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Florin Aliu
University for Business and Technology - UBT, florin.aliu@ubt-uni.net

Besnik Krasniqi
University of Prishtina, b.krasniqi@staffs.ac.uk

Emad Attia Mohamed Omran
Tomas Bata University in Zlin, omran@utb.cz

Amir Zylfiu
University of Prishtina, amir.zylfiu@gmail.com

International Risk Analysis Based on The Portfolio Diversification: The Case of Prague Stock Exchange

Florin Aliu[1], Besnik Krasniqi[2], Emad Attia Mohamed Omran[3] and Amir Zylfiu[4]

[1] Faculty of Economics, UBT – Higher Education Institution, Lagjja Kalabria, 10000 p.n., Pristina, Kosovo
[2] Faculty of Economics, University of Prishtina, Prishtina 10000, Republic of Kosovo
[3] Faculty of Management and Economics, Tomas Bata University, Zlín 760 01, Czech Republic
[4] Faculty of Economics, University of Prishtina, Prishtina 10000, Republic of Kosovo

Abstract. Stock exchanges are constantly prone to instability caused by asset bubbles. Risk level within the stock exchanges stands as the main concern for the financial investors. Stock prices are influenced by the choices completed on the domestic and international environment. The study intends to measure the risk level of the Prague Stock Exchange (PSE) from the internal risk perspectives. Portfolio diversification formula has been implemented to obtain the risk level of the PSE from 2000 till 2017. Stock prices and the trade volume of the listed companies in the PSE were collected from the Thomson Reuters Eikon database. PSE has been considered as a portfolio based on the number of listed companies on the respective years. The results confirm that financial investors in the PSE would be compensated for the risk exposure. Diversification risk and weighted average returns from 2000 till 2017 were almost moving identically. The results indicate that PSE was influenced from the last financial crises of 2008, confirmed from a decline in the weighted average returns and an increase in the diversification risk. The results of the study stand in line with the theoretical paradigms that increase in the number of stocks that reduces the `diversification risk of the portfolio.

Keywords: risk level, portfolio diversification, Prague Stock Exchange, financial crises.
JEL Classification: G110, G120

Introduction

Stock exchanges are considered the most sophisticated construction of the capitalist system. Stock prices reflect the fundamental environment of the national and international economy. The crisis of 1929-1933 and the financial downturn of 2008 proved that the stock exchanges are an excellent financial indicator that shows symptoms of the sick economy. However, stock exchanges in the countries with centrally managed economy were considered as the symbol of the capitalist system. The history of the PSE dates back in 1871 where it experienced the biggest achievement in the sugar trade, becoming a fundamental market for the entire Austro-Hungarian Empire (PSE, 2017). PSE is not the most important institutional money injector for covering business ideas and the daily economic activities of the Czech enterprises. Banks keep the major share within the Czech financial system for financing the economy (CNB, 2015).

The efficiency of the stock exchanges indicates the financial situation of the company and the ultimate prospect of the national economy. Stock exchanges that do not comprise national and international events, are considered weak efficient form. Fama (1968a; 1968b) confirms

that when stock exchanges are strong efficient form, stock prices adjust toward equilibrium (intrinsic value). Moreover, Fama (1998) shows that in the long run, no one can realize excess returns within efficient stock exchanges. However, the intrinsic value of the company indicates expectations for future cash flows (Damodaran, 2012). However, Prague Stock Exchange is characterized by low trade volume and a small number of the listed companies (PSE, 2017). The inefficiency level of the Eastern stock exchanges generates space for the abnormal returns. Dragotă and Tilica (2014) on their study indicate that excess returns can be realized within eastern European stock exchanges when proper financial instruments are used. The study by Pošta (2008) with the data from 1995 till 2007, confirm that PSE stand within weak efficient form. Moreover, a series of studies conducted in different time intervals confirm weak efficiency within PSE (Smith, 2012; Stoica and Diaconasu, 2011; Dritsaki, 2011). Lack of efficiency within PSE indicates that stock prices were characterized by information asymmetry. Aliu et al. (2019) via using diversification techniques confirms that Budapest Stock Exchange contains the lowest risk, followed from Polish Stock Exchange and Bratislava Stock Exchange.

Integration within stock exchanges creates indications for diversification benefits. Higher integration among stock exchanges diminishes diversification opportunities for financial investors and the other way around. Linne (1998) confirms that positive co-integration exists among central European stock exchanges while no integration with western stock exchanges. In contrast, MacDonald (2001) shows that there exist long-run co-movements within central European stock exchanges and western European stock exchanges.

PSE is less volatile than stock exchanges of developed countries although it comprises higher risk exposure. Information transmission within the PSE is weak to impact stock price movements in real-time. Moreover, inefficiency imposed on the PSE stocks is an additional uncertainty for the financial investors, that prices do not reflect the intrinsic value of the listed companies. Voronkova (2004) studied the long run affect within eastern stock exchanges (Poland, Czech Republic, Hungary) and western stock exchanges (France, Germany, UK), the study confirmed the long-run relationship while fewer diversification benefits for the international investors. In contrast, the study conducted by Serwa and Bohl (2003) on the shock market spread between western countries (France, Portugal, Spain, Germany, UK, Greece) and eastern European countries (Poland, Czech Republic, Hungary, Russia) confirmed weak evidence on cross-market linkages and extensive space for international diversification.

Besides the speed of reflection within stock exchanges, diversification benefits are additional concerns for the financial investors. To the best knowledge, no studies were focused on the risk exposure of the stock exchanges based on portfolio techniques. The study attempts to measure the risk level of PSE based on the portfolio diversification perspectives. The work distinguishes itself from the previous studies on the following features: 1. Generates historical outlook on the diversification risk of the PSE, from 2000 till 2017 2. Use diversification methods for measuring the risk level of the stock exchanges 3. Provides indications to the financial investors if they were compensated for the risk exposure within the PSE.

The rest of the paper is structured as follows. The first part contains an introduction and brief description of the risks related to the PSE and eastern stock exchanges. The second indicates a literature review concerning portfolio diversification. Used methodology stands in the third part. Interpretation of results and conclusions are presented in the fourth and fifth parts.

Literature Review

Standard investment theories confirm that concentrating financial investments in one place, expose investors to higher risk. Diverse financial assets contain different risk level where stocks are considered as the riskiest financial instruments. The history of the portfolio performance has

proved that constructing an optimal portfolio stands on the talent of financial investors. PSE has a small number of listed companies, which creates less space for portfolio optimization. Harry Markowitz (1952, 1959), fashioned the way risk-averse investors optimize their portfolios. Also, Markowitz's theory is built under the assumption of efficient markets, which is not a viable proposition for non-efficient stock exchanges.

Risk is mainly linked with uncertainties that investors have for future economic outcomes. Portfolio risk is measured through the standard deviation of returns. Diversification benefits are influenced by numerous aspects, such as correlation coefficient within asset classes, weights concentration and return volatility. In contrast, stock exchanges are constrained with the existing number of stocks that do not allow portfolio arrangement based on the different asset classes. Portfolio risk is vastly influenced by the correlation coefficients within financial securities (Behr at al. 2013; Drake and Fabozzi, 2010; Medo et al. 2009). Financial assets can be highly correlated in the short run, but in the long run can move in opposite directions. The portfolio is organized from a diverse set of financial securities where investors tend to find less correlated financial assets. Correlation coefficient measures short-run dependency within asset classes while the co-integration method captures the long-run effect. Mohamad et al. (2006) consider that a well-diversified portfolio, in the long run, tends to diminish the risk exposure. However, the risk of individual financial securities is calculated by a linear relationship within market returns and individual security returns, named as beta coefficients (Chen, 2003; Tofallis, 2008). Aliu and Knapkova (2017) indicate the portfolios of assets tend to be more corelated during the crisis's periods. Moreover, Aliu et al. (2017) show that crisis of 2008 hardly influenced portfolios built from the automotive companies situated in the Czech Republic.

The number of securities is an additional risk element that influence portfolio performance. The small number of financial assets is likely to increase the correlation coefficient and risk level of the portfolio (DeMiguel et al. 2013). Studies conducted by Domian et al. (2007) confirm that portfolios with 50 stocks eliminate the completely unsystematic risk of the portfolio. In contrast, the work completed by (Brands and Gallagher, 2005; Surz and Price, 2000) confirms that a portfolio with five to sixteen stocks can achieve diversification benefits.

Financial investors tend to minimize controlled risk (unsystematic risk) while they are highly exposed from the market shocks (systematic risk). Olibe et al. 2007 confirm that systematic risk is beyond the ability of the financial managers to control them. In contrast, the study by Khan (2011) considers that investing not only within the national borders but also in the international stock exchanges, tend to reduce systematic risk of the portfolio. However, the financial crisis of 2008 proved that world stock exchanges are highly integrated which creates less space for international diversification. Initial signals that the stock exchanges of Germany, Japan, and US are highly integrated, dates back to the crisis of 1987 (Dwyer and Hafer, 1988; Eun and Shim, 1989; Jeon and Von Furtsenberg, 1990; Bertero and Mayer, 1990). Moreover, this crisis confirmed that spreading financial investments worldwide does not reduce systematic risk.

The originality of our work is linked with the implementation of the portfolio risk methods to the stock exchanges. Moreover, it is the first effort on measuring the risk of the Prague Stock exchange with the diversification techniques. However, previous scholars were mainly focused on detecting macro and firm-specific factors that affect stock price movements within the PSE.

Methodology and Data

The study aims to measure the risk level of PSE based on the portfolio risk analysis. Risk has been measured on the yearly basis standing of the companies listed within the PSE. Data have been collected from the Thomson Reuters Database (Eikon, 2019). Stock prices and trade volume as two inputs used within the formula were collected daily from January 2000 till

December 2017. The risk of the PSE is influenced by factors such as variance, the standard deviation of returns, weights based on the trade volume and correlation coefficient. Higher risk on PSE is imposed by higher variance, higher standard deviation, higher positive correlation, and higher concentration level. The correlation coefficient is measured from the daily stock prices of the listed companies. Weights are measured by the trade volume that each listed company has within the PSE. Standard deviation and variance are captured from daily price movements. Each year number of correlations is different based on the number of companies operating within the PSE. The year 2000 has been used as a benchmark (base year) for comparing the risk level of the other years.

The Markowitz (1952) formula has been used to measure the risk level of the Prague Stock exchange on the yearly basis:

$$\begin{aligned}\sigma^2 = {} & (w_1^2 * \sigma_1^2) + (w_2^2 * \sigma_2^2) + (w_3^2 * \sigma_3^2) + (w_4^2 * \sigma_4^2) + (w_5^2 * \sigma_5^2) + (w_6^2 * \sigma_6^2) + (w_7^2 * \sigma_7^2) \\ & + (w_8^2 * \sigma_8^2) + (w_9^2 * \sigma_9^9) + (w_{10}^2 * \sigma_{10}^2) + 2w_1w_2 2\sigma_1\sigma_2\varphi(1,2) \\ & + 2w_1w_3 2\sigma_1\sigma_3\varphi(1,3 + 2w_1w_4 2\sigma_1\sigma_4\varphi(1,4) + 2w_1w_5 2\sigma_1\sigma_5\varphi(1,5) \\ & + 2w_1w_6 2\sigma_1\sigma_6\varphi(1,6 + 2w_1w_7 2\sigma_1\sigma_7\varphi(1,7) + 2w_1w_8 2\sigma_1\sigma_8\varphi(1,8) \\ & + 2w_1w_9 2\sigma_1\sigma_9\varphi(1,9) + 2w_1w_{10} 2\sigma_1\sigma_{10}\varphi(1,10) + 2w_2w_3 2\sigma_2\sigma_3\varphi(2,3) \\ & + 2w_2w_4 2\sigma_2\sigma_4\varphi(2,4) + 2w_3w_5 2\sigma_3\sigma_5\varphi(3,5) + 2w_3w_6 2\sigma_3\sigma_6\varphi(3,6) \\ & + 2w_3w_7 2\sigma_3\sigma_7\varphi(3,7) + 2w_3w_8 2\sigma_3\sigma_8\varphi(3,8) + \cdots \\ & + 2w_{12}w_{13} 2\sigma_{12}\sigma_{13}\varphi(12,13)\end{aligned}$$

Formula explanation*: structure of the mathematical formula is built from: correlation coefficient between stocks of each company listed within the PSE $\varphi(i,j)$, the weights of each company based on trading volume (w), standard deviation of returns (σ), variance of returns(σ^2).*

Generalized diversification risk formula stands as follows:

$$\sigma_k^2 = \sum_{i}^{nk} w_{ik}^2\, \sigma_{ik}^2 + 2\sum_{i}^{nk}\sum_{j<i}^{nk} w_{ik}w_{jk}\sigma_{jk}\rho_{ijk} \qquad (1)$$

Formula explanation: σ_k^2 of the portfolio in the year k is computed on the sample of n_k companies. Index i indicates a company, j is an auxiliary index assuring that covariance is computed on distinct companies, ω represents the weight of each listed company in the stock index within the portfolio based on their trade volume, ω^2 represents weight in square, σ^2-variance of returns (stock prices of individual listed companies in the PSE), σ stands for the standard deviation of returns (stock prices of the individual listed companies in the stock index) *while $\varphi(i,j)$ shows the correlation coefficient within returns (stock prices of the individual listed companies in the PSE).*

The mathematical formula was implemented from the following computer programs: Python 3.6.3 (version:0.21.0), Numpy (version:1.13.3), Jupiter Notebook (version:5.2.0). Generating the inputs of the risk level (σ^2) starts with splitting the tables that contain prices and trade volumes. The following matrix was used to generate the results:

$$U_{ij} = \begin{cases} a_{ij} & for\ i < j \\ 0 & for\ i \geq j \end{cases} \qquad (2)$$

Where a_{ij} represents combinations (correlation) between companies i and j.

Results

The risk of the PSE has been measured from the portfolio diversification formula. Numerous factors influence diversification risk of the Prague Stock Exchange, such as: correlation coefficient, concentration of trade volume, variance and standard deviation of returns. Table 1 shows the main inputs used for the measuring diversification risk of the PSE. The number of combinations in Table 1 represent the combinations within listed companies from 2000 till 2017. The maximum combinations have been realized between 2016 and 2017 (78 combinations). Besides, an increase in the number of combinations is linked with the number of listed companies. Diversification risk (σ^2) was moving in the same line with the volatility of returns. From 2000 till 2004 risk level was increasing since the correlation coefficient has been rising. Moreover, the number of companies listed on the PSE was quite small from 2000 till 2004 between 5 and 6 companies. Trade volume was concentrated in five companies and stock volatility was increasing at the same speed with the risk level. Based on Figure 5, the highest volume of trading from 2000 till 2004 has been realized by CEZ CP equity (40% of trade volume).

Table 1. Key inputs for measuring diversification (σ^2) of the PSE.

Years	Nr. Of Comb	Nr. Of Comp.	Avg. Correl	Risk level (σ^2)	STD (σ)	PSE (Weighted average returns)
2000	10	5	0.29	100	100	-0.14
2001	10	5	0.24	164	127%	-0.06
2002	15	6	0.38	414	160%	0.08
2003	15	6	0.54	379	209%	0.14
2004	15	6	0.41	771	229%	0.18
2005	21	7	0.40	611	192%	0.14
2006	28	8	0.35	397	182%	0.03
2007	28	8	0.13	148	107%	-0.33
2008	36	9	0.70	326	108%	-0.64
2009	36	9	0.72	108	86%	0.11
2010	45	9	0.14	18	74%	0.04
2011	45	10	0.36	70	69%	-0.10
2012	45	10	0.11	13	44%	0.05
2013	55	10	-0.01	29	47%	-0.01
2014	55	11	-0.02	3	33%	-0.01
2015	66	12	-0.03	-432	50%	0.01
2016	78	13	0.02	556	143%	-0.01
2017	78	13	0.50	757	91%	0.11

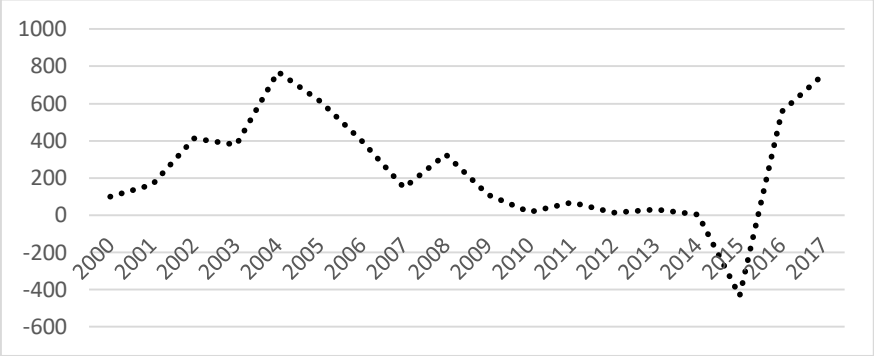
Source: Authors own calculation based on the Thomson Reuters Database.

Based on Figure 1, the decline in the diversification risk after 2004 is justified by more companies operating in the PSE. The concentration level was reduced after 2004 since more companies entered the PSE index. Average correlation coefficient within companies started to

decline and volatility of the PSE was reduced. Moreover, all these indicators made the diversification risk to decline after 2004.

Heights diversification benefits have been reached between 2010 and 2015. Figure 1 shows that risk increased faster after 2015, wherein the 2017 risk level was 7 times higher than the base year. During this period, stocks became more volatile, prices of the companies were highly correlated, and the trade volume was vastly concentrated. During 2016-2017 trade volume was concentrated mainly on the Moneta CP equity (60% of trade volume). The maximum risk level was reached in 2004 (7 times higher than the base year), while the minimum one in 2015 (4 times slower than the base year). The Figure 5 (in the appendix) shows the spread of correlation coefficients in the PSE (2000-2017). For 17 years has been realized 645 combinations (correlation coefficients). Besides, 445 combinations were positively ranged while 216 on the negatively ranged. It is quite clear that during this period PSE offered less space for diversification benefits. Moreover, most of the combinations were standing within Rij=0 and Rij=+1 which are not target investments for the financial investors.

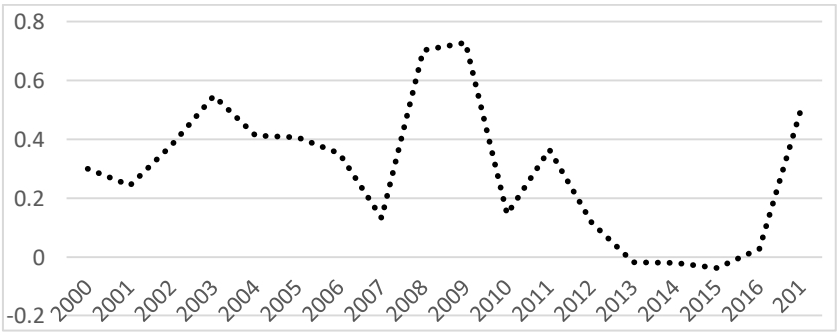
Figure 1. Diversification risk (σ^2) of the Prague Stock Exchange from 2000 till 2017



Source: Authors own elaboration based on the Thomson Reuters Database.

Figure 2 indicates an average correlation coefficient of the companies operating in the PSE from 2000 till 2017. The highest correlation coefficient is realized during the financial crisis of 2008-2009. Average correlation coefficient during the crisis period, was above Rij=+0.7. Prices of the listed companies during this period were completely correlated. Average correlation coefficient started to decline after 2009 and reached the minimum level in 2015 (Rij=-0.04).

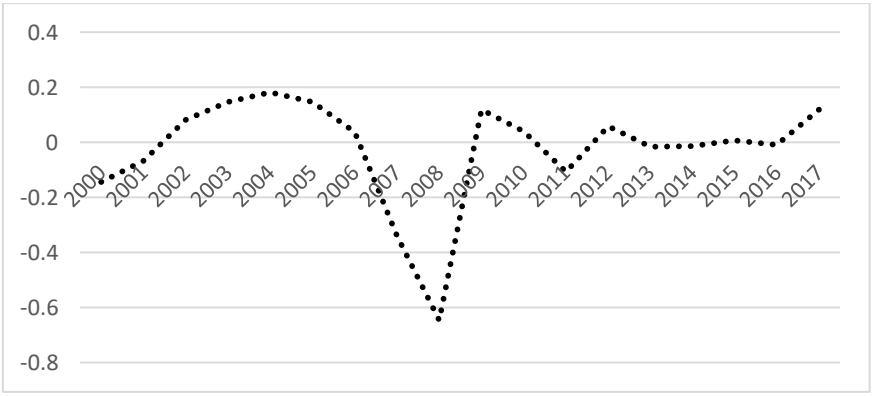
Figure 2. Average correlation coefficient based on the combinations of the companies listed in the PX index.



Source: Authors own elaboration based on the Thomson Reuters Database.

The financial crisis of 2008 which impacted the entire world financial and economic system had a huge influence on the PSE. Moreover, in 2009 was realized the highest average correlation coefficient (Rij=+0.72). The maximum diversification benefits stand between 2013 and 2015 where the average correlation coefficient was negative. The lowest diversification benefits from the correlation perspective stand from 2002 till 2009.
Figure 3 indicates the weighted average returns of the PSE index from 2000 to 2017. From 2000 till 2006 PSE realized positive performance while from 2007 till 2009 PSE experienced a huge downturn in the weighted average returns. The recovery started in 2009 while in 2011 PSE experienced another negative downturn that corresponds with the European debt crisis. Figure 3 confirms that the crisis of 2008-2009 hardly affected the performance of the companies in the PSE. The decline in the performance of the companies during 2008, justifies high positive correlation in this period. Moreover, Figure 2 and Figure 3 indicates that average correlation and weighted average returns were moving in the same direction during the crisis.

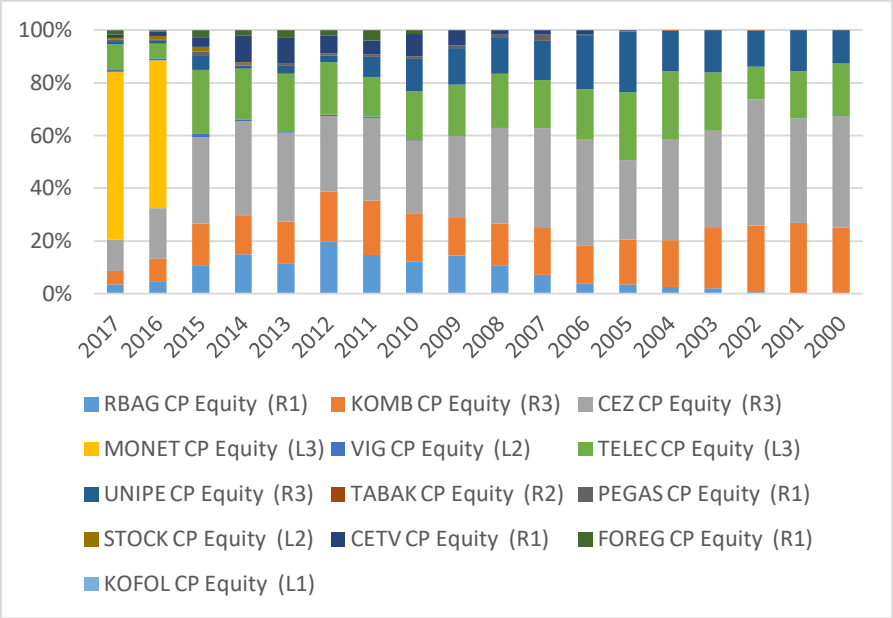
Figure **3**. Weighted average returns on the PSE based on stock price movements, from 2000 till 2017.



Source: Authors own elaboration based on the Thomson Reuters Database.

Figure 4 indicates the spread of the trade volume within the PX index from 2000 to 2017. Concentration of the trade volume is one of the inputs that increase or lowers the diversification risk of the PSE. The highest concentration from 2000 till 2007 is focused on the CEZ CP equity while during the 2016-2017 trade volume was focused on Moneta CP equity.

Figure 4. Weight concentration based on the trade volume of the companies listed on the PSE from 2000 till 2017.



Source: Authors own elaboration based on the Thomson Reuters Database.

Conclusion

The Prague Stock Exchange is an important element within the Czech financial system. PSE does not stand as a significant component of injecting business ideas and daily operations of the Czech economy. The study measured the risk level of PSE with the portfolio diversification methods. Listed companies in PSE experienced an enormous downturn during the 2008 financial crisis. Maximum weighted average returns occurred during 2004 and 2005 that corresponds with the period when the Czech Republic joined the European Union. Weighted average returns from 2000 till 2017 were positively related with the diversification risk of the PSE. Besides, increase in the diversification risk was compensated with higher weighted average returns and vice versa.

The diversification risk followed a diverse pattern among years within the PSE index. The maximum diversification risk occurred during 2004 and 2005 while the minimum one from 2010 till 2015. Moreover, the period from 2010 to 2015 was characterized by the highest diversification benefits and lowest average correlation. The crisis of 2008 increased diversification risk caused mainly from the incline of the positive correlation within listed companies. The correlation coefficient proved that the performance of the companies was affected identically during the 2008 crisis. The results show that the correlation coefficient and diversification risk increased during 2008 even though the concentration level was reduced. Moreover, the 2008 crisis indicates that even if you control unsystematic risk, is hard to manage systematic risks that are coming from the market shocks.

The number of companies listed on the PSE were rising from five in 2000 to thirteen in 2017. A higher number of the companies within the portfolio reduced the average correlation coefficient and weights concentration. The result of the work shows that an increasing number of stocks in the portfolio reduces the correlation coefficient. Results stand in line with

theoretical portfolio concepts that the size of the portfolio influence diversification risk. Moreover, the work provides indications for the financial investors on the diversification benefits within the PSE index, from 2000 till 2017. Moreover, allocating portfolios within the PSE index based on the existing concentration level would compensate financial investors for the risk exposure.

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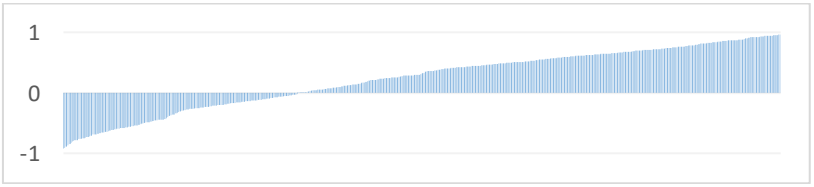
Appendix:

Figure 5. The spread correlation coefficients within companies listed in the PSE from 2000 till 2017.



Source: Authors own elaboration based on the Thomson Reuters Database.

CONTROL ACTIVITY AND MONITORING AS COSO FRAMEWORK ELEMENTS AND THEIR IMPACT ON THE PERFORMANCE OF ENTITY: CASE STUDY REPUBLIC OF KOSOVO.

Gresa Mjaku

UBT – Higher Education Institution, Lagjja Kalabria, 10000 p.n.,
Pristina, Kosovo

Abstract. This paper aims to investigate the impact of two elements of the COSO framework such as Control activity and Monitoring on the performance of Institutions of the Republic of Kosovo. Therefore, public institutions and audit agencies in our country need to work more than ever before to promote law enforcement, fight against corruption, honesty, the efficient use of public funds and the increase of government competencies and responsibilities in order to increase the performance of the entity. We employ primary data due to lack of data by secondary data from other relevant institutions. The data set includes a sample of 400 internal auditors, covering the entire auditory region in the Republic of Kosovo. An IV-GMM model is implemented to measure the impact of two determinants in the public sector together with their metering instruments. Since the reliability of the data is proven, we think that this research has presented the current state of the institutions of the Republic of Kosovo and determining the main factors of the progress of this system.
The results show that the control activity, including Comprehensive control activity, Equality in control activities and Duration of control have 56% impact on entity performance. Moreover, the results show that Monitoring as a 5th element of the COSO framework, including the self-assessment questionnaire and verification in the field as measurement instruments of monitoring, in the case of the Republic of Kosovo has an impact 41 % in performance enhancement in public entities.

Keywords: COSO framework, Internal Audit, Kosovo.

Introduction

The concept of internal control of public finances has been developed by the European Commission during the 1990s and is now used to run and support candidate countries in reforming their public management and control system. The concept is based on international standards of internal auditing in the public sector and the best practice of EU countries. For this, improvements in public finance management systems appear to be essential for the proper implementation of EU policies and sustainable achievement of development objectives. However, the study is based on responses by the sample set of primary data. While trying to make a general involvement and given that data reliability is proven, we think that this research has presented the current situation of the institutions of the Republic of Kosovo and determined the main factors of the progress of this system. Many authors have tried to explain the impact of the COSO framework elements, especially for the Control activity and Monitoring. In our