioned agencies on the creative worker in 2012.

Schools are evaluated according to the efficiency of faculties in groups according to ARRA classification. These groups are: Technical Sciences, Natural Sciences, Medical Sciences, Agricultural Sciences, Economic Sciences, Other Social Sciences, Philosophical Sciences, Law Sciences, Pedagogical Sciences, Theological Sciences, Arts.

4. Results

In this chapter we propose results for each group of faculties. In total 11 groups of faculties entered our analysis.

Group of Technical Sciences

Data Envelopment Analysis results are presented in Table 1. The results of the analysis pointed out that more than half of the faculties in the group Technical Sciences group works efficiently, and therefore it is not necessary to modify their inputs and outputs. We can say that faculties, which have not reached a value of 1, the effective threshold, are close to this limit in input-oriented model. The Faculty of Architecture of Slovak University of Technology is in the last place in this model. Differences in results in output-oriented model are considerably larger. Clearly, the Faculty of Architecture of Slovak Technical University has again achieved the worst results and its value is only 0.16, which is already very large distance from the efficient frontier functioning.

Table 1 - Technical Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Electrical Engineering of UZ	1	58	49	49	1	21	46
Faculty of Mining, Ecology, Process Control and Geotechnologies of TUKE	1	57	30	41	1	24	21
Faculty of Chemical and Food Technology of SUT	1	79	48	70	1	100	72
Faculty of Electrical Engineering and in Information Technology of SUT	1	62	49	40	1	38	46
Faculty of Environmental and Manufacturing	1	59	30	26	1	5	7

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Technology of TUZ							
Faculty of Informatics and Information Technologies of SUT	1	43	53	39	1	27	9
Faculty of Informatics of PEU	1	88	73	0	1	1	0
Faculty of Industrial Technologies of ADUT	1	55	29	59	1	50	3
Faculty of Special Technology ADUT	1	55	34	29	1	6	0
Faculty of Aeronautics of TUKE	1	55	39	36	1	11	35
Faculty of Civil Engineering of SUT	1	56	45	36	1	31	25
Faculty of Civil Engineering of TUKE	1	53	33	37	1	16	17
Faculty of Mechanical Engineering of SUT	1	59	48	23	1	15	17
Faculty of Mechanical Engineerin of UZ	1	68	63	46	1	16	79
Faculty of Engineering of SUAN	1	48	49	22	1	10	8
Faculty of Civil Engineering of UZ	0.977441	50.826918	48.872037	28.345781	0.846383	12.126072	23.629971
Faculty of Management Sciences and Informatics of UZ	0.97722	48.861003	48.861003	32.248262	0.892131	25.780963	15.532604
Faculty of Mechanical Engineering of TUKE	0.965686	54.078393	32.83331	35.730367	0.681551	15.902439	24.943089
Faculty of Electrical Engineering and Informatics of TUKE	0.957869	54.598557	43.104124	40.230516	0.826883	35.071486	32.652763
Faculty of Material	0.939189	48.837838	41.324324	37.832432	0.592716	33.742981	16.871491

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Science and technology in Trnava of SUT							
Faculty of Metallurgy of TUKE	0.908422	63.784136	34.520033	39.970565	0.74187	44.482203	33.963559
Faculty of Manufacturing Technologies of TUKE	0.901764	47.793468	51.400523	39.152423	0.605656	28.068733	34.673141
Faculty of Architecture of SUT	0.865421	47.598131	49.321495	23.366355	0.161487	12.384899	24.769799

Group of Natural Sciences

Results of Data Enveloping Analysis of Natural Sciences group are presented in Table 2. One can see that according to this analysis, group of Natural Sciences as a whole has reached one of the best results in both models. Only one faculty has not achieved the effective border. It is the Faculty of Natural Sciences of Comenius University in Bratislava, which is nevertheless very close to the optimum boundary.

Table 2 - Natural Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Ecology and Environmental Sciences of TUZ	1	61	43	45	1	16	36
Faculty of Mathematics, Physics and Informatics of CUB	1	83	76	86	1	100	88
Faculty of Natural Sciences of UCMT	1	77	54	45	1	35	9
Faculty of Natural Sciences of CPUN	1	61	70	41	1	27	23
Faculty of Natural Sciences of UMB	1	62	54	41	1	21	17
Faculty of Science of PJSUK	1	94	60	72	1	79	70
Faculty of Natural Sciences of CUB	0.987026	72.052885	63.992788	64.944712	0.95261	62.984848	62.984848

Group of Medical Sciences

Results of Data Envelopment Analysis for Medical Sciences are depicted in Table 3. The analysis shows that in the Medical Sciences group, the majority of faculties work on the efficient frontier. Beyond this limit are only the Faculty of Public Health of the Catholic University in Ruzomberok and the Faculty of Medicine of Comenius University in Bratislava.

Table 3 - Medical Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Social Sciences and Health Care of CPUN	1	53	35	36	1	65	10
Faculty of Health Care of UPP	1	42	48	0	1	8	19
Faculty of Health Care	1	68	33	47	1	29	24

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
and Social Work of TUT							
Faculty of Health Care of ADUT	1	41	37	0	1	41	0
Faculty of Pharmacy of CUB	1	62	66	47	1	74	55
Jessenius Faculty of Medicine of CUB	1	85	84	53	1	65	71
Faculty of Medicine of PJSUK	1	71	68	42	1	49	86
St. Elizabeth University of Health and Social sciences	1	38	45	27	1	10	0
Faculty of Health Care of CUR	0.801829	51.31707	35.28049	30.95122	0.207061	67.6129	23.06452
Faculty of Medicine of CUB	0.677507	54.87803	48.78047	29.75902	0.798945	72.59575	52.65957

Group of Agricultural Sciences

According to Academic Ranking and Rating Agency classification, six faculties in Slovakia are in the Agricultural Sciences group. Four of these faculties have reached the optimal threshold in Data Envelopment Analysis, thus limit of effectiveness in both analyzed models. The Faculty of Biotechnology and Food Sciences of Slovak University of Agriculture in Nitra and the Faculty of Agrobiology and Food Resources of Slovak University of Agriculture in Nitra has not reached the efficiency limit. However, they are close to the border in both models. Therefore, we can conclude that the group of Agricultural Sciences has also reached one of the highest ratings. Results for group of Agricultural Sciences are presented in Table 4.

Table 4 - Agricultural Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Wood Sciences and Technology of TUZ	1	66	52	63	1	31	13
Horticulture and Landscape Engineering Faculty of SUAN	1	71	52	53	1	24	43
Faculty of Forestry of TUZ	1	95	31	83	1	85	100
University of Veterinary Medicine and Pharmacy in Košice	1	79	74	72	1	88	48
Faculty of Biotechnology and Food Sciences of SUAN	0.993393	76.491228	69.754386	70.263158	0.971845	79.230769	42.615385
Faculty of Agrobiology and Food Resources of SUAN	0.973752	73.031429	51.608877	67.854421	0.881201	55.605928	39.04281

Group of Economic Sciences

The analysis results show that among all economic faculties in Slovakia, Faculty of Economics of Technical University in Kosice, Faculty of Economics of J. Selye University in Komarno, the Faculty of Economics and Business of Pan-European University, the Faculty of Economics and the Management Faculty of Slovak Univeristy of Agriculture in Nitra and Faculty of Management of Comenius Univeristy in Bratislava are on the efficient frontier according to input-oriented model, as well as in an output-oriented model. Results of Data Envelopment Analysis for Economic Sciences group are shown in Table 5.

Table 5 - Economic Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Economics of TUKE	1	65	71	87	1	80	80
Faculty of Economics of JSU	1	41	30	0	1	2	2
Faculty of Economics and Business of PEU	1	83	41	15	1	22	1
Faculty of Economics and the Management of SUAN	1	65	55	56	1	73	26
Faculty of Management of CUB	1	45	83	37	1	27	8
Faculty of Business Economics of UE	0.948357	53.16901	42.67606	28.39437	0.852018	44.6	16.4
International School of Management ISM	0.937500	41	30	0	0.500000	2	2
Faculty of Economics of MBU	0.91815	58.91549	48.66197	41.80282	0.908176	60.56098	19.90244
Faculty of National Economy of UE	0.832906	52.69231	49.97436	42.38462	0.807799	49.51724	49.51724
Faculty of Management of UPP	0.824435	46.15221	37.09956	15.37889	0.758032	23.74571	17.14968
Faculty of Economic Informatics of EU	0.783777	52.83099	42.32394	27.60563	0.527366	70.16000	25.04000
Faculty of Commerce of UE	0.736306	48.59621	44.17838	28.12185	0.444317	60.76738	29.25837
Faculty of Operation and Economics of Transport and Communications of UZ	0.662631	44.38462	35.78205	12.26923	0.283033	45.93103	45.93103
Faculty of Business Management of UE	0.610088	45.14652	35.9952	12.92228	0.30444	49.27082	29.56249

Group of Other Social Sciences

Data Envelopment Analysis showed that six out of ten faculties in the Other Social Sciences group operate on efficiency border in both models. The Faculty of Political Sciences and International Relations at Matej Bel University has reached the worst rating in input-oriented model, with an overall evaluation of 0.65 and should therefore adjust its inputs. University of Central Europe in Skalica is placed last in output-oriented model with score only 0.24. It is evident that this school does not achieve efficiency in the model and should adjust its outputs. The same applies for Faculty of Political Science and International Relations of Matej Bel Univeristy and Faculty of International Relations of University of Economics. Analysis results are in Table 6.

Table 6 - Other Social Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of European Studies and Regional Development of SAUN	1	65	48	30	1	30	82
Faculty of Mass Media Communication of UCM	1	56	57	48	1	3	6
Faculty of Social and Economic Relationship of ADUT	1	58	39	0	1	5	0
Faculty of Social and Economic Sciences of CUB	1	77	71	55	1	55	57
Faculty of Central European Studies of CPUN	1	76	31	72	1	75	16
Faculty of Public Administration of PJSUK	1	61	26	2	1	6	3
Faculty of Special Engineering of UZ	0.868336	64.256836	46.890124	26.715582	0.890244	30	82
University of Central Europe in Skalica	0.713524	61.202532	27.113924	3.417722	0.239016	13.955882	29.286765
Faculty of International Relations of UE	0.653165	60.744304	45.01258	33.964557	0.327205	55.011431	21.393334
Faculty of Political Science and International Relations of MBU	0.646722	60.145179	45.917287	34.339368	0.252632	63.333333	13.333333

Group of Philosophical Sciences

Based on the input-oriented and output-oriented model five out of ten faculties are on the efficient frontier. The Faculty of Philosophy of Comenius University has reached the worst rating in input-oriented model and the Faculty of Humanities of University of Matej Bel in output-oriented model. Results of Data Envelopment Analysis are presented in Table 7.

Table 7 - Philosophical Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Humanities and Natural Sciences of UPP	1	80	43	38	1	94	47
Faculty of Arts and Letters of CUR	1	84	66	34	1	32	79
Faculty of Arts of UPP	1	88	49	30	1	34	27
Faculty of Arts of CPUN	1	73	76	38	1	29	12
Faculty of Arts of PJSUK	1	74	48	32	1	79	41

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Humanities of UZ	0.943371	74.52632	48.94737	32.10526	0.779707	67.97424	55.14891
Faculty of Arts of UCMT	0.922601	78.42105	48.31579	31.36842	0.380411	66.37288	55.20339
Faculty of Arts on MBU	0.917749	73.41991	64.24242	35.48052	0.361702	94	47
Faculty of Philosophy of TU	0.862385	76.75229	45.70642	34.75229	0.545762	71.45978	58.63366
Faculty of Philosophy of CUB	0.741553	73.41379	64.41379	35.51724	0.46741	85.57804	51.34682

Group of Law Sciences

There are only five faculties located in Slovakia that we have compared on the bases of Data Envelopment Analysis. The analysis results showed that three faculties operate effectively in both models. These are the Faculty of Law of Trnava University in Trnava, the Faculty of Law of Matej Bel University in Banska Bystrica and the Faculty of Law Pavol Jozef Safarik University in Kosice. The Faculty of Law of Comenius University in Bratislava achieved the lowest rating in input-oriented model with the value of 0.92. Even the Faculty of Law of Pan European University was placed with the evaluation 0.95 above it. The Faculty of Law of Pan European University and the Law Faculty of Comenius University in Bratislava have the lowest ratings in output-oriented model with the values of 0.70 of 0.75. We notice that in terms of output-oriented model, the Faculty of Law of Pan European University works more effectively than the Faculty of Law of Comenius University in Bratislava, opposite to the input-oriented model. Results of group of Law Sciences analysis are in Table 8.

Table 8 - Law Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Law of TUT	1	73	63	90	1	96	38
Faculty of Law of MBU	1	70	56	0	1	31	9
Faculty of Law of PJSUK	1	90	49	64	1	71	67
Faculty of Law of PEU	0.945641	70.923077	58.153846	27.692308	0.699695	72.888889	27.688889
Faculty of Law of CUB	0.923342	79.407435	56.164709	64.633959	0.74817	76.79602	60.146766

Group of Pedagogical Sciences

The results of the analysis indicate that only four faculties out of nine belonging to the Pedagogical Sciences group reach the thresholds of effective functioning. However, we can conclude that all the teaching faculties are really close to the effective border in input-oriented model. The lowest value in this analysis has the Faculty of Physical Education and Sports of Comenius University in Bratislava, which is close to the efficient frontier. When talking about output-oriented model, the distances from the efficient frontier is much higher, thus differences among faculties are more significant. Data Envelopment Analysis results are shown in Table 9.

Table 9 - Pedagogical Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of Sports of UPP	1	83	37	19	1	25	39
Faculty of Education of TUT	1	82	53	62	1	100	87
Faculty of	1	73	69	52	1	31	47

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Education of CUB							
Faculty of Education of MBU	1	74	65	47	1	42	56
Faculty of Education of JSU	0.997372	80.787162	43.88438	25.88438	0.724314	33.18966	45.56035
Faculty of Education of CPUN	0.991653	76.357313	57.66614	39.66614	0.911105	40.61003	53.03064
Faculty of Education of UPP	0.969867	79.529103	49.46322	34.95085	0.708803	57.84401	60.41226
Faculty of Education of CUR	0.920877	80.116273	46.96471	31.04512	0.844172	52.90698	56.86047
Faculty of Physical Education and Sports of CUB	0.809503	79.331254	50.18916	35.90808	0.482759	100	87

Group of Theological Sciences

According to the results, three Slovak theological faculties operate on an efficient frontier under both models. Among these efficient faculties, two are from the University of Presov in Presov. Reformed Theological Faculty of J. Selye University has achieved the worst results in input-oriented model and the Roman Catholic Faculty of Theology of Comenius University in Bratislava has achieved worst results in output-oriented model. Analysis results are in Table 10.

Table 10 - Theological Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Greek-Catholic Theological Faculty of UPP	1	57	37	36	1	79	82
Faculty of Orthodox Theology of UPP	1	49	32	59	1	100	24
Faculty of Theology of CUR	1	55	52	35	1	42	43
Roman Catholic Faculty of Theology of CUB	0.955056	50.61798	37.39326	52.52809	0.311372	96.34783	34.08696
Evangelical Lutheran Theological Faculty	0.845093	54.93103	35.7069	41.94828	0.817073	79	82
Faculty of Theology of TUT	0.843101	55.82051	45.84615	35.41026	0.719512	79	82
Reformed Theological Faculty of JSU	0.690191	56.7799	38.65072	35.88995	0.042731	93.6087	41.65217

Group of Arts

Only three faculties got the rating, which corresponds to the effective functioning in group of Arts. These are: the Faculty of Dramatic Arts of Academy of Arts in Banska Bystrica, the Faculty of Arts of Technical University in Kosice and Academy of Fine Arts and Design in Bratislava. Music and Dance Faculty of Academy of Performing Arts in Bratislava was placed in the last place in input-oriented model with the value of 0.65. It is also ranked in last place in the output-oriented model with only the critical value 0.06. This value is very critical and manifest inefficient functioning of the faculty.

Table 11 - Theological Sciences

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Faculty of	1	74	47	11	1	4	0

FACULTY	Input-Oriented	I1	I2	I3	Output-Oriented	O1	O2
Dramatic Arts of AABB							
Faculty of Arts of TUKE	1	42	44	24	1	33	18
Academy of Fine Arts and Design in Bratislava	1	49	65	45	1	23	100
The Faculty of Fine Arts of AABB	0.77193	42	44	24	0.545392	31.170267	33.003812
Theatre Faculty of APAB	0.766858	47.54518	49.519343	27.606879	0.4896	17.970588	73.529412
Film and Television Faculty of APAB	0.758621	42	44	24	0.192661	26.333333	72.666667
Faculty of Music Arts of AABB	0.751459	45.584597	44.336056	22.543757	0.454545	33	18
Music and Dance Faculty of APAB	0.647059	42	44	24	0.060606	33	18

Conclusion

In this paper, we run Data Envelopment Analysis to measure technical efficiency of faculties in Slovakia. Our analysis revealed that in Technical Sciences group, 15 out of 23 faculties operate on the efficient frontier. In the Natural Sciences group, six out of seven faculties work in an efficient way, thus, this group seems to be quite equilibrated. We observe the same pattern in the Medical Sciences group, where eight out of ten faculties operate in an efficient manner. Among faculties from the Agricultural Sciences group, four out of six operate well. The Economics Sciences group is the motliest one. Here, only five out of fourteen operate in an efficient way. Moreover, differences in input-oriented and output-oriented analysis are quite relevant. In a Social Sciences group, more than one half, six out of ten, of faculties lie on the efficient frontier. The Philosophical Sciences group is the most equilibrated one, here five out of ten faculties works in an efficient manner. In Law Sciences group, three of the five faculties operate in a good way. Within Pedagogical Sciences group four out of nine faculties operate well. Moreover, all the teaching faculties are pretty close to the effective border in input-oriented model. In Theological Sciences group, three out of seven faculties work well. Here we observe the critical state of the Reformed Theological Faculty of J. Selye University. In the group of the Arts three faculties are performing well and remaining five have serious distance from successful ones. Noteworthy is maybe the fact, that in the field of Arts, intangibility and particular character of outputs can affect obtained results.

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ASSESSMENT METHODOLOGY FOR RESOURCE-EFFICIENT DEVELOPMENT OF ORGANIZATIONS IN THE CONTEXT OF THE GREEN ECONOMY

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Abstract:

The paper deals with the problem of forming comprehensive methodology for determining the level of economic, social and environmental performance of all organizations. The system of indicators that allow an individual to make a forecast of the development of economy under the conditions of its transition from "brown" to a "green" one is proposed by authors. These indicators can be grouped into three categories: indicators of economic transformation, indicators of progress and well-being, and indicators of resource efficiency. An assessment methodology for resource-efficient development at the macro level was created in accordance with the international standard of the Global Reporting Initiative and methodology for sustainable development of the industrial organizations. This methodology is based on specific categories of indicators of organization's sustainable development, such as the indicators of economic sustainability, social sustainability and environmental sustainability. The main stages in the formation and implementation of the methodology in the performance of an organization are presented in the given paper.

Keywords: green economy, brown economy, sustainable development, ecology, green economy indicators.

JEL Classification: Q01, Q57

1. Introduction

A shift towards a green economy defined the beginning of a new stage of the development of our society, when the existing paradigm is replaced by a new paradigm for the low carbon energy, necessary for sustainable economic development. In recent decades the most prominent scientists, experts and politicians regard the priority task to ensure a comprehensive and balanced development of civilization, as defined by the main task in twenty-first century. The overcoming of the modern society ecological crisis, as well as improving of the ecological state of the environment and resource management requires immediate transition to sustainable ecological and socio-economic development, like in most technologically advanced countries all over the world. Nowadays particular attention is paid to the search for possible solutions to the urgent problems of eco-economic theory and to the formation of a modern paradigm of economic and environmental management, grounding on the "green" economy. The development of methodology and conceptual principles of sustainable development is no less important than economic education in the context of myriad of global transformational and environmental challenges faced by certain countries, regions and continents. It should be mentioned that "green" economy as a system of economic activities ensures agreeable combination of three components of sustainable economic, environmental and social development.

2. Main text

Since the mid 90-ies of XX century in many developed countries monitoring of sustainable development of the economy has become an effective tool in the field of corporate governance. However, in transition economies work in this area is complicated due to the lack of developed and introduced methodological guidelines and systems of indicators of sustainable development, which could form the basis of the national economy green development (Podvorskaya, 2012). Moreover, when evaluating the performance of sustainable development of an organization, as a rule, there are particular problems associated with the lack of information support for monitoring. These problems are as follows: incomplete information, timeliness of its receipt, which, of course,

complicate an evaluation of sustainable development of industrial organizations, but can be used for a variety of research in order to improve the process of evaluation.

The concept of sustainable development was offered by the United Nations and is reflected in the documents of the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil (1992). The main result of the Conference was the creation of a new global partnership for sustainable development, which recognizes the common approach to the issues of environmental protection and socio-economic development. In this regard, scientists and politicians consider sustainable development as the development, which meets the needs of the present without compromising the ability of future generations to meet their own needs (Keating, 1993). Achieving sustainable development in any country is impossible without the achievement of sustainable development of its individual regions, and sustainable development of any region, in turn, is impossible without the effective functioning of organizations in the region. Thus, not only the governments are engaged in the creation of national strategies for sustainable development, but also the largest transnational corporations are paying a lot of attention to the development and implementation of their own corporate plans for sustainable development. The nature of these plans is to ensure that these corporations could overcome the directly proportional relationship between the level of economic development and the level of negative impact of their production performance on the environment (Kenneth, 2010).

The issue of the green economic development has become increasingly important area of investigation over the last decade. Our empirical analysis of the theoretical approaches to creating a system of indicators of the development of an organization in the emerging of a green economy showed that they need further development (Galushkina, 2011), (Musina, 2012) and (Yamchuk, 2013). Moreover, with the rapid development of market mechanisms there is a problem, associated with the need to develop a system of indicators for the analysis of sustainable development of organizations in the transition to a green economy. No less important problem is the practical application of a single mechanism, able to ensure the sustainability of enterprises at different stages of their life cycles. All this together defines the purpose of our study.

At the present stage of transformational changes, economists and political scientists developed a number of techniques that can be used to carry out the forecast level of economic development, provided its transition from "brown" to "green" economy. The most common of these procedures are as follows: disaggregation model sequence, computational model of general equilibrium, macro-econometric models and system dynamics models (Pearce, Atkinson, 1993). But these techniques are mainly used for the analysis at the short and medium period financial planning and are not suitable for incorporation in the whole of a variety of economic, environmental and social growth indicators. The most general system of indicators to measure the level of greening the economy at the macro level is the system, proposed by The United Nations Environment Programme (UNEP), which has defined three principal directions for the work on green economy indicators:

- *Indicators of economic transformation*. A green economy is first and foremost about transforming the way economies grow. It requires huge investments capital to shift towards low carbon, clean, waste minimizing, resource efficient and ecosystem, enhancing activities. The main indicators of economic transformation include the major shift in investments. Certain existing classifications in the national accounts, such as environmental goods and services sector, developed by Eurostat, provide an appropriate starting point for measuring transformation to a green economy, alongside various initiatives, especially in the private sector, to control green investment flows.
- *Indicators of resource efficiency*. A key benefit of economic transformation, apart from expected net increase in income and jobs in the medium and long term period, is improved resource efficiency in relative or absolute terms. Fundamental indicators include those on the use of materials, energy, water, land, changes to ecosystems and emissions of dangerous substances, related to economic activity. The International Panel on Sustainable Resource Management has proposed optimal indicators to capture some of these impacts, which can provide a framework for further performance in this area. The incentive is given to this area by the EU's 2020 Strategy for a

Resource Efficient Europe, which defines key directions of resource use for measurement and control (Arabei, 2010).

- *Indicators of progress and well-being.* A green economy can contribute to social progress and human well-being in two possible ways: by redirecting investments towards green goods and services or by redirecting investments towards the strengthening of human and social capital. Some of these indicators include the level of education achieved, health status of the population and the rate to which basic human needs are fulfilled. A number of these indicators are covered by the Millennium Development Goals (MDGs). Considerable attention is given to this area by the EU and the Organization for Economic Co-operation and Development as part of the initiatives on "Beyond GDP" and "Measuring the Progress of Societies", adequately. The proposal for "Rio+20" to establish a process for governments to define and commit to sustainable development goals is helping to provide a focus for discussion in the area. Investments in the main spheres of the green economy, together with policy reforms, should contribute to decoupling economic growth from resource use and environmental impacts. Such improvements can be associated to the crucial macroeconomic indicators, such as GDP, Human Development Index, poverty rates, and can even lead to refined measures, such as adjusted net domestic product taking into account depreciation of natural capital.

Synthesis of various approaches and concepts of the world of international organizations have allowed us to define a set of indicators of the transition from the traditional "brown" to the "green" economy at the macro level (see Figure 1).

GREEN ECONOMY INDICATORS AT THE MACRO-LEVEL

Indicators of economic transformation	Indicators of resource efficiency	Indicators of progress and well-being
- investments in environmental protection; - total number of pollutant from stationary sources of pollution; - expenditure on environmental protection; - the volume of collected municipal waste; - the volume of hazardous waste companies; - the volume of recycled municipal waste; - the volume of electricity produced from a renewable source; - protection of electricity from renewable sources of energy, per capita; - innovations in the use of alternative technologies (number of patients, licenses, inventions); - innovations in the field of environmental protection (number of patents, licenses, inventions).	- holding of major mineral resources (depending on the sources); - reserves of energy resources (depending on sources); - inventories of forest; inventories of aquaculture (categories by type); - inventories / quantities of water (rivers, lakes, reservoirs); - inventories of underground water resources; - environmentally adapted net domestic product; - energy-intensive industries.	- morbidity; indicators of living standards; - indicators of the level of education of the population; - indicators that are the part of a number of the Millennium Development Goals; - public access to education; the volume of production of environmentally friendly products; investments in renewable energy sources; - investments in energy-saving technologies and energy efficiency; - investments aimed at reducing greenhouse gas emissions; - public access to environmentally friendly products and services; - the cost of construction work performed on the "green" building.

Figure 1 – Green economy indicators at the macro level (summarized by authors)

In general, each country is responsible primarily for its own sustainable development, which requires improving the institutional framework for sustainable development at the national level. At the same time sustainable development at the level of individual economic units is becoming particularly urgent problem of nowadays as we found in *Key Issues for Discussion of United Nations and Sustainable Development*. The concept of a sustainable society requires a well-

balanced indicators of social, economic and environmental components, and at the organizational level, as macroeconomic indicators are not always able to give an objective assessment of the greening of the economy at the level of the region, area or a certain part of the territory. So, there is a need to develop criteria to characterize the level of separate entity greening.

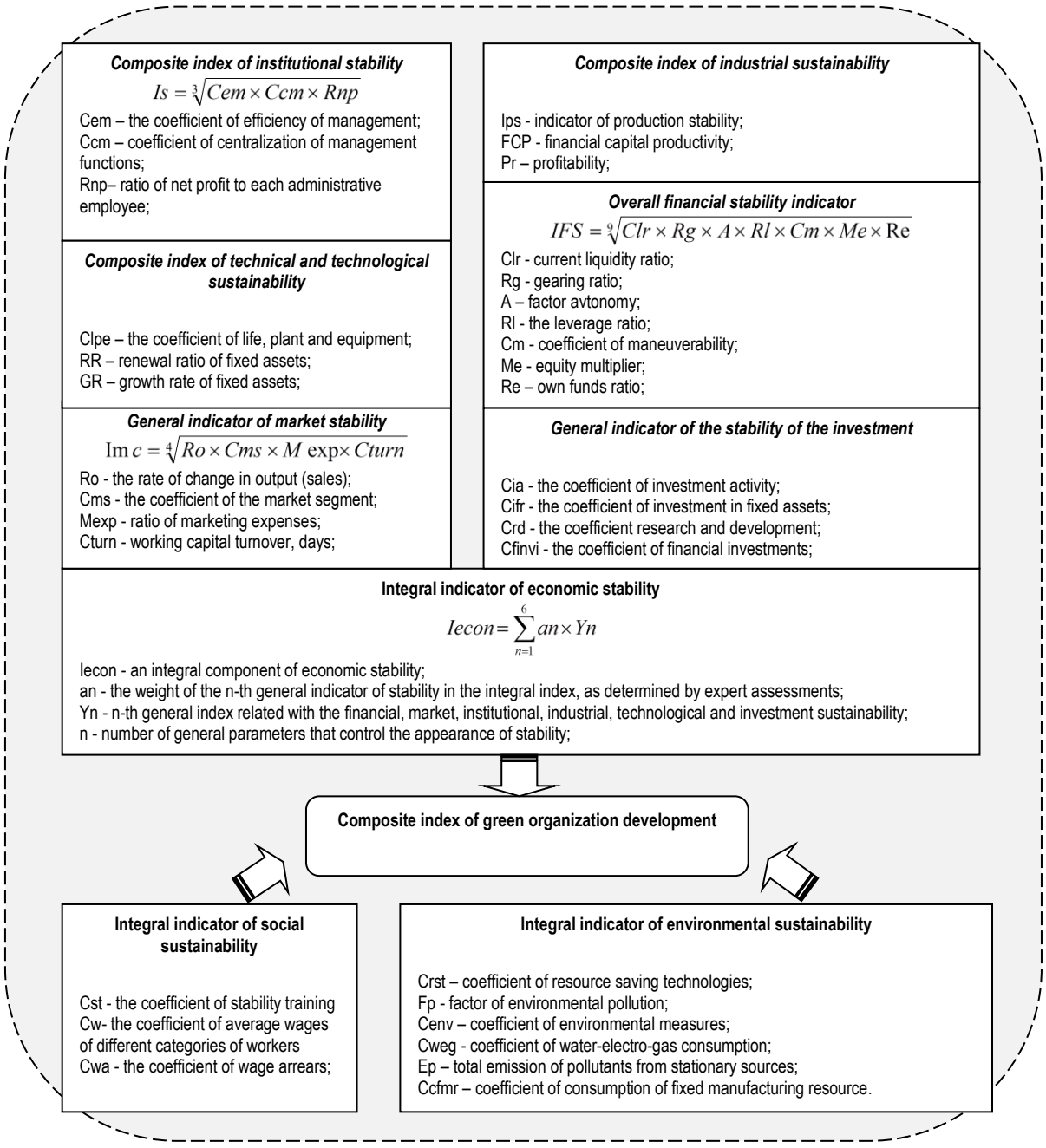

Figure 2 – Indicators determining the level of the transition of organizations to a green economy (summarized by authors)

The framework of the mass distribution of the concept of greening at the micro level is the introduction of so-called "soft" international standard of the Global Reporting Initiative, associated with the United Nations Environment Programme, on the principle of "three baskets" or Triple Bottom Line: business economics, ecology production and social policy. In this regard, based on the provisions of the international standard for reporting on sustainable development of the green economy, which identified three pillars of sustainable development of an organization (see *Statistical reporting in the field of sustainable development - Global Reporting Initiative* GRI) and

taking into account the methodology for sustainable development of an industrial organization, proposed (Homyachenkova, 2010) which is based on the principles of operation of the business to ensure the transformation of the internal environment of an organization for the purpose of self-preservation and reproduction of social and economic processes, we proposed a methodology of determining the extent of greening on the macro level. This methodology is based on the relationship of the interrelated set of indicators for sustainable development of an organization (see Figure 2).

As can be seen from Figure 2, in the proposed method the economic stability of the enterprise combines several parameters: financial, market, organizational, industrial, technical and technological, investment sustainability, each of which corresponds to a number of indicators. Under each type of the sustainability of an organization is a general indicator of sustainability. The integral indicator of economic stability is calculated by summing the weighting of each type of economic stability. The distribution of the weight of each factor, of course, is a subjective factor in the assessment, which is present only in the calculation of economic sustainability. However, in the case of expansion of the system performance and, therefore, the scope of evaluation of sustainable development, in particular, social and environmental components will be able to introduce the factor of peer review and other components of sustainable development of an organization. This dynamic system can be considered stable only in the case where all the elements are in a balanced state.

One of the most important elements of an organization as a production system is considered to be the staffs who act as a basis to assess the social sustainability of the organization. As an integral part of the green economy, social stability of the organization reflects the degree of social protection of its staff, the proportion of staff participation in the profits and in the management of production, stability in maintaining employment and so on, as in *Sustainability Reporting Guidelines. 2014*. In a broad sense, social sustainability provides attracting of organization's staff to the various social processes. In determining the degree of social stability, it is necessary to allocate three important indicators: staff stability coefficients, coefficients of average wages of different categories of workers and the debt ratio on wages.

The main goal of sustainable development management of an organization is to achieve a harmonious relationship between the economic, social and ecological functional areas. Moreover, the influence of organizations on the environment is a separate component of their functional structures. Environmentally sustainable organization accounts for the possibility of integrated solutions to economic and environmental issues in their investment decisions, as well as in determining the level of consumption of limited natural capital in the production process. In order to analyze the environmental sustainability we developed a set of the following indicators: the coefficient of resource-saving technologies, the ratio of pollution factor of environmental protection measures, the ratio of water-electricity-gas-consumption, ratio of emissions from stationary sources and the coefficient of consumption of fixed production resource.

The use of resource-saving technologies contributes positively to the increase in the degree of environmental sustainability of an organization. That is why in the process of determining the integral indicator of environmental sustainability special emphasis should be given to the coefficient of resource-saving technologies, which is the ratio between the level of the cost of alternative technologies and the net profit of the organization. Thus, in terms of repetitive production cycles in each industrial organization the adverse consequences, related with the economic, social and environmental instability, may suffer.

The proposed method of greening an organization belongs to the category management processes, which implement in some interconnected stages.

Step 1: Formation of management framework for greening of a certain organization is a purposeful process, which provides for setting and achieving certain goals. The first step is to formulate a strategy, objectives, functions, principles and techniques of business management, as well as to specify the subject and object management within the organizational concept of transition to a green economy, and to promote economic and social development in the framework of the existing environmental paradigm. The formation of a strategy for the development of green businesses requires the use of the approaches defined in international recommendations for public

reporting on sustainable development as was related in *The* Living Planet Report. *2010*. It follows a series of problems that need to be formalized by the relationship between economic and non-economic indicators to determine their actual and normative values as well as to perform structuring problems by constructing particular decision trees.

Step 2: Qualitative and quantitative analysis of external and internal stability factors on the basis of indicators of the current state and development of the organization for the purpose of early warning of danger and the development of the necessary measures aimed at greening activities. In a second step is necessary to choose specific techniques of monitoring needed to analyze the level of greening of an organization. Analysis of the key factors on the sustainable development of the organization should be carried out in the following order: 1) qualitative and quantitative determination of the effect of internal and external social, environmental, economic and risk factors on the economic performance of the organization; 2) qualitative and quantitative determination of the influence of factors of economic activity indicators for sustainable development of the organization.

Step 3: Evaluation and analysis of the level of development of the greening of an organization. At this stage it is necessary to define a specific set of indicators and composite index of green organization development. The proposed algorithm for analyzing the correspondence between the economic activities of the organization and its green development tasks should be based on the state of the financial and economic indicators and indicators of sustainable development (Tsarev, 2006).

Step 4: As a result of analysis and assessment of the level of greening activities of a certain business unit, it identifies the need for the development and conduct of administrative decisions and recommendations with targets, functions, principles and methods of control. A list of recommendations to guide organizations to improve their stability in a volatile market environment can be developed on the basis of the results of the main trends of greening business area analysis.

Step 5: Making statements. Information should be presented in the form of public reporting, developed on the basis of the methodology and technology of the balanced scorecard (BSC) and international guidelines for public reporting on sustainable development. Such an important information should be distributed to all participants in the process and be available to both external and internal users.

Conclusion

As a result of the research, we developed a methodology for assessing the level of greening of organizations, which is distinguished by the presence of the complex analysis of sustainable development and the possibility of obtaining composite index based on a set of indicators. Forming mechanism of the transition from a brown to a green economy by this technique, the organization will be able to direct the economic activities in such a way as to meet the international requirements of sustainable development, to address social, environmental and risky task, ensuring that in the end, their competitiveness and viability. The implementation of the proposals presented in this paper will contribute to solving the problems of rational use of natural resources, improve the environmental, physical and spiritual quality of life of citizens, improving environmental safety. A promising direction for research on this issue is the differentiation of indicators of greening the various areas of economic activity, through which it is possible to determine the readiness of organizations to function under conditions of ecological and socio-economic space and test the proposed methodology.

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MANAGING THE STRUCTURE OF QUALITY COSTS IN CONTEXT OF ACHIEVE "DUAL EMPHASIS"

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Abstract

Article deals with economical aspects of costs of quality (CoQ). Literature review showed that, improve of quality can increase level of sales, achieving benefits of "revenue emphasis", decrease costs achieving benefits of "costs emphasis", simultaneous achieving both effects called "dual emphasis". It also showed that, "dual emphasis" is hard to achieve. That is why the aim of the paper is to show how modeling the structure of CoQ can influence on "dual emphasis".

Key words: costs of quality, dual emphasis, revenue emphasis, costs emphasis, DOL, DFL, continual improvement.

JEL Classification: L 15, M 21

1. Introduction

One of the most important dilemmas, which should be take into consideration by management of present companies is to find effective ways of understand management in turbulent environment. One of this ways can be rational approach to problematic of quality. Demand for quality is the single most critical factor for companies to survive in the global marketplace. Quality is a wide definition refers to all processes in company. That is why improvements/deteriorations of quality have influence on effectiveness of all company. Quality should be managed comprehensively throughout the company. The concept of Total Quality Management (TQM) has been developed as a result of intense global competition. TQM has significant relationship with business performance (Ahmad *et al.*, 2012). Appropriate improvement of pro-quality actions is possible by measuring impact of quality on company efficiency. One of the tools which measure effects pro-quality actions are costs of quality (CoQ). There are many definitions and divisions of quality costs. In group of total costs of quality are costs of good quality and poor quality. The main principle of quality management is to minimize total costs of quality, thanks to removing costs of poor quality (Juran, 1988). Removing costs of poor quality often causes increase of costs of good quality. Changes in structure of total costs of quality have influence on value of total costs. Minimizing total cost is basic assumption of "costs emphasis". In conditions of sharp competition, customers want to buy products of high quality at a low price. "Revenue emphasis" puts pressure on increase customer satisfaction and what follows increase of sales. In order to maximize profit, companies should combine these two models to achieve "dual emphasis".

2. Literature review

Continuous improvement refers to both incremental and breakthrough improvement in organizational performance (Linderman, *et al.* 2004). Improvement can result in such things as improved customer value, reduction of defects and errors, improved productivity, improved cycle time performance safety, and motivation (Evans, Lindsay, 2001) (Gavurová, 2011). This often occurs through the adherence to a stepwise problem solving approach consisting of number of steps for problem contextualization, problem analysis, solution generation, and lessons learned (Kamsu-Foguem B., *et al.* 2008). The problem-solving approach focuses on a characterization of cognitive processes in reasoning tasks and cognitive considerations deal with knowledge capitalization on certain structural and processing regularities that give strength to generalizations (Patel *et al.* 2001) (Gavurová, 2011). Problem solving methods play a significant role in knowledge acquisition and engineering, since their abstract knowledge level is valuable to achieve goals of tasks by applying domain knowledge with the sequential process of searching for a solution path (Kamsu-Foguem, Rigal, Mauget, 2013).

Many quality improvement (QI) programs including six sigma, design for six sigma, and *kaizen* require collection and analysis of data to solve quality problems. Due to advances in data

collection systems and analysis tools, data mining (DM) has widely been applied for QI in manufacturing (Köksal, Batmaz, Testik, 2011). Quality problems may involve several input and output variables that are not easy to model and/or optimize (Šoltés, Gavurová, 2013). As Yang and Trewn (2004) point out, data mining (DM) and knowledge discovery in databases (KDD) have been successfully used for solving QI and control problems involving multivariate data in various stages of product/process life cycles (Köksal, Batmaz, Testik, 2011).

Ahmad (2012) pointed out that, research on TQM, Lean production, TPM and SPC investigated the implementation and their impact in isolation. Lean production, TPM and SPC have similar goals: continuous improvement, waste reduction and improving performance (Teeravaraprug, Kitiwanwong, Saetong, 2011) (Gavurová, Šoltés, Balloni, 2014). These practices are a comprehensive set of manufacturing improvement practices directed towards improving business performance. Lean production eliminates waste through inventory control and reduction time delay of process (Fullerton, Wempe, 2009). TPM helps maximize equipment performance and prevents break-down (Breja, Banwet, Iyer, 2011) and TQM aims to maintain and improve product quality and business performance. Furthermore, SPC is a monitoring process to ensure process is under control and stable (Juran, 1998).

Continual improvement is also one of principles of quality management. It is also well known that continuous improvement of quality product/services is related with changes in level and structure of total costs of quality and total costs. LNC research underlines that, there are many different definitions of the Cost of Quality available, and many are lacking in scope or precision. Often these definitions have not kept up with the times and don't account for software costs, supply chain interactions, or more as related LNC research, Cost of Quality Definition, 2012. Mizla, Pudło (2012) pointed out that, CoQ are costs that are associated not only in exact products but also in whole processes. Total costs of quality contain two main groups. First group contains costs of good quality (CoGQ), the second costs of poor quality (CoPQ). Essentially, the CoGQ relates to costs incurred to assure quality in products and prevent poor quality. The CoPQ is a measurement of the failure costs incurred in producing the product (LNC research, Cost of Quality Definition, 2012). CoQ is usually understood as the sum of conformance plus non-conformance costs, where cost of conformance is the price paid for prevention of poor quality, and cost of nonconformance is the cost of poor quality caused by product and service failure (Tawfek *et al.* 2012) (Grzebyk, M. 2010). Mizla, Pudło (2012) adds that CoQ can have fixed or variable character, they can be devided into fixed costs of quality FCoQ and variable costs of quality VCoQ. The most widely used model/approach of costs of quality is: P-A-F scheme, Crosby's model, process cost model, intangible costs for quality costing, collecting quality costs by department, method based on a team approach, life cycle model (Štefko, Bačík, Fedorko, 2013) (Feigenbaum, 1956) (Crosby, 1979) (Ross, 1977) (Marsh, 1989) (Pudło, 2007) (Fajczak – Kowalska, 2004). ABC model is alternative approach, which can be used to identification from products quantity and localization of quality costs, and in consequence helps to management of costs in more effective way. Long – term goal of ABC method is eliminate worthless activities and continuous processes and quality improvement to create zero defects. Connection between model of quality costs and ABC model is create common data base, which delivers information about different costs. No matter which quality costing approach is used, the main idea behind the CoQ analysis is the linking of improvement activities with associated costs and customer expectations, thus allowing targeted action for reducing quality costs and increasing quality improvement benefits. Therefore, a realistic estimate of CoQ, which is the appropriate tradeoff between the levels of conformance and non-conformance costs, should be considered an essential element of any quality initiative and a crucial issue for any manager. A number of organizations are now seeking both theoretical advice and practical evidence about quality related costs and the implementation of quality costing systems (Schiffauerova, Thomson, 2006). Managing the structure of total quality costs (TCoQ) influences on the level of total costs and customer satisfaction will improve quality of products/service/processes influences changes in total quality costs. The changes in value of total costs of quality are affected in two main variants of changes, increase of TCoQ, decreases TCoQ. No change in value of TCoQ, do not mean that, changes do not appear. Increase in CoGQ can cause decrease in CoPQ without changes in value of TCoQ. Customer expectations and

competition is increasing. Quality attributes and price are basic elements that determine the value of sales. If customer has to choose between two products of the same quality and different prices, choose the one that is cheaper (Cole, Mogab, 1995) (Pudło, 2007). From one hand, the company, which wants to offer the customer a lower price, will reduce costs, from other hand, clients want high quality products, and investments in quality very often generate increase costs. That is why company has to deal with "cost emphasis" and "revenue emphasis".

Rust *et al.* (2002) emphasis that, the "cost emphasis" focuses on the efficiency of the firm's processes. General cost reduction efforts (*e.g.*, downsizing) do not necessarily improve efficiency, but quality efforts that reduce costs always do. Successful programs tend to increase the productivity of quality efforts by reducing the input (labor and materials) required to produce a unit of output. These improvements can be incremental (continuous improvement) or discontinuous (process reengineering); in either case, the focus is internal and the goal is to reduce costs. Customer satisfaction improvements are sought only indirectly, through such results as increased reliability or lower prices. Cost reduction programs thus transfer their savings to the bottom line directly. Methods of quantifying cost reductions are referred to as "cost of quality" programs. Cost emphasis has an internal focus designed to introduce operations and systems that reduce costs via standardization, efficiency improvements, and defect reduction. This approach is typically the domain of accounting and operations management. Examples of such programs include six sigma, total quality management (TQM), and statistical process control (SPC) (Mittal, Anderson, Sayrak, Tadikamalla, 2005). Revenue emphasis to quality profitability focuses externally - on customer perceptions and attitudes that will lead to more sales.

Therefore, programs emphasize improving quality by addressing the issues that have the greatest impact on over-all customer satisfaction. These programs may occasionally lower costs, but more often costs rise as the firm delivers a higher level of quality that meets customer needs. This approach is typically the domain of marketing. The revenue emphasis is exemplified in programs designed to introduce and modify products and services to exceed customer expectations, to retain consumers, and improve sales to already retained customers. The dual emphasis argues that financial benefits accrue to firms from simultaneous cost reductions via efficiencies and revenue enhancements via customer satisfaction improvements. Rust *et al.* (2002) caution that in practice a dual emphasis is very difficult to implement because the efficiency and revenue enhancement perspectives stem from very different organizational philosophies. The cost emphasis is internally focused toward the firm's operations and is designed to promote efficiencies that lower costs. The revenue emphasis is externally focused toward satisfying the firm's consumers and is designed to increase revenues via spending on customers. If achieved successfully, the dual emphasis should produce the best results with respect to profitability through simultaneously increasing revenues and decreasing costs, especially in the long run. This distinction between the long-term and short-term impact is very important from a financial standpoint (Rust, Moorman, Dickson, 2002) (Mittal, Anderson, Sayrak, Tadikamalla, 2005). Mittal *et al.* (2005) find that the association between customer satisfaction and long-term financial performance is positive and relatively stronger for firms that successfully achieve a dual emphasis, successfully achieving both customer satisfaction and efficiency simultaneously. Investigation of Swaminathan *et al.* (2014) suggest that merging firms should not take a myopic perspective of only wresting efficiencies (as the finance literature suggests). Rather, merging firms should focus on simultaneously improving customer satisfaction and improving efficiency to maximize long-term firm value.

3. Methodology

Literature review showed that in practice dual emphasis is very difficult to implement because, the efficiency and revenue enhancement perspectives stem from very different organizational philosophies. The cost emphasis is internally focused toward the firm's operations and is designed to promote efficiencies that lower costs. The revenue emphasis is externally focused toward satisfying the firm's consumers and is designed to increase revenues via spending on customers (Rust, Moorman, Dickson, 2002) (Mittal, Anderson, Sayrak, Tadikamalla, 2005). Research of Pudło (2007, 2008, 2009) on Polish and Slovak companies confirmed that in

researched companies (small and medium size) more common companies use or "cost emphasis" or "revenue emphasis," 72% of companies, "dual emphasis" uses 28% of companies. The aim of this article was to show how managing the structure of CoQ can influence on "dual emphasis". Author propose model which is trying to explain and show how companies can achieve "dual emphasis" and thus provide a methodological guide for enterprises, which want to increase their profits by ensuring quality and simultaneous use of both approaches. Presented model assumes:

- improving of quality products/services generate costs,
- generated cost are called costs of quality CoQ,
- CoQ are classified into FCoQ and VCoQ,
- improving of quality products/services can cause no change, increase, decrease of total costs of quality,
- changes in structure of total costs of quality can cause no change in value of total costs
- changes in value of FCoQ and VCoQ have influence on value of DOL (degree of operating leverage), DFL (degree of financial leverage)

DOL can be calculated from *equation* 1 (Mizla, Pudło, 2012):

$$DOL = \frac{S - (VARk + VARp)}{S - (VARk + VARp) - (FIXk + FIXp)} \quad (1)$$

where: S – value of sales;
VAR k –total variable quality costs;
VAR p – other variable costs;
FIXk – total fixed quality costs;
FIXp – other fixed costs.

DFL can be calculated from equation 2:

$$DFL = \frac{S - [(VARk + VARp) - (FIXk + FIXp)]}{S - [(VARk + VARp) - (FIXk + FIXp)] - KF + PF} \quad (2)$$

where: - KF – interest expense;
- PF – interest income.

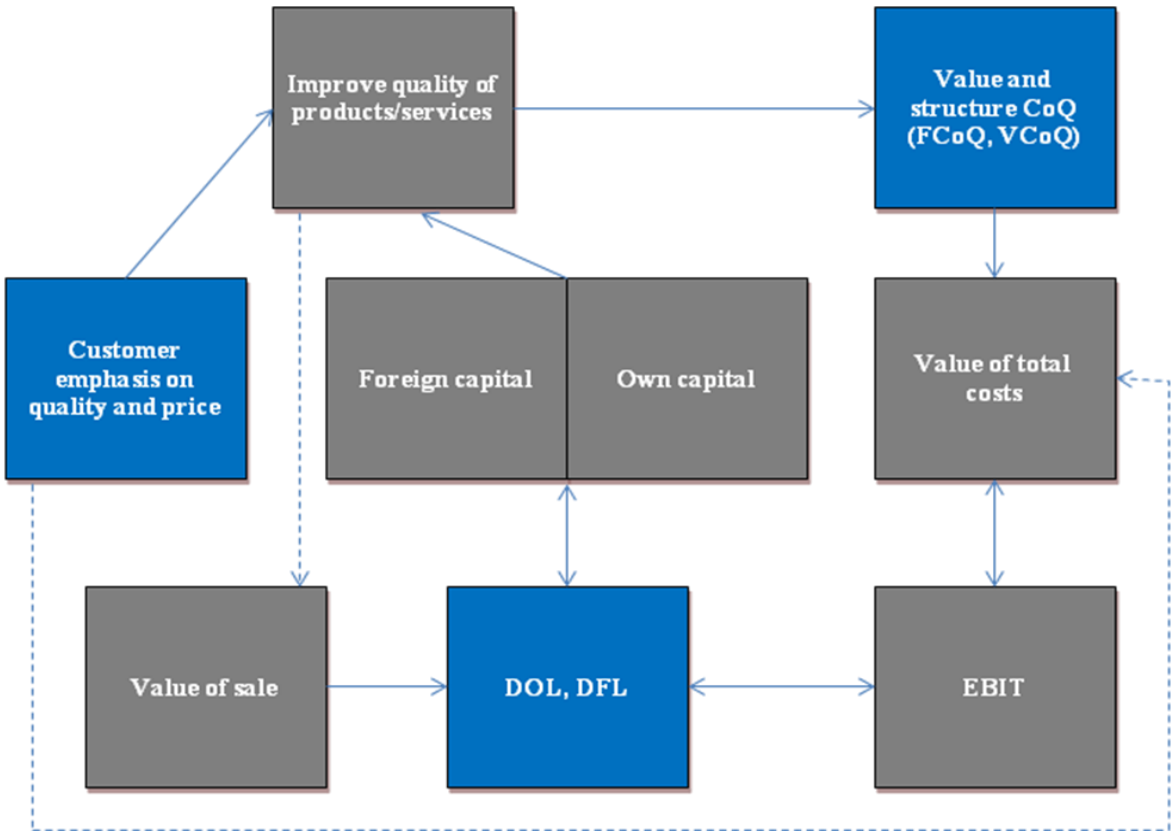
Improvements of quality products/services may be financed from own capital and foreign capital

4. Result and discussion

Model presented in Figure 1, due to classification of CoQ on FCoQ and VCoQ combines the two concepts "cost emphasis" and "revenue emphasis". So that companies can achieve "dual emphasis". Activities in area of quality generate costs, managing the value and structure of CoQ should minimize PCoQ. Activities undertaken to minimize PCoQ can cause increase of GCoQ *e.g.* decrease wastes (VCoQ) as a result of purchase machine (FCoQ), decrease of GCoQ, *e.g.* buying warehouse management system, which is prevention cost in category of FLCOQ, can decrease failure costs, which appears during errors in completing of orders in warehouse and decrease cost of labor in warehouse (FCoQ).

Ruhupatty, *et al.* (2014) underlines that cost of quality that is mostly due to internal and external failures indicate that the pursuit of quality may have failed. Ideally the bulk of quality cost should be in prevention. Only effective prevention can minimize failure costs. Changes in categories of CoQ in final can increase, decrease or do not have any change in total CoQ. Classification CoQ on FCoQ and VCoQ allows to measure influence them value and structure on EBIT (earnings before interest and taxes), because changes in total CoQ affect total fixed cost and total variable costs. According to Business Excellence (2014) normally, quality-related costs run in the range of 10 to 30 percent of sales or 25 to 40 percent of operating expenses. Some of these

costs are visible and some hidden. Therefore, changes in the value of CoQ cause changes in the value of total costs.



Source: own elaboration

Figure 1 - Influence of CoQ structure on achieving "dual emphasis".

Presented model shows that, character of changes in improvement of quality product/services influences value of earnings per unit. If we assume that level of sales is constant, companies which have more FCoQ in structure of total costs of quality achieve bigger value of earnings per unit, than companies which have more VCoQ in structure of total costs. Increase of earnings per unit is a result of decrease cost per unit (company achieve "cost emphasis"). Level of value decrease/increase cost per unit is measured by DOL. Interpretation of DOL answers at question: how much will increase EBIT when sales grew by 1%. Influence fixed and variable costs on DOL show *equation* 1. When structure and value of total cost will not change and sales will increase or decrease, company which has bigger value of FCoQ in structure of CoQ achieves bigger increases/decreases of cost per unit. As we see the effect of operating leverage can have positive and negative influence, it depends on level of sales and fluctuation of economy (economic growth, economic crisis). During those changes in structure of FCoQ and VCoQ customer received better product, sales may rise or at least not change ("revenue emphasis"). It also depends on behavior of competition. If sales do not increase or may even fall, company can use cost reduction achieved per unit to decrease price per unit. Activities in area of quality improvement can by financing from own capital or foreign capital. When company does not have enough own capital to invest in quality improvement, it can use effect of financial leverage DFL. DFL informs how much will increase EAT (earnings after taxes) when EBIT grew by 1%. Influence fixed and variable costs on degree of financial leverage also depend on structure of total costs and CoQ (see *equation* 2). When ROA (return on assets) is bigger than interest rate on foreign capital, company achieves positive effect of DFL. Also, companies which have more fixed costs in structure of total cost and have more foreign capital in structure of capital achieve bigger increase of EAT as a result of changing structure of costs (in situation when sales do not change or increases). DFL can

have also negative effect, when company have more fixed costs in structure of total cost and sales decreasing, companies with bigger value of foreign capital have bigger decrease of EAT.

It is also necessary to add, that improve quality of product/service it is possible to achieve in two ways, continual improvement, investing into quality. Continual improvement, understood as small changes, which improve quality and do not cause big changes in value of total costs rather changes in structure of total costs of quality. Literature review shows that this approach is achieved thanks to using company potential (mainly human capital), methods and techniques of quality management. Changes in structure of CoQ as a result of continuous improvement may cause changes in prevention costs. Prevention activities can replace one another, eg. external training are replaced by internal training, which improve workers knowledge and consequently reduce the level of errors caused by workers. Investing into quality author understands as spending money on improve quality/service e.g. buying new machines, technologies, cars, warehouse. Those investments can by financing from own and foreign capital. Taking into account the level of actual and future sales, management can change structure of capital and use effect of financial leverage. Analysis of presented model allows company achieve "dual emphasis", thanks to modeling of structure of total CoQ as a result of change in area of quality improvement, thanks to using company potential through better organizing of activities or investing into quality can achieve lower costs per unit (costs emphasis). Deliver customers better quality products without changing or lowering price can increase sales "revenue emphasis".

Conclusion

Activities in area of quality generate costs of quality (CoQ). Literature review shows that there are many definitions and classifications of CoQ. The aim of this article was to show how managing the structure of CoQ can influence "dual emphasis". Traditional classification of CoQ divides them on prevention cost, appraisal costs and failure costs are not enough to fulfill the aim. Classification of CoQ on FCoQ and VCoQ showed how changes in improve quality product/services on EBIT and level of cost per unit. Modeling the structure of CoQ allows from one hand lowering cost per unit "cost emphasis" from another hand fulfill customer expectations, which leads to increase sales "revenue emphasis". In consequences company achieves "dual emphasis". Achieved effect of "dual emphasis" depends on directions of changes: continuous improvement, investing into quality and changes in individual groups of CoQ, quality and price products of competition, fluctuation of economy.

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SOLVENCY CAPITAL FOR NON LIFE INSURANCE: MODELLING DEPENDENCE USING COPULAS

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Abstract:

The aim of this article is to improve the internal model of the solvency 2 framework, by assessing a solvency capital for non life insurance portfolio, taking into account potential dependencies between insured risks. We used two stochastic models and a simulation technique to determine the distribution of reserve. Then we modelled the dependence using several copulas and the best one was selected using a goodness of fit test. Finally we evaluated the solvency capital in the dependent and independent case. By comparing the results, we highlighted the effect of dependence on solvency capital of the insurance company.

Keywords: solvency capital requirement, reserves, claims dependence, copulas functions, goodness of fit test, simulation methods.

JEL Classification: C13, G17, G22

1. Introduction

Plenty actuarial research in recent years has focused on the solvency of the insurance companies. Indeed, insurance company must have a level of liability (equities and technical reserve), which allows it to be solvent in future years. Historically, the insurance companies were sufficiently capitalized compared to their engagements: the markets were controlled and less volatile. Furthermore the correlation between the risks of insurance was not considered. Recently, we remark that the claims increased and the legal environment became more uncertain: the Lothar storm in 1999 and the disaster of the World Trade Center in 2001 were responsible of a number of insolvency among various lines of business: damage, catastrophes, industrial accidents, trading losses, civil responsibility. Also, some situations are observed almost every day, as for example, in auto insurance, accidents may involve several insured at once in a collision. These events proved that the risks of insurance could be dependent, and this dependence can bind liabilities or assets of insurance. Thus, control of risk has become essential. One way is to consider dependence between insured risks. *For example*, linear correlation is frequently used in practice as a measure of dependence notably by the solvency 2 framework see (Commission 2010). However, it cannot capture the non-linear dependence relationships that exist between different risks, especially when extreme events are highly dependent between lines of business.

Recently, several actuarial studies have applied copulas functions to fully capture a wide range of dependence structure amongst different insured risks. (Frees and Valdez 1998) have proposed copula function to measure dependence between risks of insurance, and to evaluate the loss of life mortality, the loss of adjustment expenses and reinsurance contract pricing. Moreover (Frees and Wang 2006) have used copulas for estimating the credibility of aggregate loss. In addition, (Kaishev and Dimitrova 2006) have shown the importance of copulas in reinsurance. (Antonin and Benjamin 2001) also used copulas to assess the amount of the reserve, they provided a model which combined at the same time the theory of copula and the theory of credibility in order to detect better the dependence between the lines of business. Furthermore, (Belguise and Levi 2002), (Faivre 2002) and (Cadoux and Loizeau 2004) have shown that the model with copulas allows for an aggregation of risks and evaluates a capital higher than when assuming independence. Similarly, (Krauth 2007) has modeled the dependence using three models (bootstrap, common shock and copulas) to assess the amount of insurance reserves. In addition,

(Bargés *et al.* 2009) evaluated the capital allocation for the overall portfolio using the TVaR as a measure of risk and a FGM copula. More recently (Zhao and Zhou 2010) have applied semi parametric copula models to individual level insurance claims data to forecast loss reserves, and (Shi and Frees 2011) have investigated the aggregate insurance loss reserving data with bivariate copulas and linear models. Besides, (Diers *et al.* 2012) have shown the flexibility of a Berntein copula to model a several lines of business. Moreover (Zhang and Dukic 2013) have introduced a Bayesian multivariate model based on the use of parametric copula to model dependencies between various lines of insurance claims.

All studies mentioned above have considered copulas functions as a powerful tool to resolve the problem of dependence between insurance risks. However, the new solvency 2 frameworks launched in 2001 which is the basis framework for the European insurance market, consider the correlation coefficient to measure dependence and to aggregate risks. Or this measure is insufficient to capture the non linear dependence of insurance risks.

For that, the purpose of this work consists, to model the structure of dependence between underwriting risks of non life portfolio of a Tunisian insurance company, and to assess the solvency capital requirement (SCR) by the new solvency 2 approaches. Indeed this paper is primarily motivated to show the importance of the internal model of the Solvency 2 framework compared to the standard model, and to extend the internal model by including copula approach in assessing reserves and capital.

On the basis of this framework, we consider in this paper, two models, the standard model and the internal model of Solvency 2, the last one is investigated in two cases; the independence and the dependence case in which a copula approach is used to model the structure of dependence. A goodness of fit test for copula was implemented to select the best one for the data and a simulation method of conditional distribution of the copula is applied to include dependence in the internal model.

The paper is organized as follows. Section 2 presents the Solvency 2 framework. In Section 3 we present reserving models. In section 4 we provide the copulas functions. Section 5 reports the empirical results. Some comparisons with other papers are discussed in section 6, followed by concluding remarks and some open questions in Section 7.

2. Solvency 2 framework

Solvency 2 provides a practical tool to evaluate the Solvency Capital requirement (SCR) for insurance companies in order to manage their risks (reserve risk, premium risk, catastrophe risk...). Two models were proposed: the standard model and the internal model. These models take the advantage of evaluating liabilities in stochastic way, contrary to Solvency 1, which evaluates liabilities with deterministic methods.

In this paper, we focus on reserve risk, which results from fluctuations in the timing and amount of claims payment. We present here models of SCR for reserve risk, for two lines of business denoted by k and l, but the models can be generalized for more lines of business.

Standard model

The European Insurance and Occupational Pension Authority (EIOPA) see (Commission 2010) defines a common standard formula for all the insurance companies in order to manage their risks.

The SCR is defined as

$$SCR_{aggregate} = \rho(\sigma_{total})V_{total} \tag{2.1}$$

$$\rho(\sigma_{total}) = \frac{\exp(N_{0.995} \times \sqrt{\log(\sigma_{total}^2 + 1)})}{\sqrt{\sigma_{total}^2 + 1}} - 1$$

where: $N_{0.995}$ is the quantile of the standard normal distribution.

$$\sigma_{total} = \sqrt{\frac{1}{V_{total}^2} \cdot \sum_{k,l=1}^{n} Corr_{k,l} \cdot \sigma_k \cdot \sigma_l \cdot V_k \cdot V_l}$$

is the overall standard deviation of the insurance portfolio, and σ_k, σ_l are the standard deviations of reserve risk respectively, for the line of business k and the line of business l fixed by the EIOPA see Table 7 in Appendix B. $V_{total} = V_k + V_i$ is the total estimate of technical reserve, which is the amount of claims would rationally pay to settle the obligations, V_k and V_l are respectively the best estimate of reserve for the line of business *k* and the line of business *l*.

Internal model

The EIOPA recommends the use of an internal model adapted to the risks, which are really supported by the insurer. Capital reserve risk equation for the line of business *k*, is given by:

$$SCR_k = VaR_{99.5\%}^k - BE_k \tag{2.2}$$

where $VaR_{99.5\%}^k$ is the Value at Risk of the line of business *k* at confidence level 99, 5%.

BE_k is the best estimate of the total reserves of the line of business *k*.

This best estimate must be calculated by at least two models using actuarial techniques (see Section 3). After computing an SCR for each line of business, we evaluate the aggregate SCR obtained by:

$$SCR_{agregate} = \sqrt{\sum_{k,l} Corr_{k,l} SCR_k SCR_l} \tag{2.3}$$

where: $Corr_{k,l}$ is the correlation matrix of the two lines of business, and SCR_k, SCR_l are the solvency capital requirement respectively for the line of business *k* and the line of business *l*.

3. Best estimate models

We present here two classical models for evaluating Best Estimate of reserve risk; the Stochastic Chain Ladder model and the Generalized Linear Model.

3.1 Stochastic Chain Ladder model

Chain Ladder model is the traditional and the straightforward technique to estimate future claims amounts see (Mack, 1993) and (Mack, 1994). This technique is applied to cumulative claims data. We assume that the data consist of a triangle of incremental claims, $\{y_{ij} : i = 1.....n;\ j = 1.....n-i+1\}$

i: refers to the row, and indicate the accident year.

j: refers to the column, and indicate the delay year (or development year).

We assume that these incremental claims are independent. Then, the cumulative claims data are obtained by:

$$C_{ij} = y_{i,j} + \sum_{k=1}^{j-1} y_{ik} \tag{3.1}$$

The Chain Ladder methods consist of forecasting the future claims $C_{i,j}$, by estimating a development factors as

$$\lambda_j = \frac{\sum_{i=1}^{n-j} C_{i,j+1}}{\sum_{i=1}^{n-j} C_{i,j}} \qquad 1 \le j \le n-1 \tag{3.2}$$

Then, the conditional expected loss, which is the best estimate of the future claims are:

$$E(C_{i,j+1} \mid C_{i,1}.....C_{ij}) = \lambda_j C_{ij} \tag{3.3}$$

For $1 \le i \le n$ and $1 \le j \le n$, we have $V(C_{i,j+1} \setminus C_{i,1}.....C_{ij}) = C_{ij}\sigma_j^2$, with σ_j is the volatility of the development year defined as

$$\sigma_j^2 = \frac{1}{n-j-1}\sum_{i=1}^{n-j} C_{ij}\left(\frac{C_{i,j+1}}{C_{ij}} - \lambda_j\right)^2 \tag{3.4}$$

The amount of the expected reserves $E(R_i = C_{i,n} - C_{i,n-i+1} \middle| C_{i,1}.....C_{i,j})$ is estimated by:

$$R_i = C_{i,n} - C_{i,n-i+1} \tag{3.5}$$

Thus the best estimate of the total amount of reserves is:

$$R = \sum_{i=1}^{n} R_i$$

.

The uncertainty on the estimation of reserves can be measured by:

$$mse(R_i) = C_{i,n}^2 \sum_{k=n+1-i}^{n-1} \frac{\sigma_k^2}{\lambda_k^2}\left(\frac{1}{C_{ik}} + \frac{1}{\sum_{j=1}^{n-k} C_{j,k}}\right) \tag{3.6}$$

In alternative measure of uncertainty is the standard error $se(R_i) = \sqrt{mse(R_i)}$ and the coefficient of variation $cv = \frac{se}{E(R_i)}$.

Chain Ladder method is considered as the standard reserving model for reserve estimation. However, this method presents several disadvantages. In fact, it assumes a linear relationship in claims between the development years; it multiply a claim in development year j by a factor λ_j to obtain a future claim in development year *j + 1*, so the risk of accumulated errors is important. Also, this method does not take into account the various change in the inflation, law.

3.2 Generalized Linear Model

In alternative model to the Stochastic Chain Ladder model was proposed by (Nelder and Wedderburn 1972), the Generalized Linear Model (GLM). Contrary to Chain Ladder technique, this method is applied to incremental data $y_{i,j}$.

We assume that the response variable $y_{i,j}$ are independent and belong to the exponential family distributions defined as

$$f(y_{i,j}, \theta_{i,j}\phi) = \exp\left\{\frac{y_{i,j}\theta_{i,j} - b(\theta_{i,j})}{a_{i,j}(\phi)} + c(y_{i,j}, \phi)\right\} \tag{3.7}$$

where $a_{i,j}(\phi)$, $b(\theta_{i,j})$ and $c(y_{i,j}, \phi)$ are functions specified in advance, $\theta_{i,j}$ is a parameter related to the mean and ϕ scale parameter related to the variance. For more details we refer the readers to (McCullagh and Nelder, 1989).

We denote the best estimate of claims amounts as $\mu_{ij} = E(y_{i,j}) = b^{-1}(\theta_{i,j})$ and $V(y_{i,j}) = \phi V(\mu_{i,j}) = \phi b^{'}(\theta_{i,j})$.

The mean $\mu_{i,j}$ is related to the covariates via the link funtion g, that is differentiable and monotonic, such that $g(\mu_{i,j}) = \eta_{i,j}$, this link function can be: identity, log, logit and reciprocal. Alternatively, as pointed out by (Merz and Wuthrich, 2008), a log link is typically a natural choice in the insurance reserving context.

$\eta_{i,j}$, is the linear predictor and is defined by $\eta_{i,j} = X_{i,j}\beta$, where $X_{i,j}$ is a matrix of covariates and β is the vector of parameters. In our context, we use accident years and development years for covariates of future claims.

The model parameters are estimated using maximum likelihood, and the best estimate is given by: $E(y_{i,j}) = \hat{\mu}_{i,j} = g^{-1}(\eta_{i,j})$. The amount of reserve for each year is calculated by $R_i = \sum_{j>n-i+1} \hat{\mu}_{i,j}$ and the best estimate of the total amount of reserves is $R = \sum_{i=1}^{n} R_i$.

In order to estimate the mean squared error that measure the uncertainty of reserves, we used the Delta methods of (England and Verrall 1999) that requires the variance covariance matrix, so the mse of each year of occurrence is calculated as follow

$$mse(\hat{R}_i) = \sum_{j>n+1-i} \phi \hat{\mu}_{ij} + \sum_{j>n+1-i} \hat{\mu}_{ij}^2 V(\hat{\eta}_{ij}) + 2 \sum_{\substack{j,k>n+1-i \\ j<k}} \hat{\mu}_{ij} \hat{\mu}_{ik} \operatorname{cov}(\hat{\eta}_{ij}, \hat{\eta}_{ik}) \quad 1 \le i \le n \tag{3.8}$$

and the *mse* of the total reserves is

$$mse(\hat{R}) = \sum_{j>n+1-i} V(y_{ij}) + \sum_{j>n+1-i} \hat{\mu}_{ij}^2 V(\hat{\eta}_{ij}) + 2 \sum_{\substack{j,k>n+1-i \\ j<k}} \hat{\mu}_{i_1 j} \hat{\mu}_{i_2 k} \operatorname{cov}(\hat{\eta}_{i_1 j}, \hat{\eta}_{i_2 k}) \tag{3.9}$$

The main problem with models like those above, that Chain ladder and GLM do not take into account the dependence structure between the different lines of business that is often induced by such factors: inflation, catastrophe events. Also, another example; a car accident can cause both a material damage related to the car and a human damage related to the driver. Another example for dependence is the climate states (snowy, rainy) can influence the number of car accident as their amounts of claims. In addition these models may not predict an accurate reserves since the data are non linear and non Gaussian. For that, a new type of model must be introduced to fill these gaps.

In the next section we introduce the copula function that has been discovered for creating bivariate distributions and taking into account the dependence between marginals.

4. Copulas

In this section, we provide an appropriate statistical model for dependent claims amounts relative to the two lines of business. Copulas functions have been introduced in the insurance context by (Frees and Valdez 1998). A copula is based on an assumption that both marginal distributions are known. For more details about copula functions, we refer readers to (Nelsen 2006).

Let $F_X(x)$ and $F_Y(y)$ denote the marginal distribution functions of the variables *X* corresponding to the claims amounts of the line Auto Damage and *Y* corresponding to the claims amounts of the line Auto Liability.

The joint distribution function $F_{X,Y}(x,y)$ is then obtained as:

$$F_{X,Y}(x,y) = C(F_X(x), F_Y(y)) \tag{4.1}$$

where: $C(u,v)$ is the *Copula*, a cumulative distribution function for a bivariate distribution with support on the unit square and uniform marginals.

In this paper, we assume that the marginal distributions are continuous with density functions $f_X(x)$ and $f_Y(y)$. Then, the joint density function is:

$$f_{X,Y}(x,y) = f_X(x) f_Y(y) C_{12}[f_X(x), f_Y(y)] \tag{4.2}$$

where: $C_{12}(u,v)=\dfrac{\partial\partial C(u,v)}{\partial u\partial v}$

The conditional distribution function of $Y \mid X = x$ is:

$$F_{Y\setminus X}(y\setminus x)=C_1[F_X(x),F_Y(y)] \tag{4.3}$$

where: $C_1(u,v)=\dfrac{\partial C(u,v)}{\partial u}$

In the insurance context, (Frees and Valdez 1998) provide a number of copulas. In each case the parameter α measures the degree of association. In the present work, we used several copulas in order to select the appropriate one that describes the structure of dependence between the two lines of business.

We investigate the Achimedean copulas and their survival copulas, which are more appropriate to insurance data than elliptical copulas, because elliptical copulas are generally applied to symmetric distributions.

Gumbel

This copula models a positive dependence and represents the risks which are more concentrated in the upper tail. It is defined as

$$C_\alpha(u,v)=\exp(-\left[(-\ln u)^\alpha+(-\ln v)^\alpha\right]^{\frac{1}{\alpha}}) \qquad \alpha\geq 1 \tag{4.4}$$

where: α is the parameter dependence. The Gumbel copula has upper tail dependence $\lambda_U=2-2^{\frac{1}{\alpha}}$, but no lower tail dependence.

Fank

This copula models both positive and negative dependence, but it has no tail dependence, it is defined as

$$C(u,v)=-\frac{1}{\alpha}\ln\left[1+\frac{(e^{-\alpha u}-1)(e^{-\alpha v}-1)}{(e^{-\alpha}-1)}\right] \quad \alpha\neq 0 \tag{4.5}$$

Clayton

This copula models positive dependence. Unlike to the Gumbel copula, it represents the risks which are more concentrated in the lower tail, so it correlates small losses. It is defined as

$$C(u,v)=(u^{-\alpha}+v^{-\alpha}-1)^{-\frac{1}{\alpha}} \qquad \alpha\in[-1,\infty)\setminus\{0\} \tag{4.6}$$

The Clayton copula has lower tail dependence $\lambda_U=0$ and $\lambda_L=2^{-\frac{1}{\alpha}}$.

Rotated Gumbel

It is the survival copula of the Gumbel copula, it is defined by:

$$C(u,v)=u+v-1+C_G(1-u,1-v;\alpha) \qquad \alpha\in[1,\infty) \tag{4.7}$$

where: C_G is the Gumbel copula.

The Rotated Gumbel copula has a lower tail dependence $\lambda_U = 0$ and $\lambda_L = 2 - 2^{\frac{1}{\alpha}}$.

Rotated Clayton

It is the survival copula of the Clayton copula, it is defined by:

$$C(u,v) = u + v - 1 + C_C(1-u, 1-v; \alpha) \qquad \alpha \in [-1, \infty) \setminus \{0\} \tag{4.8}$$

where: C_C is the Clayton Copula.

The Rotated Clayton copula has an upper tail dependence $\lambda_U = 2^{-\frac{1}{\alpha}}$ and $\lambda_L = 0$. By using these copulas, we are able to detect dependence in the tails.

In order to estimate copulas model, we are based on the Canonical maximum likelihood method. This method consists in transforming the data of claims amount $(x_1^t, ..., x_N^t)$ into uniform variates $(\overset{\wedge t}{u}_1, ..., \overset{\wedge t}{u}_N)$ using the empirical distribution functions, and then estimates the parameter in the following way:

$$\overset{\wedge}{\alpha} = \arg\max \sum_{t=1}^{T} \ln c(\overset{\wedge t}{u}_1, ..., \overset{\wedge t}{u}_N; \alpha) \tag{4.9}$$

The parameters of copulas are estimated by maximizing the log likelihood function of each copula, the procedure yields consistent and asymptotically normal estimates.

In the next section, we report empirical results obtained from using the models above.

5. Results

5.1 Modeling Solvency Capital Requirement with the Solvency 2 framework

Data were supplied by a Tunisian insurance company and consist of claims amounts of two lines of business Auto Damage and Auto Liability settled at a corresponding accident year and development year. These claims amounts are net of reinsurance, classified in so called run off triangle. Here, n = 8 accident years are available (from 2001 to 2008). The line Auto Damage corresponds to the damage of the car. It is a short line of business that once the claim is declared it will be paid after a short time.

The line Auto liability is defined as a legal obligation for anyone to repair the damage caused to others, it is called a slow development line of business, because there will be a time lag between the date of occurrence claim and the date of full refund.

In order to estimate the future claims amounts and the reserves, we begin by selecting the adequate parametric distribution for the data. We carried out a Kolmogorov-Smirnov goodness of fit test for the two lines of business. This test assesses the relationship between the empirical distribution and the estimated parametric distribution. A large p-value indicates a non significant difference between the two. We tested three distributions: Poisson, Log normal and Gamma, that belong to the exponential family, and have been extensively studied for incremental claims amounts in the loss reserving literature, see (England and Verrall 1999).

Table 1- Kolmogorov-Smirnov test

	POISSON	LOG NORMAL	GAMMA
p-value Auto Damage	$1.37\ 10^{-5}$	0.04	0.1
p-value Auto Liability	$1.51\ \ 10^{-5}$	0.03	0.21

As can be seen from Table 1, the p-value of the Kolmogorov-Smirnov test indicates that the Gamma model is the better fit for the data. Claims amounts of the two lines of business follow approximately the Gamma distribution. This is consistent with actuarial research. In fact, this distribution is well known in actuarial modelling of claims distribution ((England and Verrall 1999) and (Mack 1991)).

For this data set two models are fitted the Stochastic Chain Ladder and the Generalized Linear Model. The data analysis is conducted in R program using functions BootChain-Ladder and glmReserve from package ChainLadder (see (Gesmann *et al.* 2014)). The estimated total reserves with their relative standard errors and coefficient of variations are listed in Table 2.

Table 2- Total reserves (*in thousands* TND), standard errors and coefficient of variations for the lines of business Auto Damage and Auto Liability

		AUTO DAMAGE	AUTO LIABILITY
Stochastic Chain Ladder	R	51.037	177.155
	se	11.237	50.569
	cv (%)	22.02	28.500
GLM Gamma	R	45.343	179.251
	se	10.286	48.460
	cv (%)	21.690	27

Although the solvency 2 framework requires the use of different actuarial techniques to evaluate the total reserves, one can conclude from results of Table 2 that the reserve estimates for each lines of business with Stochastic Chain Ladder and GLM Gamma are quite comparable, with some small differences. Looking for the Auto Damage, the GLM Gamma provides total reserves lower than the Stochastic Chain Ladder and inversely for the Auto Liability. It provides a total amount of reserves slightly more than Stochastic Chain Ladder model. Auto Liability is considered as a slow development line of business, so GLM Gamma estimates a prudent amount of reserve.

For the measure of uncertainty of reserve, standard errors and the coefficient of variations of GLM Gamma are lower than Stochastic Chain Ladder, so GLM model is considerably more robust, and can estimate the accurate reserves for the claims. We retain this model to evaluate Value at Risk and SCR.

In order to evaluate Value at Risk of reserves, we need to determine the whole distribution for the total reserves. For that we use the bootstrap approach. In the *Appendix A* we present the algorithm of the bootstrap process. Having the distributions of total reserves, Value at risk is calculated by applying the empirical VaR (quantile) at a confidence level 99.5%, and best estimate (BE) is calculated as the mean of the total reserves.

Table 3- $VaR_{99.5\%}$ (*in thousands* TND) for the Auto Damage and Auto Liability

	VaR $_{99.5\%}$ Auto Damage	$VaR_{99.5\%}$ of Auto Liabiliy
2001	0	0
2002	1.604	1.997
2003	2.286	3.550

	VaR $_{99.5\%}$ Auto Damage	VaR$_{99.5\%}$ of Auto Liabiliy
2004	3.836	7.061
2005	11.205	28.002
2006	14.215	37.655
2007	24.146	103.715
2008	65.168	292.528
TOTAL	**122.464**	**474.510**
Aggregate	87.447	383.869

Table 4- SCR Standard Model versus SCR Internal Model (*in thousand* TND)

	SCR STANDARD MODEL	SCR INTERNAL MODEL
Auto Damage	10.198	36.457
Auto Liability	65. 051	203.171
SCR T otal	75.249	239.629
SCR Aggregate	69.506	61.510

It is noticed from the results of Table 3 that the VaR$_{99.5\%}$ increases remarkably over the accident years. As these recent years are more uncertain, they require a high level of reserves.

Moreover, the VaR$_{99.5\%}$ of aggregate reserves is always less than the sum of VaR$_{99.5\%}$ of each accident year. That means, it should more capital to cover independently each risk, than to cover the aggregate risk. In this configuration, the diversification between accident years has a significant influence on the calculation of reserves which leads to improve the solvency and the efficiency in the insurance company. So VaR$_{99.5\%}$ of aggregate reserves was used to evaluate the SCR.

From Table 4, we remark that the aggregate SCR evaluated with the standard or internal model is always lower than that in total. Specifically, for the internal model the difference is outstanding, the diversification is more remarkable than in the standard model. Thus the diversification between lines of business in insurance reduces the overall risk and provides a solvency capital which takes into account the compensation between risks. This can be explained by the fact, that the internal model is based on a quantification of internal and proper risks of the company, unlike the standard model that uses statistics established by the EIOPA (see Appendix B and (Commission, 2010)).

Finally, it appears that the evaluation of the SCR with the internal model seems to be the most interesting; it calculates a coverage capital in adequacy with the proper risks of the company, ensuring both solvency for the insured and the economy for equities.

5.2 Modeling Solvency Capital Requirement with the Copula approach

As mentioned in section 2 the aggregation of risks in the Solvency 2 approach is done using the correlation coefficient. However, the dependence is in general non linear and the risks are non-Gaussian. So, we introduced in our paper the copulas function to model the dependence between the Auto Damage and Auto Liability. In order to estimate the parameter of dependence α

, we fit the claims amounts relative to the two lines of business by maximizing the log likelihood of each copula function. (All estimates of copulas functions were made using the copula toolbox provided by Andrew Patton (University of Oxford-Department of economics)) and some functions created by authors on MATLAB7. We present here the results obtained from these models.

Table 5- Loglikelihood, parameter estimates, information criteria and Kendall's process test

COPULA	LL	α	AIC	BIC	λ_U	λ_L	P-value
GUMBEL	2.02	1.35	-3.98	-3.94	0.33	0	0.038
FRANK	4.78	3.37	-9.49	-9.45	0	0	0.21
CLAYTON	8.56	1.32	-17.07	-17.03	0	0.59	0.27
ROTATED GUMBEL	6.7	1.62	-13.34	-13.3	0	0.46	0.017
ROTATED CLAYTON	0.96	0.42	-1.86	-1.81	0.19	0	0.01

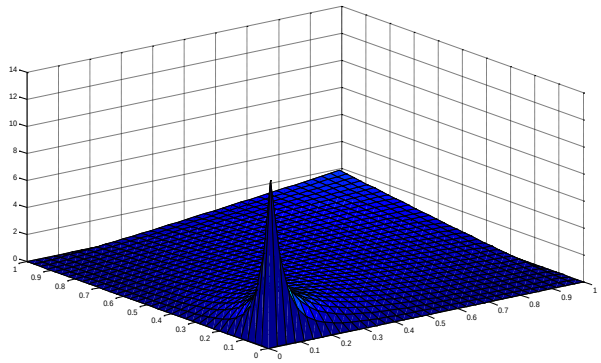

Figure 1- Density of the Clayton Copula α = 1.32

It is noticed from the results of Table 5 that the Clayton copula is the more adequate for modeling dependence of the two lines of business Auto Damage and Auto Liability. This copula presents the maximum log-likelihood and the minimum information criteria AIC and BIC. It captures a positive association, α = 1.32. This can be interpreted as, when the claims amounts of the line of business Auto Damage are high (respectively low), those of the line of business Auto Liability have more risk to be high (respectively low).

As can be seen, results of tails dependence of the Clayton copula show that both insured risk are independent in the up level of claims amounts distribution and dependent on the lower level of the latter. In other words, in car accident, there is a non null probability to have a risk in the line Auto Liability knowing that already has a risk in the line Auto Damage. Thus, the Clayton copula is the best candidate to model dependence between the two triangles of claims.

In Addition, to validate our choice we proceeded to implement a goodness of fit test of copulas: the Kendall's process test (for more details about this test see (Genest *et al.* 2009).

We remark that this copula presents the highest p-value of the Kendall's process test. So it is more appropriate to describe the structure of dependence of the two lines of business. Consequently, we retain this copula to assess the solvency capital. In order to evaluate the SCR of the internal model, we carried out a simulation method in two cases: dependent case and independent case (see *Appendix C*).

5.3 Impact of dependence on the internal model of Solvency 2 framework

In this section, we analyze the impact of dependence on the evaluation of reserves and SCR. A striking illustration of the impact of dependence on the total reserves can be seen in Figure 2 and Figure 3.

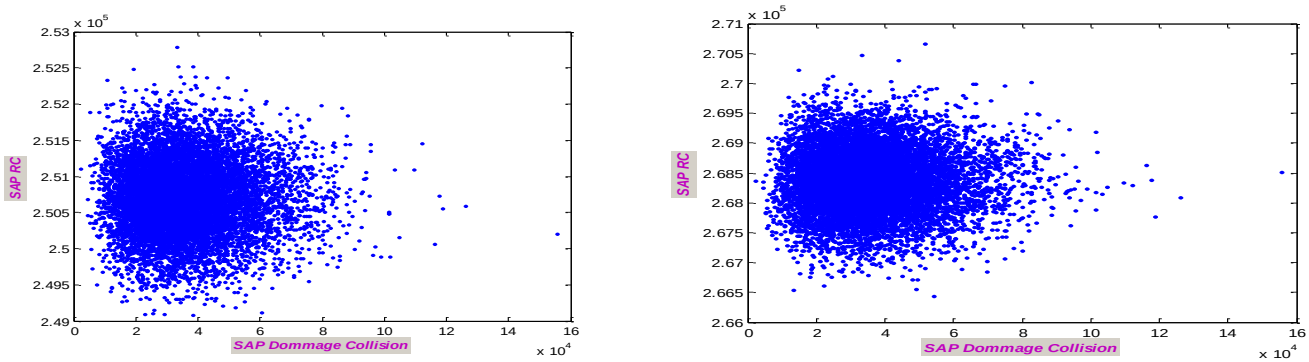

Figure 2- Scatter plots of the total reserves in independent case (*in the left*) versus dependent case (*in the right*)

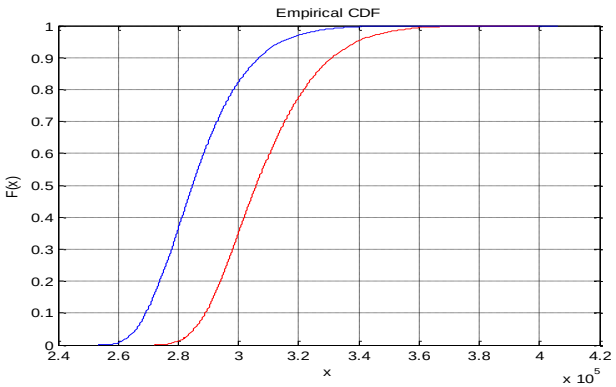

Figure 3- Distribution functions of the total reserves independent case (*in blue*) versus dependent case (*in red*)

Comparing the two plots of Figure 2, it shows that the scatter plot of the total reserves evaluated in dependent case is considerably more extended than reserves of the independent case.

Also, Figure 3 displays that distribution function of total reserves in dependent case is below that corresponding to the independent case. Indeed, for a given level of probability, taking into account the dependence leads us to put amount of reserve higher than when we assume independence between lines of business.

Afterwards, we present numerical results of modelling SCR with internal model, results are summarized in Table 6.

Table 6: VaR $_{99.5\%}$ Standards errors, Coefficients of variation and SCR in dependent case *vs* independent case

	Dependent case	Independent case
VaR $_{99.5\%}$	360.970	335.710
se	13.824	15.095
cv%	4.5	6.7
SCR	136.375	111.115
Deviation/ Independent	22 .7%	

From Table 6, we note that the $VaR_{99.5\%}$ in the dependent case (model with the Clayton copula) is higher than the independent model; this is explained by the fact that taking into account the dependence between the two lines of business leads to estimate a prudent level of reserve. But, we remark that the standard error of the dependent case is significantly lower than in the independent case that gives a more precision for the prediction of reserves.

Moreover, as we can see, the solvency capital computed in the dependent case is much higher than what was estimated in the independent case. In fact, a car accident can affect the line Auto Damage as well as the line Auto Liability, as it causes a material damage, and it can frequently cause physical injuries related to the civil responsibility. In addition, the deviation between independent and dependant SCR is of 22.7%. So the assumption of independence between lines of business will underestimate the amount of total reserves and thus can generate a risk of error in estimating the SCR of 22.7%.

Furthermore, in order to highlight the phenomenon of dependence, we compare results of Table 6 with Table 4. We can show that the SCR of the internal model evaluated with the copula approach is significantly higher than that assessed with the internal model of Solvency 2 as well as the aggregate SCR evaluated with the standard model. We can say that the estimate of this dependence is qualified as additional information that has in December 31, 2008 for the eight future years in order to immobilize an accurate solvency capital.

6. Discussion

Our study is within the scope of future solvency 2 framework. Indeed, the Solvency Capital Requirement is evaluated based on models proposed by the EIOPA. However actuarial studies in literature used risk measures (VaR, TVaR) at different thresholds.

(Cadoux and Loizeau 2004) used a portfolio of monthly data; they modelled the dependencies of intra lines of business using the Gumbel and Frank copulas that respectively model in intensive and symmetrical dependence. They relied on a khi-deu test to select the best copula. Nevertheless, this test requires a division into classes, which reduces its power. They showed that the Value at Risk increases of 33% to 41% from the VaR in the independence case. These results are consistent with our study which the deviation is about 22.7%.

(Krauth 2007) showed that the effect of dependence between lines of business occurs only at the extreme quantiles. This study shares a common assumption with us since, she modelled the distributions of lines of business using Gamma distribution and fitted the claims amounts with two models Chain Ladder and GLM. Her results are similar to us.

(Antonin and Benjamin 2001) detected a positive dependence and retained the Correlated Frailty Copula, which models a strong dependence in the upper tail, conversely, to our finding that our lines of business display lower tail dependence. This difference is due to the characteristics of lines of business that represent in intensive dependence between the high claims amounts. Also, they have criticized the copula model which tends to impose the same copula for each cell of triangle. Therefore, they proposed a model that combines the credibility theory and the copula approach, which was not possible in our study, since the model requires additional information for each line of business.

An alternative approach is presented by (Shi and Frees 2011), where a copula regression model was used to model the dependence between two lines of business. Their study exhibits a negative association between a personal and a commercial auto lines. They showed that if two subportfolios are negatively associated, one expects to see a predictive distribution that is tighter than the product copula (independence case). Contrary to our study that exhibit a positive dependence and the predictive distribution (estimated in the dependence case) spreads out more than in the independence case.

Conclusion

Control of risk has become a major issue in insurance where the risks are more dangerous and more concentrated. Previous research studied reserves and capital based on the independence assumption between lines of business. However, claims prove that they are dependent. It is within

the framework of assessing a solvency capital requirement including dependence structure that is the objective of our study.

We carried out an analysis of a non life portfolio consists of two lines of business Auto Damage and Auto Liability. We assessed the SCR by the two models proposed by Solvency 2 and we noticed that the aggregate SCR of the internal model is lower than the SCR in total, and this is due to diversification effect and compensation between risks. This result illustrates a potential benefits for in insurance company since, it reduces the cost of capital. An important implication of this observation is that the insurer might consider expanding the Auto Damage or shrinking the Auto Liability to take best advantage of the diversification effect. Thus, we retained the internal model that provides a capital an adequacy of the proper risks of the company. The main contribution in this paper is to improve the internal model chosen. As innovative; we propose to introduce the copula approach in the internal model. The analysis between the two lines of business revealed a structure of dependence at the lower tail distribution described by the Clayton copula. The evaluation of the SCR showed that taking into account the dependence increases the solvency capital as well as the precision on reserves (minimum standard error). So our study provides a model to assess the accurate reserve and SCR for the insurance companies that are adapted to the characteristic of lines of business and suggest that evaluating SCR with the copula approach is more appropriate.

This study is a first step of modeling dependence between two lines of business. Future work should therefore include several lines of business. Also, an important question is to determine the dependence between claims of the one run off triangle. Finally, and after assessing the SCR, it is interesting to conduct an adequate allocation of the latter to evaluate the performance of each line of business.

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Appendix A

Here, we present Bootstrap process applied to the two lines of business:

First, we fit the data and estimate the best estimate of claims amounts $\hat{\mu}_{i,j}$ of the run-of triangle using GLM Gamma.

Second, we calculate the residuals off triangle as follows: $\frac{y_{i,j} - \hat{\mu}_{i,j}}{\sqrt{V(\hat{\mu}_{i,j})}}$.

Third, we resample residuals 10000 times. A bootstrap data sample is then created by inverting the formula for the residuals using the resampled residuals, together with the fitted best estimate of claims amounts: $y_{i,j} = \hat{r}_{i,j} \times \sqrt{V(\hat{\mu}_{i,j})} + \hat{\mu}_{i,j}$.

Having obtained the bootstrap sample, here 10000 run off triangles, the GLM Gamma model is refitted and we calculate reserves of accident years, and the total reserves for each triangle. Finally we obtain the distributions of Ri for each accident years and the whole distribution of the total reserves. (See Figure 4 for the distribution of total reserves of the two lines of business)

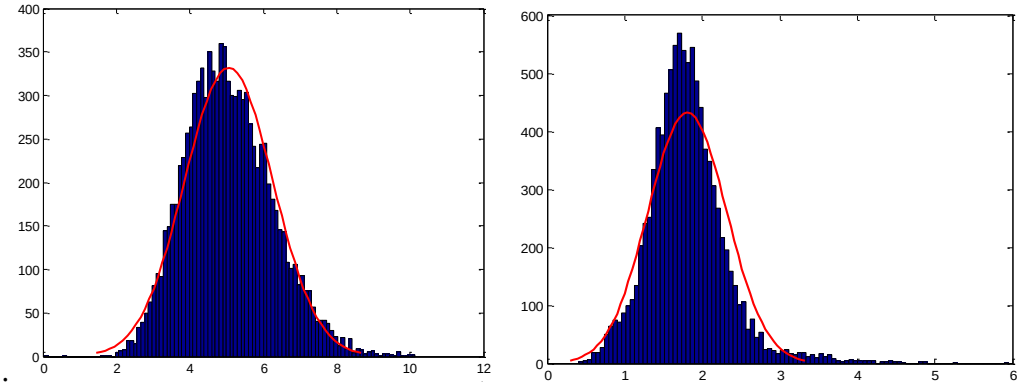

Figure 4- Total reserves distributions of the lines of business Auto Damage (*in the left*) and Auto Liability (*in the right*)

APPENDIX B

Table 7- Standard deviations of the lines of business Auto Damage and Auto Liability fixed by the EIOPA

Lines of Business	σ
Auto Damage	7%
Auto Liability	12%

Appendix C

Dependent Case

To simulate the joint distribution via the subjacent copula (in our case the Clayton copula) and obtain estimates for the $VaR_{99.5\%}$,we used the conditional sampling method as follows: generate two independent uniform random vectors, u and v. Let the conditional distribution of v given u be:

$$C(v \mid u) = p = \frac{\partial C(u,v)}{\partial u} = v^{-\alpha-1}(u^{-\alpha} + v^{-\alpha} - 1)^{\frac{-1-\alpha}{\alpha}}$$

Solve the above expression to obtain v, a function of the conditional probability *P* and u, so: $v = \left[\frac{u^{-\alpha} - 1}{p^{\frac{-\alpha}{\alpha+1}} - 1} \right]^{\frac{-1}{\alpha}}$

Transform the uniform random vectors (u,v) into the vectors $(y_{i,j}^1, y_{i,j}^2)$, using the inverse Gamma function, $y_{i,j}^1 = F_1^{-1}(u)$ and $y_{i,j}^2 = F_2^{-1}(v)$, where F_1 and F_2 are the estimated marginal distributions of the Auto Damage and Auto Liability.

The total future claims amounts, $y_{i,j}^{total} = y_{i,j}^1 + y_{i,j}^2$ and the total amount of reserve, $R_{dep} = \sum_{i+j \geq n} y_{i,j}^{total}$.

By repeating these steps 10000 times, we obtain the distribution of the total reserves on which the $VaR_{0.995\%}$, se and the BE (which is the mean of the total reserves) are calculated.

Independent Case

Generate two independent uniform random vectors, u and v.

Transform the uniform random vectors (u,v) into the vectors $(y_{i,j}^1, y_{i,j}^2)$, using the inverse Gamma function, $y_{i,j}^1 = F_1^{-1}(u)$ and $y_{i,j}^2 = F_2^{-1}(v)$.

The total future claims amounts, $y_{i,j}^{total} = y_{i,j}^1 + y_{i,j}^2$ and the total amount of reserve, $R_{indep} = \sum_{i+j \geq n} y_{i,j}^{total}$.

Like in the dependent case, we repeated these steps 10000 times to obtain the distribution of the total reserves on which the SCR of the internal model is calculated.

MODELLING VOLATILITY: EVIDENCE FROM THE BUCHAREST STOCK EXCHANGE*

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Abstract:

Financial series tend to be characterized by volatility and this characteristic affects both financial series of developed markets and emerging markets. Because of the emerging markets have provided major investment opportunities in last decades their volatility has been widely investigated in the literature. The most popular volatility models are the Autoregressive Conditional Heteroscedastic (ARCH) or Generalized Autoregressive Conditional Heteroscedastic (GARCH) models. This paper aims to investigate the volatility of Bucharest Stock Exchange, BET index as an emerging capital market and compare forecasting power for volatility of this index during 2000-2014. To do this, this paper use GARCH, TARCH, EGARCH and PARCH models against Generalized Error distribution. We estimate these models then we compare the forecasting power of these GARCH type models in sample period. The results show that the EGARCH is the best model by means of forecasting performance.

Keywords: stock returns; volatility; GARCH models; emerging markets.

JEL classification: C13, C32 C51, C52, G17

1. Introduction

The conditional variance of financial time series is important for measuring risk and volatility of these series. Conditional distributions of high-frequency returns of financial data have excess of kurtosis, negative skewness, and volatility pooling and leverage effects. Volatility of stock exchange indices and forecasting of their volatility have enormously increasing literature for both investors and academicians. The prices of financial securities have constant inconsistency and their returns over the various periods of time are notably volatile and complicated to forecast. The modelling volatility started with the Autoregressive Conditional Heteroskedasticity (ARCH) model, introduced by (Engle, 1982) and generalized by (Bollerslev, 1986) in GARCH model. Although ARCH and GARCH models capture volatility clustering and leptokurtosis, they fail to model the leverage effect. After these two papers, various types of GARCH models were proposed to solve this problem such as the Exponential GARCH (EGARCH) model , the Threshold GARCH (TARCH) model and the Power ARCH (PARCH) model.

Aim of this paper is to investigate the volatility and of Bucharest Stock Exchange, namely Bucharest Exchange Trading Index (BET) as an emerging capital market for the last decade. Also we aim to compare forecasting power of GARCH-type models to find the relevant GARCH-type model for BET. We investigate the forecasting performance of GARCH, EGARCH, TARCH and PARCH models together with the Generalized Error Distribution (GED).

Bucharest Exchange Trading Index (BET) is a capitalization weighted index which was developed with a base value of 1000 as of September 22, 1997. BET is the first index developed by the BSE and comprised of the most liquid 10 stocks listed on the Bucharest Stock Exchange BSE tier 1. Currently, the Bucharest Stock Exchange calculates and publishes a few indices: BET, BET-C, BET-FI, ROTX, BEX-XT, BET-NG, RASDAQ-C, RAQ-I, RAQ-II. BET. (Pele *et al.*, 2013; Bloomberg, 2013)

Investigating volatility of returns of stock markets and comparing forecasting accuracy of returns of stock markets have achieved attractiveness all over the world. Because of aim of the paper we focused on paper about European and emerging stock markets.

* This paper is adopted the paper which is entitled as "*Modelling Volatility: Evidence from the Bucharest Stock Exchange*" that was presented in *The International Conference on Economic Sciences and Business Administration (ICESBA 2014)*, 24 October 2014, Bucharest, Romania

(Emerson *et al.*, 1997), (Shields, 1997), and (Scheicher, 1999) investigates Polish stock returns. (Scheicher, 2001) (Syriopoulos, 2007) and (Haroutounian and Price, 2010) analyze the emerging markets in Central and Eastern Europe. (Vošvrda and Žıkeš, 2004) is another research about the Czech, Hungarian and Polish stock markets. (Rockinger and Urga, 2012) make a model for transition economies and established economies. (Ugurlu *et al.*, 2012) and (Thalassinos *et al.* 2013) investigate the forecasting performance of GARCH-type model to European Emerging Economies and Turkey and Czech Republic stock exchange respectively.

This paper is organized as follows. Section 2 describes the volatility models which are used in this paper. Section 3 shows empirical application results. Section 4 contains summary of the paper and some concluding remarks.

2. Method

In this section we review the GARCH-type models which are used in the empirical application section of this paper.

Engle (1982) developed Autoregressive Conditional Heteroscedastic (ARCH) model. ARCH models based on the variance of the error term at time t depends on the realized values of the squared error terms in previous time periods. The model is specified as:

$$y_t = u_t \tag{2.1}$$

$$u_t \sim N(0,) \tag{2.2}$$

$$\sigma_t^2 = \alpha_0 + \sum_{t=1}^{q} \alpha_j u_{t-i}^2 \tag{2.3}$$

This model is referred to as ARCH(q), where q refers to the order of the lagged squared returns included in the model. (Bollerslev, 1986) and (Taylor, 1986) proposed the GARCH(p,q) random process. The process allows the conditional variance of variable to be dependent upon previous lags; first lag of the squared residual from the mean equation and present news about the volatility from the previous period which is as follows:

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i u_{t-i}^2 + \sum_{j=1}^{q} \beta_i \sigma_{t-i}^2 \tag{2.4}$$

All parameters in variance equation must be positive and $\sum_{i=1}^{q} \alpha_i + \sum_{i=1}^{p} \beta_i$ is expected to be less than one but it is close to 1. If the sum of the coefficients equals to 1 it is called an Integrated GARCH (IGARCH) process.

(Nelson, 1991) proposed the Exponential GARCH (EGARCH) model as follows:

$$\ln(\sigma_t^2) = \omega + \sum_{t=1}^{p} \left(\alpha_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \gamma_i \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right) + \sum_{j=1}^{q} \beta_i \ln(\sigma_{t-i}^2) \tag{2.5}$$

In the equation γ_i represent leverage effects which accounts for the asymmetry of the model. While the basic GARCH model requires the restrictions the EGARCH model allows unrestricted estimation of the variance. If $\gamma_i < 0$ it indicates presence of leverage effect which means that leverage effect bad news increases volatility.

Threshold GARCH (TARCH) model was developed by (Zakoian, 1994). In TARCH model the leverage effect is expressed in a quadratic form as follows:

$$\sigma_t^2 = \omega + \sum_{j=1}^{p} \alpha_i u_{t-i}^2 + \sum_{k=1}^{r} \gamma_k u_{t-k}^2 I_{t-k}^- + \sum_{i=1}^{q} \beta_j \sigma_{t-j}^2 \tag{2.6}$$

$$\textit{where: } I_{t-k}^- = \begin{cases} 1 & u_{t-i} < 0 \\ 0 & u_{t-i} = 0 \end{cases}$$

The effect of the $u_{t-i} > 0$ represents the good news and $u_{t-i} < 0$ represents the bad news have different outcomes on the conditional variance. The impact of the news is asymmetric and the leverage effects exist when $\gamma_k \neq 0$.

The power-ARCH (PARCH) specification proposed by (Ding *et al.*, 1993) generalises the transformation of the error term in the models as follows:

$$\sigma_t^{\delta} = \omega + \sum_{j=1}^{p} \alpha_i (|u_{t-i}| - \gamma_i u_{t-i})^{\delta} + \sum_{i=1}^{q} \beta_j \sigma_{t-j}^{\delta} \quad (2.7)$$

where: δ is power parameter, γ_i is an optional threshold parameter

3. Empirical Application

We use daily data in stock exchanges of BET Index for the period 1/5/2004-6/10/2014 thus we have 2607 observations. Data collected from Reuters. We use return series as follows:

$$return = \log\left(\frac{BET_t}{BET_{t-1}}\right) \quad (3.1)$$

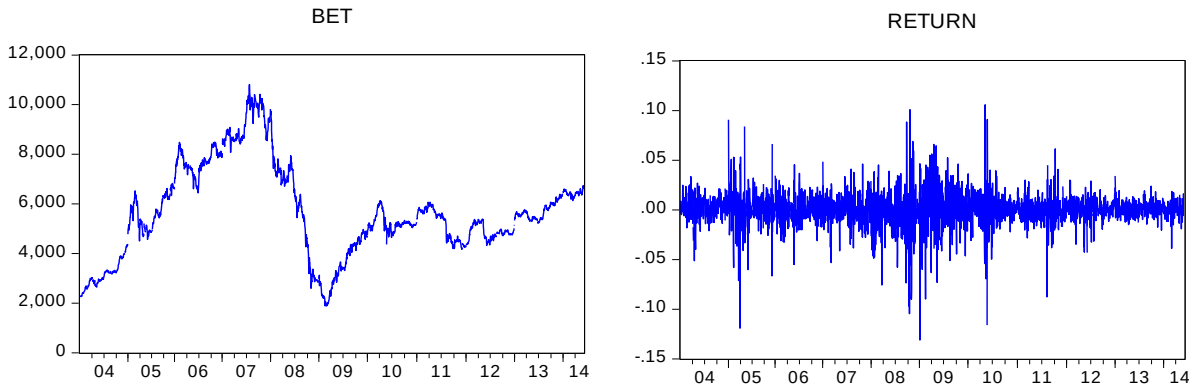

Figure 1: Graph of BET and Return Series of BET Source: Author Calculation

Table 1: Descriptive Statistics

	Return
Mean	0.000416
Median	0.000647
Maximum	0.105645
Minimum	-0.131168
Std. Dev.	0.017425
Skewness	-0.544454
Kurtosis	10.690960
Jarque-Bera	6551.549000
Probability	0.000000
Observations	**2,606**

Source: Author Calculation

Table 1 summarizes descriptive statistics of return series. Because the skewness of the variable is negative and kurtosis is higher than 3, the descriptive statistics indicate that the return of BET has negative skewness and high positive kurtosis. These values signify that the distributions of the series have a long left tail and leptokurtic. Jarque-Bera (JB) statistics reject the null hypothesis of normal distribution at the 1% level of significance for the variable.

Before the variance of the series is to estimate the mean model of the mean equation should be estimated. To estimate the mean equation we find the exact ARIMA(p,d,q) model. In the model; p is the number of autoregressive terms, d is the number of differencing operators, and q is the number of lagged forecast errors in the prediction equation.

Before the model is chosen unit root test must be used to see d part of the model. Table 2 shows unit root tests results of the variable. ADF and DF-GLS tests results conclude that return is stationary then d part of the model is "0" then ARMA(p,q) model must be used instead of ARIMA(p,d,q).

Table 2: Unit Root Test Results of Return

	Intercept	Trend and Intercept
ADF	-47.0073(0)***	-47.0239(0)***
DF-GLS	-46.66605(0)***	-46.84999(0)***
PP	-47.08005 (12) ***	-47.08553(12) ***

Notes: The figures in square brackets show the lag length by SIC for ADF and Bartlett Kernel for PP test. *, ** and *** indicate statistical significance at the 10, 5 and 1% levels, respectively

Source: Author Calculation

The correlogram of the return series shows no systematic pattern according to autocorrelation function (ACF), and partial autocorrelation function (PACF) (See: *Appendix*). We set the maximum lag ARMA(2,2) in order to estimate mean equation and consider (1,1), (1,2), (2,1) and (2,2) as specifications for choosing the best model. Existence of ARCH effect in these mean models is tested by ARCH-LM test. If the value of the ARCH LM test statistic is greater than the critical value from the χ^2 distribution, the null hypothesis of there is no ARCH effect is rejected. After the ARMA(p,q) model is defined as a mean part of the series we will estimate the GARCH-type models. We set the maximum lag order in the GARCH-type part to 2 and consider (1,1), (1,2), (2,1) and (2,2) too as used in ARMA part. To compare ARMA(p,p) models and GARCH-type models, we use the Akaike Information Criterion (AIC) (Akaike, 1973), Schwarz Information Criterion (SIC) (Schwarz, 1978), Hannan-Quinn Criterion (HQC) (Hannan and Quinn, 1979), log-likelihood and R squared. The model which has smaller AIC, BIC and HQC value and the greater R squared and loglikelihood value is the better the model.

Table 3: Estimation results of the ARMA Models

COEFFICIENT	ARMA (1,1)	ARMA (1,2)	ARMA (2,1)	ARMA (2,2)
intercept	0.000417	0.000417	0.000412	0.000414
AR(1)	0.014048	-0.40397	0.500484	-0.36794***
AR(2)	-	-	-0.05005	-0.68256***
MA(1)	0.06824	0.486967	-	0.43619***
MA (2)		0.04123	-	0.716625***
R^2	0.00673	0.006829	0.006969	**0.009398**

COEFFICIENT	ARMA (1,1)	ARMA (1,2)	ARMA (2,1)	ARMA (2,2)
AIC	-5.2663	-5.26563	-5.26547	**-5.26715**
SIC	-5.25954	-5.25662	-5.25646	**-5.25589**
HQC	-5.26385	-5.26236	-5.26221	**-5.26307**
Loglikelihood	6862.349	6862.478	6859.645	**6862.833**
ARCH (1)	302.4293***	304.0687***	300.4242***	297.6099***
ARCH(5)	361.9099***	363.0508***	359.8138***	357.2484***

Notes: The bold fonts show the selected criteria.

*, ** and *** indicate statistical significance at the 10, 5 and 1% levels, respectively

Source: Author Calculation

Table 3 shows the results of ARMA(p,q) models. All criteria indicate that the ARMA(2,2) is the best model, also only this model has significant coefficients. In the second step, we estimate a set of GARCH-type processes with a generalized error distribution using GARCH, EGARCH, TARCH and PARCH models with ARMA(2,2) process in mean equation.

Table 4 shows the results of the GARCH-type models. Before interpretation of the models significance conditions for estimated parameters must be held. In this step we aim to choose best model, for this reasons we are not going to examine these conditions and only the results of criteria is going to compare. The best model for AIC and HQC is TARCH(2,2). SIC concluded that the ARCH(2,2) model is the best. PARCH (1,1) and PARCH(2,2) was selected from R squared and Loglikelihood criterion respectively. Although TARCH(2,2) model was selected by two criteria, according to the five criteria none of model has strong dominance to other.

The GARCH-type models can be compared by their forecasting performance by using forecasting error criteria. In this paper we compare estimated variance for all models for 1/03/2014-6/10/2014 in sample period using static forecast. We select the period to show 2014 year's data. Four criteria are used to evaluate the forecast accuracy for the sample namely, Mean Square Error (MSE) and Mean Absolute Error (MAE):

$$MSE_1 = n^{-1}\sum_{t=1}^{n}(\sigma_t^2 - \hat{\sigma}_t^2)^2 \quad (3.2)$$

$$MSE_2 = n^{-1}\sum_{t=1}^{n}(\sigma_t - \hat{\sigma}_t)^2 \quad (3.3)$$

$$MAE_1 = n^{-1}\sum_{t=1}^{n}|\sigma_t^2 - \hat{\sigma}_t^2|^2 \quad (3.4)$$

$$MAE_2 = n^{-1}\sum_{t=1}^{n}|\sigma_t - \hat{\sigma}_t|^2 \quad (3.5)$$

where: n is the number of forecasts, σ_t^2 is the actual volatility and $\hat{\sigma}_t^2$ is the volatility forecast at day t.

Coefficient	GARCH (1,1)	GARCH (1,2)	GARCH (2,1)	GARCH (2,2)	EGARCH (1,1)	EGARCH (1,2)	EGARCH (2,1)	EGARCH (2,2)
ω	5.74 x10^{-6}***	7.15 x10^{-6}***	2.83 x10^{-6}***	1.27 x10^{-6}***	-0.6169***	-0.6795***	-0.4672***	-0.3190***
α1	0.180984***	0.2352***	0.3075***	0.3024***	0.3491***	0.4249***	0.4788***	0.4883***
α2			-0.2130***	-0.2577***			-0.2091***	-0.2816***
γ1					-0.0365**	-0.0500**	-0.0439	-0.0488
γ2							0.0176	0.0304
β1	0.813674***	0.2668***	0.9002***	1.2654***	0.9583***	0.4127***	0.9693***	1.0315
β2		0.4889***		-0.3125****		0.5451***		-0.0506***
v	1.2520***	1.2610***	1.2703***	1.2776***	1.2679***	1.2854***	1.3118***	1.2789***
R^2	0.0077	0.0076	0.0076	0.0076	0.0079	0.0076	0.0076	0.0075
AIC	-5.7705	-5.7750	-5.7800	-5.7826	-5.7716	-5.7809	-5.7783	-5.7792
SIC	-5.7503	-5.7525	-5.7575	**-5.7578**	-5.7491	-5.7561	-5.7513	-5.7500
HQC	-5.7632	-5.7669	-5.7719	-5.7736	-5.7635	-5.7719	-5.7685	-5.7686
Logl.	7522.264	7529.0810	7535.5840	7539.9270	7524.6460	7537.7430	7535.3800	7537.5710
ARCH(5)	6.5621	3.1579	2.3140	1.7614	7.2362	3.3227	2.4836	3.5863
Coefficient	**TARCH (1,1)**	**TARCH (1,2)**	**TARCH (2,1)**	**TARCH (2,2)**	**PARCH (1,1)**	**PARCH (1,2)**	**PARCH (2,1)**	**PARCH (2,2)**
ω	6.73 x10^{-6}***	7.95 x10^{-6}***	2.99 x10^{-6}***	1.15 x10^{-6}**	8.93 x10^{-6}***	0.0001	2.84 x10^{-5}	3.61 x10^{-6}
α1	0.1601***	0.2102***	0.3008***	0.2877***	0.1944***	0.2476***	0.2996***	0.2856***
α2			-0.2092***	-0.2460			0.1010	0.1485**
γ1	0.0576*	0.0592	0.0098***	-0.0012***	0.0921**	0.0899*	-0.1974***	-0.2476***
γ2							0.1264	0.1734***
β1	0.8005***	0.2665**	0.8976***	1.2956***	0.8162***	0.2827**	0.9030***	1.3499***
β2		0.4809***		-0.3392***		0.4843***		-0.3862***
δ					1.4121***	1.3828***	1.4957***	1.7051***
v	1.2731***	1.27 x10^{-6}***	1.2704***	1.2867***	1.2589***	1.2680***	1.2753	1.2872***
R^2	0.0078	0.0078	0.0077	0.0078	**0.0079**	0.0078	0.0077	0.0078
AIC	-5.7697	-5.7751	-5.7794	**-5.7840**	-5.7719	-5.7767	-5.7799	-5.7836
SIC	-5.7471	-5.7503	-5.7546	-5.7569	-5.7471	-5.7497	-5.7506	-5.7521
HQC	-5.7615	-5.7661	-5.7704	**-5.7742**	-5.7629	-5.7669	-5.7693	-5.7722
Logl.	7522.0990	7530.1880	7535.7360	7542.7370	7526.0450	7533.2400	7538.4340	**7544.2610**
ARCH(5)	4.6202	2.5684	2.0927	1.4294	7.2958	3.5841	2.8717	2.3598

Notes: The bold fonts show the selected criteria. *, ** and *** indicate statistical significance at the 10, 5 and 1% levels, respectively. v shows GED parameter. If GED parameter equals two it means normal distribution if it is less than two it means leptokurtic distribution. δ is the power of the conditional standard deviation process.
Source: Author Calculation

Table 4: Estimation results of the GARCH Type Models

Table 5: Comparison Forecasting Performance of GARCH-type Models

CRITERION	GARCH (1,1)	GARCH (1,2)	GARCH (2,1)	GARCH (2,2)
MSE1	2.75348 x10^{-8}	2.64013 x10^{-8}	2.65268 x10^{-8}	2.68233 x10^{-8}
MSE2	4.70024 x10^{-5}	4.51454 x10^{-5}	4.46425 x10^{-5}	4.44975 x10^{-5}
MAE1	8.84287 x10^{-5}	8.67443 x10^{-5}	8.53613 x10^{-5}	8.50496 x10^{-5}
MAE2	0.005685322	0.00561891	0.005553817	0.005518952
CRITERION	**TARCH (1,1)**	**TARCH (1,2)**	**TARCH (2,1)**	**TARCH (2,2)**
MSE1	2.81852 x10^{-8}	2.66746 x10^{-8}	4.81601 x10^{-8}	2.66245 x10^{-8}
MSE2	4.84847 x10^{-5}	4.51144 x10^{-5}	4.51144 x10^{-5}	4.43071 x10^{-5}
MAE1	9.09225 x10^{-5}	8.60816 x10^{-5}	8.60816 x10^{-5}	8.47503 x10^{-5}
MAE2	0.005777002	0.005585907	0.005585907	0.005518374
CRITERION	**EGARCH (1,1)**	**EGARCH (1,2)**	**EGARCH (2,1)**	**EGARCH (2,2)**
MSE1	2.73202 x10^{-8}	2.51014 x10^{-8}	2.61637 x10^{-8}	2.60132 x10^{-8}
MSE2	4.62145 x10^{-5}	4.17345 x10^{-5}	4.34523 x10^{-5}	4.18254 x10^{-5}
MAE1	8.63471 x10^{-5}	8.0017 x10^{-5}	8.33985 x10^{-5}	8.10262 x10^{-5}
MAE2	0.005564041	0.00532046	0.005431897	0.005312196
CRITERION	**PARCH (1,1)**	**PARCH (1,2)**	**PARCH (2,1)**	**PARCH (2,2)**
MSE1	2.70041 x10^{-8}	2.5839 x10^{-8}	2.60592 x10^{-8}	2.66318 x10^{-8}
MSE2	4.62548 x10^{-5}	4.42667 x10^{-5}	4.35832 x10^{-5}	4.30049 x10^{-5}
MAE1	5.75549 x10^{-7}	8.43061 x10^{-5}	8.31733 x10^{-5}	8.24342 x10^{-5}
MAE2	0.00560942	0.005523667	0.005457809	0.00537086

Notes: The bold fonts show the selected criteria
Source: Author Calculation

Table 5 reports the forecasting performance of the GARCH, EGARCH, TARCH and PARCH models. The BET volatility forecasts obtained from EGARCH(1,2) model have the greatest forecasting accuracy under MSE1 and MSE2. EGARCH(2,2) and PARCH(1,1) have greatest forecast models for BET under MAE2 and MAE1 respectively. That is, EGARCH model is a better choice than the other models in terms of BET volatility forecasting.

As it stated above significance conditions for estimated parameters must be examined. The results of the selected model which is EGARCH(1,2) is below:

$$\ln(\sigma_t^2) = -0.6795 + 0.4249\left|\frac{\varepsilon_{t-i}}{\sigma_{t-i}}\right| - 0.0500\frac{\varepsilon_{t-i}}{\sigma_{t-i}} + 0.4127\ln(\sigma_{t-i}^2) + 0.5451\ln(\sigma_{t-i}^2)$$

Except the coefficient of leverage effect is significant in 5% level rest of the coefficients are statistically significant in 1% level (Table 4). The leverage effect is negative and significant means that leverage effect bad news increase volatility in Bucharest Stock Exchange Trading Index (BET).

Conclusion

The first aim of the paper is to estimate the volatility model of Bucharest Exchange Trading Index (BET) by using GARCH, EGARCH, TARCH and PARCH models. The second aim is to compare forecasting performance of the used GARCH-type models to find best model for return of the BET.

The empirical application was started with interpretation of descriptive statistics. The results show excess of kurtosis, negative skewness and normality of distribution of the return series. Before the GARCH-type models were selected the ARMA models estimated to modelling the mean of the series using several criteria.

It is found that ARMA(2,2) model is the best model for investigated variable. Based on the ARMA model GARCH-type models were estimated. We compared the forecasting performance of several GARCH-type models using GED distribution for the return of BET. We found that the EGARCH(1,2) model is the most promising for characterizing the behaviour of the return of BET. In other words EGARCH model is more useful than the other models which are used in this paper for Bucharest Exchange Trading Index returns. Also the EGARCH(1,2) model shows that Bucharest Exchange Trading Index has leverage effect.

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*** Bucharest Stock Exchange Trading Index, last modified October 1, 2014, http://www.bloomberg.com/quote/BET:IND

APPENDIX

Included observations: 2604

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.016	0.016	0.6755	0.411
		2	0.002	0.001	0.6815	0.711
		3	0.000	0.000	0.6817	0.877
		4	-0.008	-0.008	0.8414	0.933
		5	0.021	0.021	1.9812	0.852
		6	-0.009	-0.009	2.1811	0.902
		7	0.006	0.007	2.2905	0.942
		8	0.056	0.055	10.384	0.239
		9	0.025	0.024	12.070	0.209
		10	-0.007	-0.009	12.214	0.271
		11	0.058	0.059	21.077	0.033
		12	0.006	0.005	21.165	0.048
		13	0.025	0.023	22.792	0.044
		14	0.046	0.046	28.394	0.013
		15	0.039	0.040	32.474	0.006
		16	0.013	0.006	32.915	0.008
		17	0.029	0.028	35.068	0.006
		18	-0.016	-0.017	35.730	0.008
		19	0.053	0.047	43.064	0.001
		20	-0.009	-0.014	43.256	0.002
		21	0.012	0.011	43.610	0.003
		22	-0.024	-0.035	45.110	0.003
		23	0.017	0.013	45.835	0.003
		24	-0.017	-0.026	46.609	0.004
		25	0.009	0.004	46.823	0.005
		26	0.012	0.004	47.191	0.007
		27	0.008	0.002	47.344	0.009
		28	0.020	0.009	48.410	0.010
		29	0.052	0.052	55.484	0.002
		30	-0.010	-0.020	55.749	0.003
		31	0.012	0.012	56.132	0.004
		32	0.019	0.016	57.059	0.004
		33	-0.024	-0.023	58.535	0.004
		34	0.020	0.012	59.563	0.004

THE PERFORMANCE MEASUREMENT SYSTEM – POTENTIALS AND BARRIERS FOR ITS IMPLEMENTATION IN HEALTHCARE FACILITIES

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Abstract:

Balanced Scorecard (BSC) belongs to the most detailed prepared and the best known approaches to the performance measurement and management. The original idea behind the BSC was to define such parameters of the company performance which reflect the final performance better than hitherto preferred complex rentability values. Compared to the traditional system, which measures performances focused primarily on financial area, essence of BSC particularly is underpinning difficult quantifying of qualitative indicators (customer loyalty, employee loyalty, rate and reasons for turnover, employee satisfaction, etc.) and their connection to traditional financial indicators. Hereby is the basic condition of BSC method fulfilled, and it is its balance. The core of the system is the way and the content of the conception of the measures in a mutual balance and the causal bonds connected with the strategy formulation. The paper declares the partial results of the research realized in the Slovak Republic and focuses on the critical areas of the BSC implementation.

Keywords: Balanced Scorecard, BSC, performance indicators, strategic performance measurement system, strategic map, KPI.

JEL Classification:

1. Introduction

Balanced Scorecard (BSC) constitutes a strategic management measurement and communication tool, which allowing in an easy way to point out, how company is well on its way to achieving its strategic objectives. It represents a multidimensional system allowing the definition and implementation of the strategy at all organizational levels of the enterprise in order to maximize value creation (Marinič, 2008). BSC is based on the basic business management tasks and by the specified business strategy allows to achieve its vision, while it lays stress on key factors (Key Business Drivers) affecting the formation of the final value of the company through four basic perspectives: financial, customer, employee and internal business processes. The balance in the system is ensured by the balance of the implementation and evaluation strategies. With the correct design of indicators in response to the corporate strategy are earmarking the strategic priorities and through causal-consequence connections also the way to the strategy realization. The manuscript is based on the results of the first research focused on the BSC use in Slovakia from 2008 to 2010, whose aim was to systematize, to review and to evaluate the selected attributes of the BSC application in the context of the implementation process in the surveyed organizations, to identify problem areas of BSC implementation and propose possible solutions to address them (Gavurová, 2011, 2012; Šoltés – Gavurová, 2013, 2014a).

2. The research sample

Given the nature of the businesses engaged in guidance and counselling services and also businesses in information systems and information technology (IS/IT), was obtaining information on enterprises implementing BSC in Slovakia through corporate websites. Scanned were the most visited websites by number of unique visitors and by entering keywords related to the issue to specified companies implementing BSC in Slovakia. On this basis it was found 40 companies indicated with BSC implementation, of which only 20 actually implemented BSC. These companies were subsequently contacted. 16 respondents were interested in participating in research. In the research realization was used the combined method of contacting in the form of written, electronic and personal

interviewing. Part of the research was obtaining information - references about BSC users from businesses implementing BSC. We acquired a second research sample of companies with implemented BSC. The first research sample consisted of advisory and consulting companies as companies implementing the BSC system. In the sample are represented companies with a history from 3 to 19 years, and most are represented businesses that have 12 years since its establishment (37.5%). Thus the sample consists of companies established in the industry quite a long time. In greatest measure are represented micro enterprises with 62.5%, at a significantly lesser extent are small businesses with 25% and medium-sized enterprises with 12.5%. The second sample (BSC users) are represented businesses from 8 to 14 years from its establishment, with the highest proportion are represented companies established in the industry for 10 years (37.5%). Number of employees in the company says solely about medium and large enterprises. Five-year experiences with established BSC system has 38% of respondents, the same proportion of companies are represented with a period of use of the BSC system from 6 to 14 years (25%). 13% of respondents have BSC in the introduction stage, respectively in initial operation as a pilot run. The BSC system was the most commonly implemented in the field of trade and industry (71%) and in a lesser extent in the healthcare system (29%) (Gavurová, 2011) (Šoltés, Gavurová, 2013, 2014b).

In the context of research outcomes is purpose of the manuscript - critical areas analysis of the BSC system implementation.

3. Perspectives of Balanced Scorecard system

During the designing of the BSC is management attention scheduling in several areas - to business perspectives, which are equally important for the company and are supporting the achievement of the strategic objectives (Szabo et al. 2013). The financial perspective, customer, employee and internal business processes perspective are four traditional views of the company and its activities. BSC but also takes into account the interest groups participating in the any activities of the enterprise, for example shareholders and partners objectives, employees and customers requirements, management objectives, requirements for environmental protection and so on. BSC perspectives are causally related to each other, starting from the learning and growth perspective continuing with internal business processes perspective, then continuing with customer perspective and ending with the financial sector. Each perspective is for the next perspective driving force with what is developing so-called strategic trajectory: from the learning and growth perspective to the financial perspective. Each perspective have defined objectives derived from the vision and mission of the company and together connected by causal-consequence connections (Tkáčová – Bánociová, 2013; Bačík – Fedorko, 2013; Štefko *et al.* 2013; Užík – Šoltés, 2009). Their direction corresponds to the direction of causal connections between strategic perspectives. The objectives of individual perspectives have defined indicators and target values, with what is creating a strategically balanced system of measuring indicators - Balanced Scorecard.

4. Analysis of critical areas in Balanced Scorecard

Based on the literature study and implementation of research (Gavurová, 2012), we identified the following critical areas related so to support implementation of the strategy, as well as with performance measurement: metric, statics, interest groups, social aspects.

Metric

The most serious reserves are directed in the metric area, which with connection of objective financial measures with subjective measures of non-financial problems became a complex issue, requiring an individualized approach (Kaplan – Norton, 2006). The most common causes of system failure is poor, ambiguously or too complex defined indicators, its insufficient number which does not cover all necessary areas more. The problem is the redundancy of indicators that generate the amount of irrelevant data. As regards the definition of indicators, the BSC methodology does not clearly defined and it is a difficult task especially in customer, employee perspective and in the learning and growth perspective. Generally valid indicators does not exist, company have to find them and in determining process observe some certain rules, logical process, which means that their development necessarily precedes the determination of strategic objectives. Objective of BSC is not to create

indicators inset, but organization dedicated to the strategy through the BSC. The structure of the indicators represents a further aspect of BSC critical areas. Practice declares in system applications many dependent and uncontrollable indicators (external indicators). If the system BSC serve as a driving force for strategic process improvement, should include independent indicators and managers influenced (indicators of internal business processes). The structure of indicators should be declined in the context of the balancing indicators element. It is clear from its own title "Balanced Scorecard system" that the structure of the system is related to the balance. In the enterprise is necessary to establish indicators so that does not prevail financial over the non-financial and vice versa. Between verbal scale (soft) and numeric scale (hard) has to strike a balance. The balance have also be between the long-term (strategic) and short term (operational) indicators, internal and external, causal (performance) and delayed (result). In the companies often absent indicators underpinning the qualifications of employees, loyalty and their satisfaction level of motivation.

The determination of target and critical values

As part of the conception of metrics is also problematic to determine the target and critical values, because in the literature is no methodology for their determination. Target and critical values of parameters are the result of negotiation processes of the various interest groups, and significantly underestimates the use of statistical-mathematical models or industry standards and intercompany analysis. Prerequisite for the proper determination of target and critical values is the availability and quality of data. Partial problems in BSC metrics area are initiated also by the erroneous nature of the connection between the indicators, what results in incorrect identification of the driving forces. If at the same time lacks the quantitative relationship between non-financial and expected financial results that leads to BSC system failure. The issue of the connections between indicators should be examined in the context of the already mentioned balance of BSC indicators (Šoltés – Gavurová, 2013) and with absence of interaction of causal links, and thus the subsequent lack of feedback (Neumaierová, 2005).

Statics of BSC system

The BSC system can be considered as static because in one of the strategic map correlates values in the time stated (Norreklit, 2000). The strategy map represents simplified model of the real system, in which lacks making provision for time delaying, as well as changes in the external environment, leading to a substantial revision of existing, implemented strategies or to creation of the emergence strategy. Therefore, it is necessary to link the BSC to monitoring system of organizations external environment, in particular to competition. The BSC system is static also due to further lack, and it is unconnection of BSC to the strategic analysis process and strategy formulation. This has the effect that in the introduction of BSC system is the implementation strategy phase separated from the other phases of the strategic management and BSC system largely tends to orientation only to measuring and managing performance.

Stakeholders

The BSC system does not select importance of information arising from BSC indicators for owners on the one hand, and the managers on the other. The incorrect adjustment of BSC system generates a lot of information, which in an organization's management process or managers do not need. The importance of strategic maps in BSC is undeniable, however, their lack of incomplete consideration of relevant stakeholders such as suppliers, public authorities and so on.

Social aspects

The topic of an expert discussion and researches are largely technical aspects of the deployment and use of the BSC system. Mastering the BSC methodology represents 10-20% of the success and the implementation process and management of organizational change from 80 to 90% (Kwaliteit in Bedrijf, 1998), therefore, the BSC is considered as a technical management tool. We neglect the fact that the mere introduction of BSC can induce changes in the strategy, it is therefore necessary to focus on the critical social aspects such as organizational culture, leadership style, communication within the organization. From these critical areas schemes of BSC system implementation we can mention that the BSC system, despite its long development since 1990 and the

progressive development it has its weaknesses in the field of metric. Concerns not only the very system focus on a combination of numerical and verbal indicators into one coherent whole, but also structuring of verbal indicators, the cascading to lower levels, feedback aggregation and interpretation combined with the results of numerical indicators. Table 1 gives an overview of the critical areas of the BSC system and their impacts.

Table 1 The critical areas of implementation of BSC system

ASPECT	CRITICAL AREAS		IMPACT
The selection and design of indicators	The number of indicators	Excess of amount	The management congestion with irrelevant information.
		Insufficient amount	Focusing attention on what is measured, not underpinned other important areas of management.
	The balance of indicators	Financial - Non-financial	Unbalance system. Unreliable predictions of future results, distorted performance quantification, unreliable implementation of the strategy
		External - Internal	
		Cause - Effect	
		Strategic - Operational	
Connections between indicators	The absence of logical relations	Target values unfounded by mathematical-statistical models, the result of intuition, negotiation and consensus management.	Distorted quantification of performance, unreliable implementation of the strategy.
	The absence of methodology and historical data	Incorrect identification of causalities if they are not authenticated with historical data.	
	The absence of relations in different time periods strategic maps	No consideration of time delay results in single strategic maps is compared with the results of only one period.	Distorted quantification of performance, unreliable implementation of the strategy, no consideration of the system cyclicality.
Establishment of target and critical values	The structure and character of indicators	Too complex indicators in order to ensure system reliability.	Excess amount of indicators, the information is often irrelevant, unused and unnecessary for management.
		Transparent indicator preference - effort to increase motivation and more accurate interpretation of the results.	By preferring easily quantifiable indicators are absenting indicators and also actually relevant information for management.
	The enlargement process - cascading (roll-out).	Distribution of complex indicators on lower levels and back aggregation, of results.	Distorted quantification of performance, by excessive amount of indicators are disrupted relations of responsibility as well as problems with upwards aggregation of the results.

Source: own processing

5. Strategic maps in the Balanced Scorecad system

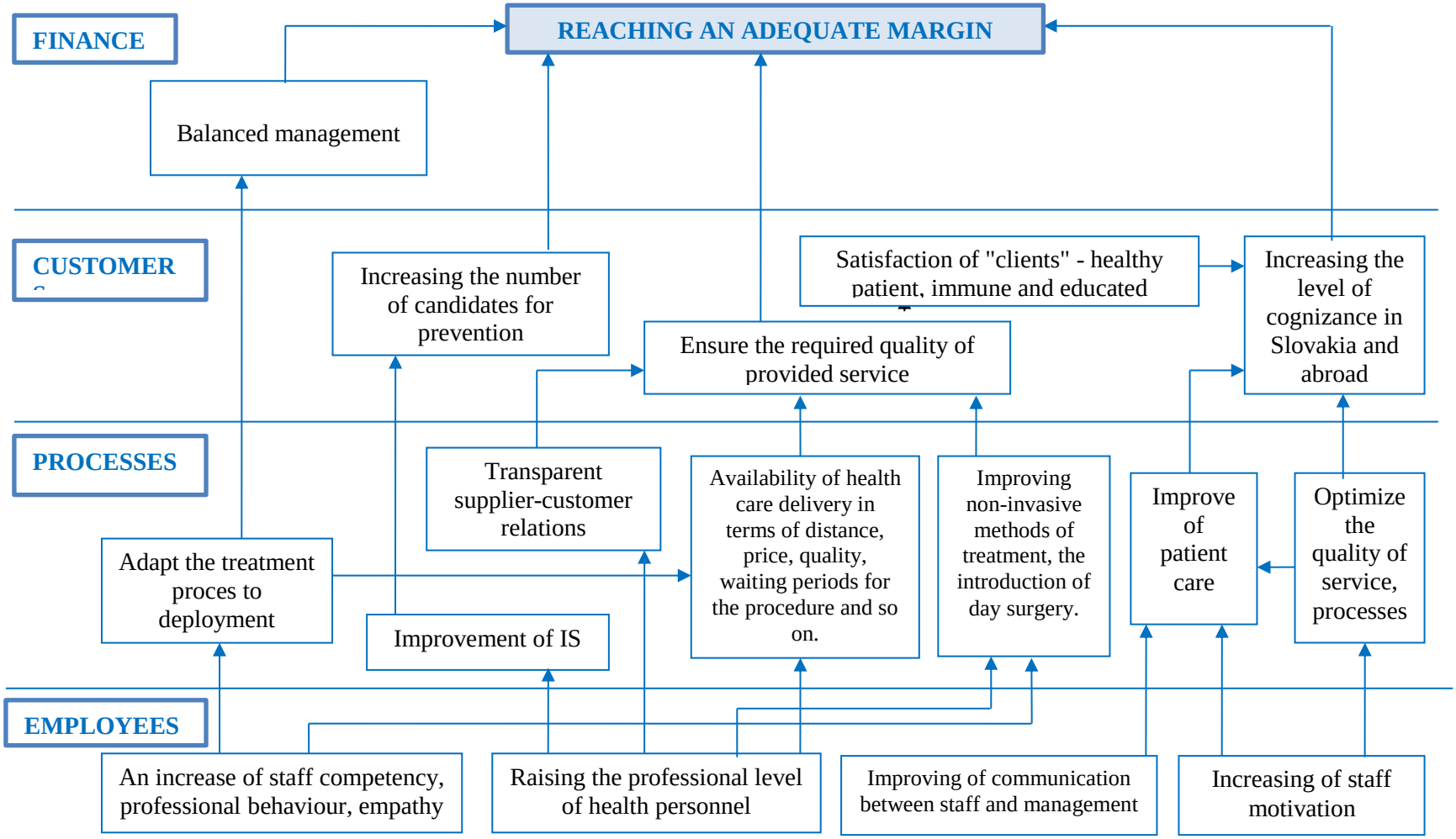
The strategy map (chains of cause and effect) contains various elements of the strategy and their interrelationships. Based on the knowledge of the links between the strategic objectives can be conceive different strategic scenarios. Elaboration and consecutive relationship documentation of cause and effect is one of the fundamental and at the same time the most difficult elements of the BSC. The benefit is particularly clear illustration of the connections and dependencies among strategic objectives and thereby is clarifying sided effects in achieving strategic objectives. The condition for knowledge contexts and relationships between strategic objectives is to understand the strategy, which are profiled strategic objectives with greater and lesser importance. In the BSC are captured only selected critical success factors, including those that allow on the market obtaining a particular position. In the analysed companies were the strategic maps elaborated largely at the level of the enterprise. The problem was particularly uncontrolled methodology in determining the chains of causes and effects between strategic objectives.

Among the best known methodologies belongs (Horvath & Partners, 2004):

- an application Enterprise Value Map (EVM);
- derivation cause and effect chains based on individual strategic objectives of learning and growth perspective;
- derivation cause and effect chains based on individual strategic objectives of financial perspective - deductive approach;
- derivation cause and effect chains based on individual strategic objectives of financial perspective - inductive approach;
- derivation cause and effect chains based on individual strategic objectives of customer perspective;
- application of cause and effect matrices illustrating connection between strategic objectives.

Managers of enterprises with implemented BSC system were required through the semi-structured interview and for introduction of any strategic objectives, as well as indicators to them, to each BSC perspectives. As the businesses strategic maps are confidential, the data obtained allow us to produce a draft of enterprises strategy maps, which are operating in various sectors. These strategic maps can be used in enterprises as a model, how to detect and present the relationships between the defined objectives (Šoltés – Gavurová, 2014a; Gavurová – Hyránek, 2013). Example of proposal strategic map of organizations providing healthcare provides Figure 1.

On the basis of the executed analyse in the context of the research, as well-studied professional resources, we recommend that appropriate support tools in the process of BSC strategic maps: AHP - Analytical Hierarchy Process to support the electoral process and defining objectives and MIC-MAC - structure analysis (Matrice d'Impacts Croisés Multiplication Appliqués à un Classement) to verify the reliability of the causal-consequential relations. Analytical Hierarchy Process – AHP is a technique that helps in structuring complex decision-making problems. It was developed by Thomas L. Saaty (Saaty, 1980) and is based on knowledge of mathematics and psychology. It provides a conceptual framework for the identification and quantification of key elements, linking them to the decision-making objectives and evaluation of the various options. AHP supports modelling of unstructured problems. The process is based on the decomposition of the decision problem from the top level (objectives at management level) through intermediate levels (criteria by which the next level are dependent), to the lowest level (represents a list of the options). Decomposition rationality of the decision problem consists in analysing of the problem in an increasingly smaller basic constituents and in guiding the decision maker through the confrontation of opinions (substantiated by data or judgments) to determine the impacts intensity of the individual elements in the hierarchy. Outcomes of the evaluation process have quantitative form. In the final phase of the process are derived priorities for each under consideration option in the form of a numeric expression that determines the relative ability of the possibilities to support the objective achievement.



Source: own processing

Figure 1 Strategic map of organization which is providing healthcare.

The strategy map and BSC system in the strategic management of the organization should ensure that the monitoring and evaluation process will be continuous and will also comply with signalling function. It has to be able to detect in sufficient time negative tendencies and thus allow realization of continuous correction processes to eliminate the failure risk to achieve the strategic objective. BSC principle is very simple and extremely useful if it is implemented and used correctly (Gavurová *et al*. 2014). BSC can be adapted to the specific industrial conditions. It can have more perspectives with different content focus (*e.g.* the health and safety perspective, environmental perspective, etc.). Diametrically opposed will be constructed strategic maps and indicators, which are depending on whether they are in private or public sector (schools, hospitals, contributory and non-profit organizations, etc.).

Based on the research results (Gavurová, 2011, 2012) were during designing of strategic maps profiled several problematic issues:

- Nonacquaintance of techniques and methodologies in their designing. Some relations of cause and effect cannot be quantified, the problem is mainly in non-financial area.
- Misunderstanding of the graphic representation of the cause and effect relations.
- Effort to analyse every conceivable relationship between the objective, which lead to aggregating all connections and ultimately to the formation of a complex and opaque matrices. These are not applicable for practical application, with a minimum explanatory value. In an effort to avoid unnecessary connections with insignificant character is displayed as a strategically important chain of causes and effects, with a high expressive ability, facilitating communication strategy.
- Effort to find algorithmic logic in the chain of causes and effects and suppression of intuition, experience. In result of not making provision for all the factors, which affect the strategic objective, it is not possible with change in a single target value clearly predict the change in the value of other objectives.
- The prevailing tendency to apply during examining the strategy established in the chain of causes and effects used to correlation analysis. BSC in chains of causes and effects does not consider all factors acting on the strategic objective; therefore it is not appropriate to apply correlation analysis because there are insufficient factors, due to the operating with unrealistic information.

In regards to the crucial importance of the strategic map conception in the BSC system is using only brainstorming techniques and mental models, as well as designing maps based solely on logical connections is insufficient. Application of appropriate strategic methods helps to better define the problem, awareness of more possible connections, variants of solutions, as well as verification of the suitability of their choice. Exaggerated "overload" with analytical methods used in the process of implementing the BSC may lead management in the wrong direction, on the contrary, insufficient or imperfect use of analytical methods can significantly impair the quality of the implemented BSC or BSC make "useless" for a further period of the business operation.

Conclusion

BSC allows communicating the vision and strategic objectives for all levels of the enterprise in the form of operational objectives. Employees are committed to the achievement of strategic objectives within their daily job descriptions, which often acts as a powerful motivational tool. On the other hand, by the operationalization of the strategy, as well as the precise definition of the indicators and their values BSC allows you to discover the hidden deficits in corporate activities and define important primary tasks. Expert implementation of the BSC spells out the powers and responsibility for the taken actions. This simple and transparent BSC structure leads to a reduction of duplication in management as well as in administration. BSC principle is very simple and extremely useful if it is implemented and used correctly. Exclusive of the positive feedback of added value of the implemented BSC for effective measurement and performance management in organizations were also reported negative experiences declaring lack of BSC benefits, dissatisfaction with the system and fail of expectations stemming from the opinion that the BSC is dysfunctional and unhelpful. Realized research declares critical areas of BSC system, by which can the BSC system does not bring desired effects. During implementing the BSC most organizations underestimate the need for communication and education; therefore it is necessary to bear in mind these two critical success factors. By applying

of suitably methods, tools and indicators, respecting weaknesses and finding ways of eliminating them will BSC system constantly improve and enable to managers to obtain the benefits of this powerful management tool.

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