

Comovements of Financial Markets in the EU Countries

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This article examines comovements between stock and government bond markets in the EU countries. Previous authors mostly indicated significant highly volatile comovements between the markets. In addition, it was proven in several markets that in times of financial crisis the comovements between financial markets are becoming stronger and negative correlations appear indicating flight-to-quality from stocks to government bonds. Despite of that, there exists a tendency to analyze only financial markets of Eurozone countries leaving the rest of the EU members behind. The aim of this research was to fill this gap by providing insights of co-movements between stocks and government bond markets of all the EU countries together with recommendations for portfolio diversification.

The first stage of the research was implemented by using Pearson's correlation coefficient. Logarithmic returns on 52 market indices were used for calculations of correlation coefficients in the period of 1993–2012. The second stage of the research included the estimation of correlations in the period of 2008–2013, commonly referred to as financial crisis. In addition, statistical significance of coefficients was evaluated by testing Fisher's null hypothesis.

The results of the research show that majority of correlation coefficients between stock and government bond indices were rather small and not significant during the full sample period with the exception in financial markets of Greece, Hungary, Lithuania and Romania (weak-medium statistically significant correlations). The results indicate financial markets in the countries mentioned being more related than in the rest of the EU countries, not being suitable for diversification between asset classes. No significant negative correlation between market indices in 1993–2013 was recorded implying that in times of stock market fall government bond markets would not be the safe haven for investors. Analysis of comovements between stock and government bond markets of the EU countries in the period from 2008 resulted in increase of correlation coefficients in 19 of 25 EU countries analyzed indicating strengthened comovements in times of financial stress. Despite of that, most of these correlations were positive. This is not beneficial for investors as diversification effect might disappear when it's most needed. As exceptions should be mentioned Scandinavian countries where significant negative correlation coefficients obtained between stock and government bond indices indicate an existence of flight-to-quality. This could not be confirmed for the rest of the EU countries' markets.

The results of the research partly comply with the results of previous studies in the topic, mostly confirming the tendencies for biggest EU financial markets. The research can be further implemented towards different directions: inclusion of the US as the major financial market, concentration on the countries with strongest comovements and provision of detailed estimation of them; inclusion of corporate bond indices; choice of other method for estimation of comovements between financial markets of the EU countries. Finally, the analysis needs more focus on the investigation of the reasons for differences in the relationship between financial markets.

Keywords: financial markets, government bond indices, stock indices, financial crisis, European Union.

Introduction

Integration across different financial asset markets has gained much attention in academic literature. According to modern investment theory each investment is measured by its profitability and risk, and the possibilities of each investment being intercorrelated are analyzed in their interaction – portfolio (Rutkauskas & Stankeviciene, 2003). Recently some of the authors started questioning the separation between financial markets of different asset classes and offering models for explanation of the connections between them (Bekaert & Grenadier, 2001;

Kim *et al.*, 2006; Jang *et al.*, 2008). With globalization and free flow of capital, developed markets became highly integrated into the world market and correlations across different countries have increased (Brennan *et al.*, 2011). According to Gallali & Kilani (2010) these correlations play a determinant role in an international diversification strategy. For this reason, an accurate evaluation of this factor helps investors to form an optimal portfolio. Despite of that, there are still unsolved problematic questions. The fact that correlation between stocks and bonds has gained a vital role in portfolio allocation decisions made a timely determination of this correlation a question of high importance. (Rey,

2000) states that worldwide comovements of financial markets influence capital flows, investment and consumption decisions.

Multiple authors tried to answer this question (Li, 2002; Ilmanen, 2003; Kim *et al.*, 2006; Baur & Lucey, 2008; Yang *et al.*, 2009; Baele *et al.*, 2009) and came up with evaluation of comovements between different asset class indices in major financial markets. These evaluations were mainly made in order to enlighten the construction of optimum portfolio. As Valakevičius & Vaznelyte (2012) states, construction of optimal investment portfolio is very complicated task and an investor will always bear risks when involving stocks in his decision. This is not always thought to be valid for bonds. According to Levisauskaite (2010) even though from investor's point of view bonds or other fixed-income securities can be treated as a "safe" asset, in reality the safety of investment is strongly related with the default risk of an issuer. In the periods of financial turmoil, when the trust in governments decrease, the securities issued by governments from risk point of view become closer substitutes for stocks. As a result, understanding of comovements between stock and bond markets helps to improve markets' efficiency, elevate the information congregation process, accelerate capital allocation functions and increase resilience in times of financial stress. Finally, it also helps investors to diversify between two main asset classes and reduce overall risk. Even though this reduction is commonly implemented by diversifying portfolio between international financial markets, an alternative to that is a diversification between asset classes in the same country as being one of sustainable investment decisions. The sustainable investment decisions are the strategy that allows securing not less than market generated profitability, as well as invested capital value increase (Rutkauskas, Miecinskiene and Stasytyte, 2008).

It's widely thought that correlation between assets with different risk-return characteristics is not strong enough providing an opportunity to benefit from diversification between asset classes. This might be true during the whole business cycle, but previous researchers (Cappiello *et al.*, 2003; Scruggs and Glabadanidis, 2003; Andersson *et al.*, 2004; Baele *et al.*, 2009) found the relation between the assets being very unstable and changing in times of financial stress. The recent financial crisis together with the following European sovereign debt crisis revealed comovements between financial markets being much stronger than were expected to be. This might be seen as a threat for return on investments.

The novelty of this research comes from the fact that previous researches in stock and bond markets mostly covered the US and several other major countries (usually G7). None of the previous researchers analyzed comovements between stock and bond markets in all the European Union (EU) countries, so the amplitude of this research makes it important. Furthermore, there is a novelty in methodology: the research includes evaluation of comovements between stock and bond markets by using several different methods and periods.

The object of the research is stock and bond markets of the EU countries.

The aim of the research is to examine the comovements between stock and bond markets in the EU countries and to provide an insight about the benefits of diversification between asset classes during the whole economic cycle and in time of financial stress.

To reach the aim of the research the following objectives are raised:

1. To analyze and synthesize previous studies of stock and government bond markets and comovements between them;
2. To come up with methodology for investigation of comovements between stock and government bond markets in the EU countries;
3. To estimate comovements between stock and government bond markets of the EU countries;
4. To estimate comovements between stock and government bond markets of the EU countries in the period of financial crisis and compare them with comovements in full sample period;
5. To provide recommendations for diversification between asset classes in the EU countries.

For the implementation of this research 2 hypotheses were raised:

Hypothesis 1: The relationship between returns on main stock and government bond indices in financial markets of the EU countries is strong.

Hypothesis 2: The relationship between returns on main stock and government bond indices in financial markets of the EU countries became stronger in the period of financial crisis from 2008.

The methods and sources of the research include analysis and synthesis of scientific literature, mathematical and statistical functions: logarithmic returns, standard deviations, simple and rolling correlation coefficients, tests of Fisher's null hypothesis for statistical significance. The main sources used are *Thomson Reuter's*, *World Bank's* and *Federation of European Securities Exchange (FESE)* databases. Research covers 20 year period from 1993 to 2013. The paper is intended to be beneficial for investors when choosing regional diversification between the EU countries and between asset classes in the same EU country.

Literature Review

The correlation of stocks and bonds was firstly analyzed by Keim and Stambaugh (1986) who found a low positive correlation between stocks and bonds. Afterwards, a number of studies in this field have increased and the concentration of analysis from international diversification in stock markets was transferred to international stock and bond markets (Andersson, Krylova and Vahamaa, 2004; Baele, Bekaert and Inghbrecht, 2009; Baur, 2009). During the next decade researchers ascertained that stock and bond returns exhibit a modest positive correlation and tend to move to the same direction. Despite of that, recent studies documented sustained periods of negative correlation. Overall, it is commonly agreed that correlation between stock and bond returns exhibits significant time-variation (Fleming *et al.*, 1998; Gulko, 2002; Li, 2002; Cappiello *et al.*, 2003; Connolly *et al.*, 2005).

There is a big set of studies purposed for analyzing the economic forces influencing the changes in stock-bond correlations. Some of the most interesting results are obtained by Ilmanen (2003), who found that most of the systematic risk in the economy is in equities and government bonds hedge against tough times during recessions as well as in various financial market crises. This is consistent with a study of Yang *et al.*, (2009) who concluded that bonds are better hedge against stock market risk and offer more diversification benefits in the US than in the UK. The relationship between stocks and government bonds is nothing but stable: the correlation tends to be positive but occasionally dips below zero.

On the contrary to that, (Scruggs & Glabadanidis, 2003) found a conditional correlation since the mid-1960. Bond market variance increases in response to bond market return shocks and is almost unaffected by stock market return shocks.

(Similarly *et al.*, 2006) analyze flight-to-quality in stock and bond markets and find extreme changes with high fluctuations between returns on stocks and bonds varying significantly over the post-war period. Higher stock market volatility causes the correlations to decrease while higher bond market volatility increases them. This fact indicates existence of flight-to-quality. In the study implemented two years later Baur and Lucey (2008) also obtained a proof of flight-to-quality as common feature in a crisis. The flights mentioned can enlarge the stability and resiliency of the financial system: diversification gives its effects when it's most needed.

(D'Addona & Kind, 2006) calculate historical correlations between stocks and bonds with exponentially weighted moving average correlation (EWMA). Their results indicate that inflation shocks reduce the correlation between stocks and bonds and the higher variability of the dividend-yield boosts the variability of stock returns and reduces the correlation between stocks and bonds.

The novelty of approach can be found in a work of (Andersson *et al.*, 2004) who examine how expectations for inflation and economic growth together with stock market uncertainty affect correlation between stock and bond returns. The results indicate that high stock market uncertainty leads to decoupling between stock and bond prices. The focus on expectations rather than real economic ratios was later continued by (Yang *et al.*, 2009) who found bigger expectations for future inflation causing stronger comovements between stock and bond returns. This tendency is also valid for other macroeconomic factors, such as the real interest rate and unexpected inflation.

Cappiello *et al.*, (2008) document strong comovements in equity market volatility between different countries. Annualized average volatility series for equities show linkages during periods of financial stress, such as the stock market crash in 1987, the beginning of the Gulf War, and the Asian financial crisis. Bond market volatilities, differently, demonstrate less clear linkages, exhibiting, instead, increases to region-specific events. This is consistent with tendency, noticed by Maslov & Roehner, (2003). The authors find a strong connection between stocks and bonds during crash-rebound episodes: immediately after the crash investors sell their risky bonds,

and after the rebound they sell some of their safest bonds (usually government) to buy back the risky ones.

Kim *et al.*, (2006) continued a previous study of Connolly *et al.*, (2005) who found that the future stock-bond correlation at higher daily frequency decreases with increasing stock market uncertainty, concluding that this is influenced by the flight-to-quality phenomenon. The authors also found that stock-bond market integration moved to zero and even negative mean levels in most countries, consistently with flight-to-quality. In addition, volatility between markets has stabilizing effects and the introduction of European Monetary Union (EMU) caused an increased segmentation between stock and bond returns in European markets. The economic integration induced by the introduction of EMU and the reduction in currency risk has stimulated inter-financial market integration. It has a drawback: increasing monetary policy convergence might have created uncertain investor sentiments in international financial system.

(Baele *et al.*, 2009) in their wide study observe positive correlations between excess returns of stock and bond indices until the end of 1980's, and decreasing correlations afterwards. They also exclude that non-macro variables, especially stock and bond market illiquidity factors most likely explain these correlations. The results coincide with Baur's, (2009) who states that decline of stock-bond correlation in recent years is explainable by a more frequent portfolio rebalancing due to globalization and lower benefits from international diversification across similar markets. The results suggest that if investors act in a similar way across stock markets and across bond markets they also act in similar ways rebalancing their portfolios and change the weights for stocks and bonds. The findings coincide with some previous researches stating that a higher degree of comovements between the markets and globalization leads to increased correlations.

(Finally & Viitanen, 2011) indicates that all biggest economies except Italy and Spain, exhibited financial market stability under extreme market conditions and potentially systemic events as assessed by international stock-bond return relations. During extreme conditions in financial markets, correlations between stocks and bonds stay below/close to zero. The periods of extremely negative stock-bond correlations took place around the South American economic crisis in 2002, the financial crisis starting in 2007 and European sovereign debt crisis from April 2010. Overall, the negative relation between stocks and bonds implies that the bonds are excellent safe havens against major systematic risks.

The analysis and compilation of the results obtained in previous studies has revealed several important drawbacks. Firstly, most of the studies of comovements between different asset classes were implemented in the US or took into account only several European countries with no attention to smaller economies. According to Draksaitė (2013) changes in global markets directly influence the economy of small open countries and their sensitivity to the global economic changes is particularly high, so it is important to include these countries into consideration. Secondly, there wasn't enough unity in data and methods used by different authors. Thirdly, even though previous authors found that relationships between stock and bond

returns tend to decrease with the time, there is still a lack of investigation of how exactly these relationships change in times of crisis. With the on-going financial crisis and decreased confidence in government bond markets, it is crucial to investigate the comovements between stock and bond markets in all the EU countries.

Data Sample

The research is implemented by using stock and bond indices as these indices are considered to be statistical measures, representing the situation of financial assets markets and the changes inside them (Uzdanaviziute & Rudzakis, 2011). This research involves 27 EU countries with its own stock and government bond market indices, so there should be 54 market indices to analyze (Table 1).

Despite of that, Estonia's and Malta's government bond markets are not analyzed due to the fact that there are no bonds that could comply with the definition of long-term bonds issued for convergence purposes. As a result, government bond market indices are not calculated in these countries.

The choice of equity market indices was implemented in the following order: benchmark indices (price indices), serving as points of reference for evaluating market; blue chip indices (tending to perform similarly to the economy as a whole). Yet, for some countries the total return and/or broad market indices were used due to data limitations. The price chosen is adjusted close, as most commonly used performing analysis of historical returns.

Table 1

Stock and bond indices used in the research

| COUNTRY | STOCK INDEX | | BOND INDEX | | COUNTRY | STOCK INDEX | | BOND INDEX | |
|----------------|--------------|-----------------|------------------------|-----------------|----------------|-------------|-----------------|-------------------------|-----------------|
| | INDEX USED | DATA AVAILABLE | INDEX USED | DATA AVAILABLE | | INDEX USED | DATA AVAILABLE | INDEX USED | DATA AVAILABLE |
| Austria | ATX | FULL | OE BENCHMARK | Full | Latvia | OMXR | From 2000-01-01 | BOFA EMRG SOV LATVIA | From 2005-01-01 |
| Belgium | BEL-20 | FULL | BG BENCHMARK | Full | Lithuania | OMXV | From 2000-01-01 | BOFA EMRG SOV LITHUANIA | From 2005-01-01 |
| Bulgaria | BSE SOFIX | From 2000-10-01 | BOFA EMRG SOV BULGARIA | From 1996-01-01 | Luxembourg | LuxX | From 1999-01-01 | BARCLAYS AGGLX ISSUERS | From 2004-10-01 |
| Cyprus | TOTMKCP | FULL | CGBI WBIG CYPRUS SOV. | From 2002-04-01 | Malta | MSE | From 1995-01-01 | - | - |
| Czech Republic | PRAGUE SE PX | From 1994-04-01 | CZ BENCHMARK | From 2000-05-01 | Netherlands | AEX.AS | FULL | NL BENCHMARK | Full |
| Denmark | OMXC20 | FULL | DK BENCHMARK | Full | Poland | WIG | FULL | PO BENCHMARK | From 2001-01-01 |
| Estonia | OMXT | From 1996-06-01 | - | - | Portugal | PSI-20 | FULL | PT BENCHMARK | From 1993-08-01 |
| Finland | OMXH25 | FULL | FN BENCHMARK | Full | Romania | BET-10 | From 1997-09-01 | BOFA EMRG SOV ROMANIA | From 2001-08-01 |
| France | CAC40 | FULL | FR BENCHMARK | Full | Slovakia | SXSAX16 | From 1993-09-01 | BOFA ML SLOVAKIA GOV | From 2005-01-03 |
| Germany | DAX30 | FULL | BD BENCHMARK | Full | Slovenia | MSSLVNL | From 2000-06-01 | BOFA ML SLOVENIA GOV | From 2008-01-02 |
| Greece | GD.AT | FULL | GR BENCHMARK | From 1999-04-01 | Spain | IBEX35 | FULL | ES BENCHMARK | Full |
| Hungary | BUXINDX | FULL | HN BENCHMARK | From 1999-02-01 | Sweden | OMXS30 | FULL | SD BENCHMARK | Full |
| Ireland | ISEQ GENERAL | FULL | IR BENCHMARK | Full | United Kingdom | FTSE100 | FULL | UK BENCHMARK | Full |
| Italy | MIB40 | FULL | IT BENCHMARK | Full | | | | | |

Source: compiled by the authors based on Thomson Reuters and FESE data

The choice of bond market indices was implemented by choosing government bond indices. Value of corporate bonds is affected by company-related factors while price of government bonds depends on more global factors and represents the risk of the country itself. This is relevant when analyzing connections between different financial markets in the EU countries. In addition, government bonds used to represent a minimum risk for investors as being totally backed up by the confidence in state. Finally, in the context of financial crisis a flight-to-quality was commonly argued to be triggered, leading to intensified purchase of government bonds rather than investing in equity markets. Due to these reasons, the use of government bond market indices is seen as the most adequate way for evaluation of comovements between stock and bond markets. Price indices of government bonds are used in order to coincide with price indices of stocks used. The preferred maturity is 10 years: according to (Baur & Lucey, 2006), long term government bonds should be selected over short term government bonds because they can be considered as closer maturity substitutes to stocks and monetary policy operations are more likely to have an unclear influence on short-term rather than on long-term government bonds. The same opinion is held by (Kim *et al.*, 2006). (Li, 2002; Andersson *et al.*, 2004) and other authors use 10 year government

bond indices as the most appropriate for comparison with stocks. Due to that, mostly 10 year government bond market indices are used. If a country does not provide the data of 10 year maturity government bond indices, all maturity bond indices are used. The chosen currency for government bond market indices was euro with the exception for several countries with the prerogative to benchmark indices.

The chosen research period is 20 years from February 1993 to February 2013. This has been done in order to examine the situation during both relatively volatile and more stable periods. Despite of that, data for the whole period were not available for some countries. In addition, the research of comovements of stock and government bond markets is also implemented in shorter period: January 2008-February 2013. This is done for two main reasons. Firstly, from this date data of stock and government bond indices are available for every EU country. Secondly, the period from 2008 is considered as time of the crisis in financial markets. It's widely stated in the literature that relationship between stock and government bond markets tend to change its direction in times of financial crisis. For calculation of returns, a monthly frequency was chosen.

Finally, a fact of high significance is that even though clear criteria were set for the data to be chosen, it was not

possible to fulfill those criteria in all the markets analyzed and there appeared some limitations: not full data sample, difference in market indices used.

Research Methodology

As already mentioned, two hypotheses were raised in this research.

Hypothesis 1: Comovements between returns on main stock and government bond indices in financial markets of the EU countries are strong.

The hypothesis is accepted if more than 50 % of correlation coefficients indicate medium or strong relationship between the markets and these correlations are statistically significant at 0,05 level.

It was already stated that the dependence between stock and bond markets tends to change in times of financial stress. In order to check the fairness of this statement, the second hypothesis was formulated:

Hypothesis 2: Comovements between returns on main stock and government bond indices in the financial markets of the EU countries became stronger in the period of financial crisis from 2008.

The hypothesis is confirmed if correlations between stock and government bond markets increase in more than 50 % of the EU countries when reducing the calculation period to 2008–2013.

The research is implemented by using logarithmic returns on market indices for evaluation of comovements between the markets. The calculation of these returns is implemented by using the formula.

$$\text{Logarithmic Return} = \ln\left(\frac{P_{t+1}}{P_t}\right) \quad (1)$$

Where: P_{t+1} – the index value in month $t+1$
 P_t – the index value in month t

Logarithmic returns were calculated for both stock and government bond indices in all 27 countries and multiplied by 12 in order to receive annual basis.

As one of the simplest and most popular ways for estimation of comovements between two variables, Pearson correlation coefficient was chosen for this research. This measure of strength and direction of linear statistical relationship between two variables is influenced by the distribution of the independent variable in the sample and is defined as follows (2).

$$\rho_{xy} = \frac{\text{Cov}(x, y)}{S_x S_y} \quad (2)$$

Where: $\text{Cov}(x, y)$ – covariance between the log returns of indices;

S_x – standard deviation of log return on first index;

S_y – standard deviation of log return on second index.

If the correlation coefficient between two variables is equal to zero, these variables are statistically independent. On the contrary, a value close to 1 (-1) indicates very strong linear positive (negative) relationship between variables.

Calculation of correlations itself is not a sufficiently reliable measure of relationship between market indices. One of the most common measures of statistical

significance of empirical analysis is the test of *Fisher's null hypothesis*. The testing starts with the formulation of the null hypothesis to check:

$H_0: \rho_{xy} = 0$, - correlation is statistically insignificant;

$H_1: \rho_{xy} \neq 0$, - correlation is statistically significant, the variables are dependent.

In order to check the validity of the null hypothesis a level α of statistical significance was chosen to be 0,05. (*Type 1 error rate*).

H_0 is rejected if $p < \alpha$ and H_0 is accepted if $p \geq \alpha$.

The *p-value* is the probability of obtaining a test statistic at least as extreme as the one that was actually observed, assuming that the null hypothesis is true. If the *p-value* is less than the significance level, indicating that the observed result would be highly unlikely under the null hypothesis, the null hypothesis is rejected. This reflects the validity of H_1 and the fact that correlation is statistically significant.

The calculation of correlation coefficients between stock and bond indices is implemented towards these directions:

1. *Correlation coefficients between stock and government bond indices in the same EU country in 1993–2013;*

2. *Rolling window correlations between stock and government bond indices in the same EU country in 1993–2013.*

It should be analyzed whether it is reasonable to assume that those correlations are constant or time varying. For this purpose by using 3 formula moving averages of correlations are calculated:

$$\rho_T = \frac{\sum_{t=T-m}^{t=T-1} x_t y_t}{\sqrt{\sum_{t=T-m}^{t=T-1} x_t^2 \sum_{t=T-m}^{t=T-1} y_t^2}} \quad (3)$$

Where: x_t and y_t - return series of the stock and bond indices;

m - length of the window used. Due to the practice already implemented by other authors, the 12 month rolling window is also used in this research.

3. *Correlation coefficients between stock and government bond indices in the same country in January 2008-February 2013.* In the end of the analysis the shorter period is chosen in order to check the changes in the relationship in time of financial crisis.

The calculation of the correlations between different asset class indices in the same EU country is expected to lead to the conclusions of either stock and bond markets in the EU countries are highly connected with each other.

Research Results

The verification of *Hypothesis 1* is implemented in two steps. Firstly, the correlation coefficients between stock and government bond indices in the same EU country are calculated. Secondly, the volatility of correlations is estimated by calculating rolling correlation windows. The graphical representation of the correlations can be seen in Figure 1.

The results obtained are diverse. Most of the correlation coefficients between different asset class indices were small. First of all, indices in some countries demonstrate very small negative correlations between the markets. This happens in Denmark, Finland, Germany, Ireland, Luxembourg, Spain and Sweden. These correlations are not significant enough to be stated as leading to replacement of investments between asset classes. This fact is also proven when

looking at statistical significance of the correlations, evaluated by the *p-value*. All the *p-values* for correlations mentioned exceeded the 0.05 level of significance.

Positive, but very weak correlations between stock and government bond markets ($\rho \leq 0.3$) were obtained in Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, France, Italy, Latvia, the Netherlands, Poland, Portugal, Slovakia, Slovenia and the UK.

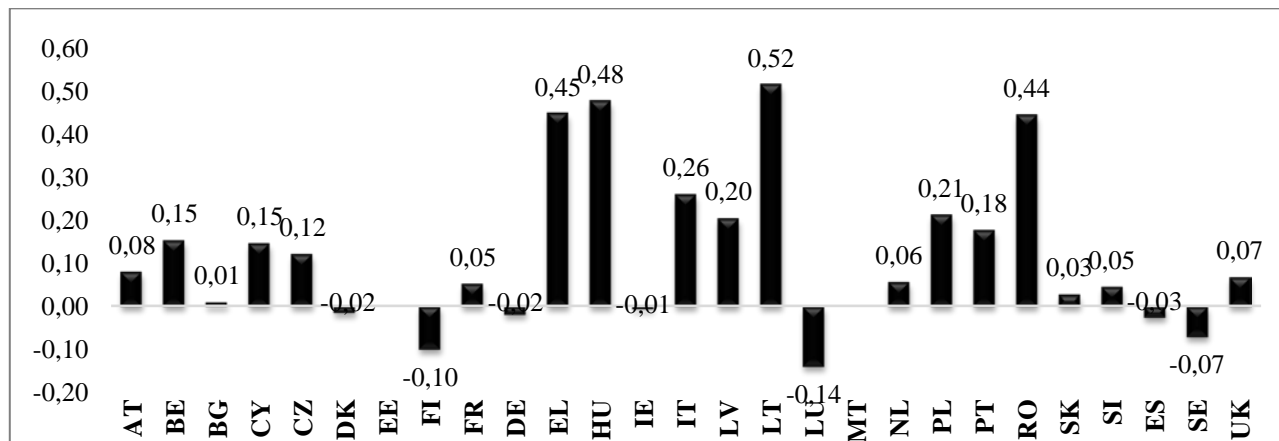


Figure 1. Correlation coefficients between stock and government bond indices in the EU countries in 1993–2013
Source: the authors' calculations based on Thomson Reuters data

When looking at statistical significance of those correlations, it can be seen that only in Italy and Portugal they were significant at 0,05 level, indicating that for the rest of the countries the linear relationship between financial markets during the research period wasn't meaningful enough. Correlation coefficients between stock and government bond indices in Belgium, Latvia and Poland were significant at 0,05 level. In the rest of the countries mentioned the coefficients weren't statistically significant. This indicates the majority of stock and government bond indices not moving together and diversification between asset classes in a country being beneficial for the investor.

Only 4 countries (Greece, Hungary, Lithuania and Romania) have weak-medium correlations between stock and government bond indices, all being significant at 0,05 level of significance. This means that stock and government bond markets in these countries were connected more than anticipated during the research period. This tendency requires for a deeper analysis. The only country with medium correlation between stock and government bond markets was Lithuania ($\rho=0,515$) where stock and government bond markets were more related than financial markets in the rest of the EU countries. These results might be caused by several reasons. Firstly, all the countries mentioned lacked data of stock and government bond indices for the full sample period, so the shorter period may have influenced the correlations. Secondly, for evaluation of comovements between financial markets in all these countries with the exception of Greece, all maturity government bond market indices were used. This type of indices might also influence stronger comovements between the markets. Finally, it's also possible that due to the fact that these countries are relatively new members of the EU, investors don't strongly

differentiate between stock and government bond markets in these countries, assigning similar risk and expected returns to both types of markets. As a result, stock and bond markets may commove stronger.

Even though the results obtained are heterogeneous and there exist significant correlations between stock and government bond indices in some of the EU countries, this is not a tendency. The majority of correlation coefficients between the EU countries' stock and government bond indices are close to zero and indicate weak dependence between the markets. This leads to a conclusion that stock and bond markets of the EU countries might not be influenced by the same factors or differently react to their changes. As already mentioned only 4 countries' markets demonstrate significant comovements during the research period. This is not enough to accept the hypothesis and due to this fact the *Hypothesis 1* is rejected. The relationship between stock and government bond markets in the EU countries is weak.

Even though this should be beneficial for investor when choosing a diversification between asset classes strategy, this strategy might be not as beneficial as it was assumed to be. No significant negative correlation between markets of different asset classes in 1993–2013 was recorded implying that in times of stock market fall government bond markets would not be the safe haven for investors. Due to that and no significant negative correlations existing between stock and government bond markets of the EU countries, there is no basis for approval of flight-to-quality between these markets in the last 20 years. The fairness of this statement will be further checked with the evaluation of comovements between stock and government bond markets in the EU countries in the period of financial crisis in 2008–2013.

In addition to the analysis already implemented and in order to determine whether the correlations between stock and government bond markets in the EU countries were stable or volatile during the research period, rolling correlations between market indices in the same EU country were calculated. The minimum and maximum values of the rolling correlation windows together with the standard deviation of these correlations are graphically presented in Figure 2.

The left axis represents minimum and maximum correlation coefficients while the right axis represents standard deviations of those coefficients. Rolling

correlations between stock and government bond indices in all the countries estimated were volatile, mostly varying from strong positive to strong negative values. This fact is very interesting because it shows that the relationship between stock and government bond markets in all the EU countries is time-varying and can't be interpreted as stable. Even in stable economies, such as Germany, at one period of time the correlations between stock and government bond indices were medium positive ($r=0,66$) while at other period of time this turned to opposite direction and the markets correlated strongly negatively ($r=-0,81$).

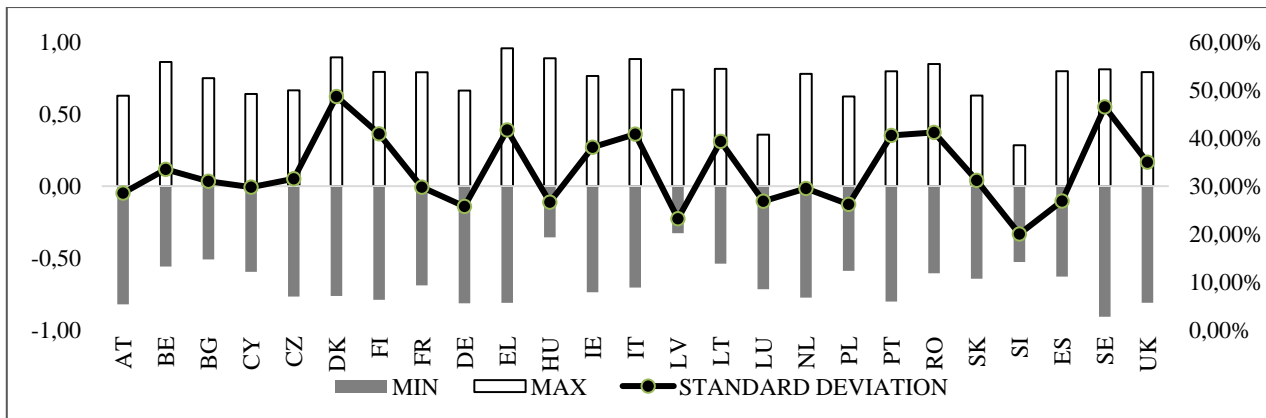


Figure 2. Characteristics of rolling correlation windows between stock and government bond indices in the EU countries in 1993–2013
Source: the authors' calculations based on Thomson Reuters data

The latter correlation coefficient might have been assumed by investor as indicating big diversification effect between stocks and government bonds and in times of financial stress may have encouraged him to invest in government bonds triggering flight-to-quality phenomenon. Since this relationship was instantaneous, later, when stock and government bond indices would have started moving together again, investor would experience significant losses. This tendency can be seen when looking at big standard deviations of rolling correlations. Mostly varying from 20 % to 50 % these deviations represent high volatility of correlations between stock and government bond indices.

Most volatile rolling correlations with standard deviations exceeding 40 % were derived between stock and government bond indices in Denmark, Sweden, Greece, Romania, Finland, Italy and Portugal. This is an interesting point because such countries as Denmark and Sweden with strong developed financial markets represented the least stable relationship between stock and government bond markets during the research period. Contrarily, the least volatile rolling correlations were in Slovenia and Latvia.

This fact again might be caused by the lack of data in both markets. With less data available fluctuations of the relationship between the markets might not reflect the reality.

The analysis of comovements between stock and government bond markets in the EU countries in 1993–2013 has led to a conclusion that there is a tendency of them to depend on each other, but it cannot be interpreted as strong. In addition, the dependencies between stock and

government bond markets in the EU countries can be named to be volatile and during the full research period. Various authors have concluded that the relationships between different asset classes tend to change in times of financial stress in the markets. In order to check the fairness of this statement comovements between the stock and government bond markets in the EU countries in the period from 2008, referred to as financial crisis, are analyzed further. The evaluation of comovements between stock and government bond indices in the EU countries showed a wide distribution of correlation coefficients between financial markets during this shorter sample period (Figure 3).

Most of the EU countries experienced very weak, statistically insignificant correlations between stock and government bond markets with correlation coefficients being smaller than 0,3 and either positive (Belgium, Cyprus, the Czech Republic, France, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Slovenia, Spain and the UK) or negative (Austria, Bulgaria, Germany, Slovakia). None of them were statistically significant with the exception of Belgium. Even though correlation between stock and government bond indices in this country was positively weak, it appeared to be significant at 0,05 level. Despite of that, it can be still stated that even in times of financial crisis financial markets of different asset classes in countries mentioned tended to move independently from each other. This fact should be beneficial for investors diversifying between the asset classes in the same country.

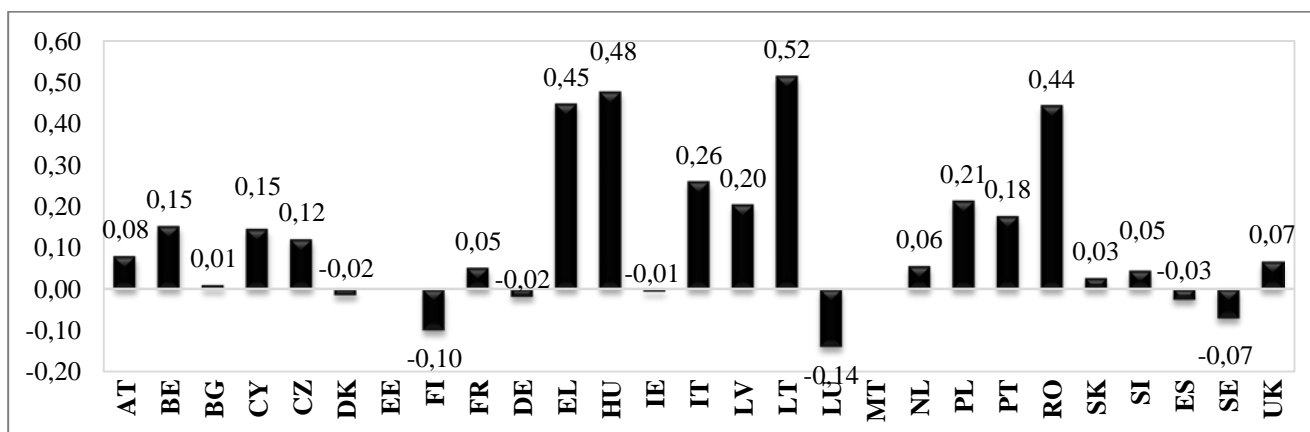


Figure 3. Correlation coefficients between stock and government bond indices in the EU countries in 2008–2013

Source: the authors' calculations, based on Thomson Reuters data

Traditional financial theorists claim that in times of financial stress stock and government bond indices should move to different directions due to willingness of investors to reduce the risk and return. Contrarily, data of several EU countries stock and government bond indices indicate an opposite relation. It can be seen that there are several countries where correlations between stock and government bond indices were positive and strong enough for indication of comovements between the markets. These results were obtained in Greece, Hungary, Lithuania, Poland, Portugal and Romania. The highest correlation coefficients were calculated in Hungary, Greece, Lithuania and Romania, indicating medium relationship between the markets during the research period. All these correlation coefficients were significant at 0,05 level. To support these correlations the arguments already mentioned can be used: not full data sample, later integration (for Lithuania, Poland and Romania) and serious country's financial problems in recent years (Greece, Portugal). The results show that diversification between asset classes in these countries would be damaging due to stock and government bond market comovements to the same direction in times of financial stress.

Finally, there also exist three countries where correlation coefficients between stock and government bond markets were negative during the period of 2008–

2013: Denmark (-0,395), Finland (-0,399) and Sweden (-0,456). All these coefficients were significant at 0,05 level and indicate inverse relationship between stock and government bond markets. Financial markets of these countries are usually seen as stable and as a tendency are chosen by more risk-averse investors. A conclusion might be derived that during the times of high changeability and uncertainty in global economy even investors in stock markets mentioned changed their preferences to government bonds in order to avoid high risk and assure safe return. In other words, it can be stated that Denmark's, Finland's and Sweden's financial markets experienced flight-to-quality phenomenon.

In order to check the fairness of the statement of increasing correlations in financial markets in times of financial stress, the Hypothesis 2 was tested:

Hypothesis 2: The relationship between returns on main stock and government bond indices in the financial markets of the EU countries became stronger in the period of financial crisis from 2008.

This hypothesis is confirmed if correlations between stock and government bond markets increased in more than 50 % of the EU countries when reducing the calculation period to 2008–2013. Correlation coefficients obtained in both periods are plotted in Figure 4.

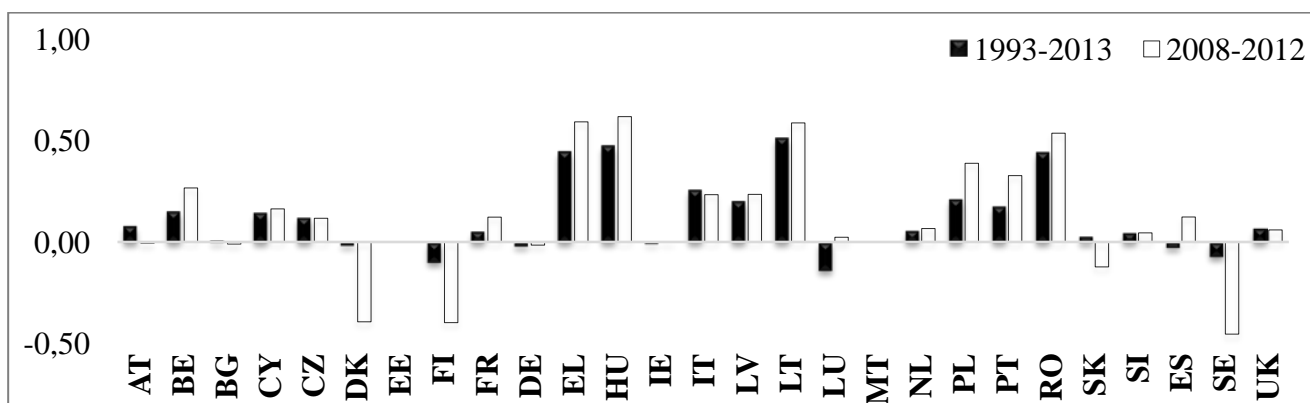


Figure 4. Correlation coefficients between stock and government bond indices in the EU countries in 1993–2013 and 2008–2013

Source: the authors' calculations, based on Thomson Reuters data

It can be seen that in most of the countries correlations between stock and government bond markets increased significantly to both positive and negative directions in the period from 2008. Most of them didn't change their directions with the exception of Austria, Bulgaria, Ireland, Luxembourg, Slovakia and Spain. These changes were very small and left correlations insignificant. In the countries with weak-medium correlations between stock and government bond markets the significance of coefficients also increased. Most significant increase in correlations between stock and government bond markets was obtained in the countries already mentioned: Denmark, Finland and Sweden. The exceptions with decrease in correlation coefficients when shortening the research period were Austria, the Czech Republic, Germany, Italy, Luxembourg and the UK. Having in mind that correlations in Slovenia didn't change because the data of its government bond indices only available from 2008, this leaves financial markets of 19 EU countries with stronger comovements between markets in time of financial crisis from 2008. Due to that, *Hypothesis 2* is accepted. The strength of the relationship between stock and government bond markets in the EU countries increased in the period of financial crisis from 2008. This has a dual impact on investor's decision-making. From one point of view, this is beneficial for allocation of investments in countries such as Denmark or Finland because it leads investor to benefit by dividing the risks between different asset classes. On the contrary to that, this fact is harmful for investors who diversified in countries such as Greece or Hungary. Due to significant comovements between stock and government bond indices in these markets the diversification effect might disappear by leaving investor with losses in times of declining financial markets.

Conclusions

The results of previous researches of relationship between financial markets indicate significant volatile comovements. Multiple authors have proven existence of comovements between stock and government bond markets in major EU countries, not generalizing it as a tendency. It was also proven that in times of financial crisis those comovements are becoming stronger and negative correlations appear indicating flight-to-quality from stocks to government bonds. Despite of that, this is mainly concluded for Eurozone countries leaving the rest of the EU members behind. The aim of this research was to fill this gap by providing insights of comovements between stock and government bond markets in all the EU countries together with recommendations for portfolio diversification.

Analysis of comovements between stock and government bond markets in the EU countries showed that most of correlation coefficients were rather small, not significant and lead to rejection of *Hypothesis 1*: the relationship between stock and government bond indices in the EU countries was rather weak. The exception exists in financial markets of Greece, Hungary, Lithuania and Romania with weak-medium significant correlations, probably caused by lack of data, different indices used or

these countries being new members of the EU (with the exception of Greece). The results indicate financial markets in these countries being more related than in the rest of EU countries, not suitable for diversification between asset classes. Even though the rejection of the first hypothesis shows the possibility of diversification between asset classes in most of the EU countries, this strategy might not be as beneficial as assumed to be. No significant negative correlation between market indices of different asset classes in 1993–2013 was recorded implying that in times of stock market fall government bond markets aren't the safe haven. As a result there is no basis for approval of flight-to-quality between these markets in the last 20 years. In addition, rolling correlations revealed volatile dependencies between stock and government bond markets of the EU countries. There was a tendency of correlations becoming more negative with the ongoing financial crisis that was further estimated by analyzing changes of comovements in 2008–2013.

Analysis of comovements between stock and government bond markets of the EU countries from 2008 resulted in increase of correlation coefficients in 19 of 25 countries analyzed. Due to that, *Hypothesis 2* was accepted. Despite of that, most of the correlations were positive. This isn't beneficial for investors: due to significant comovements between markets in countries as Greece or Hungary the diversification effect may disappear when most needed. As the exceptions should be mentioned Denmark, Finland and Sweden. Significant negative correlations obtained in these countries indicate the existence of flight-to-quality and benefits from inter-asset diversification in Scandinavian countries in times of financial stress. Comovements between stocks and government bonds in other EU countries tend to be not strong during the period of financial crisis, not allowing to confirm a wide scope flight-to-quality between the markets.

The results of the research are significant because they provide a possibility to compare comovements between stock and government bond markets in all the EU countries. This is beneficial for investor, searching for diversification opportunities. As the final outcome of the research, 1 of 2 hypotheses raised was accepted indicating financial markets of the EU countries being less related than expected to be and leaving place for diversification benefits. The results of the research contradict with those obtained by (Yang *et al.*, 2009), stating that bonds help to hedge against stock market risk. In addition, there is no basis for overall approval of flight-to-quality between all the EU financial markets. Evaluation of comovements between stock and government bond markets resulted in determination of large variations in intra-asset correlations as (Li, 2002; Scruggs & Glabadanidis, 2003; Cappiello *et al.*, 2006) had already noticed. (Li, 2002; Andersson *et al.*, 2004; D'Addonna & Kind, 2006) related the changes in these correlations with the inflation.

The approval of the Hypothesis 2 allies with the fact that comovements between stock and government bond markets tend to increase due to globalization and financial stress, as Baur (2009) has noticed. The fact that the increase in the correlations between stock and government bond indices in financial crisis was not very high also partly

coincides with the assertion of Viitanen (2011) that stock-bond relations tend to be stable under extreme market conditions. The author only analyzed the biggest financial markets for which this research also provides quite stable relationship in time of financial stress. In addition, the exclusion of possible flight-to-quality in Scandinavian countries in the period of 2008–2013 coincides with results of (Baur & Lucey; 2006; 2008) confirming flight-to-quality

only in several EU countries. Finally, the results of financial markets' comovements in the period of financial crisis contradict with the research of (Baele *et al.*, 2009) stating that correlations between stock and government bond indices in most of the EU countries decreased with the time. The results should be interpreted cautiously due to limitations of the research mentioned.

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ES šalių finansų rinkų tarpusavio priklausomybė

Santrauka

Finansų rinkų tarpusavio integracijos procesai akademinėje literatūroje tiriami gana plačiai, tačiau pastaraisiais metais pastebimas didesnis susidomėjimas skirtingų turto klasių rinkomis bei jų tarpusavio priklausomybe, kuriams modeliai šiai priklausomybei vertinti. Kartu su globalizacija ir laisvėjančiais kapitalo srautais, išsivysčiusios finansų rinkos tampa vis labiau priklausomos viena nuo kitos, o tai atspindi ir jų rinkos indeksų pokyčiuose. Ši priklausomybė yra svarbi kuriant investicijų diversifikavimo strategiją, todėl adekvatus jos vertinimas padeda investuotojams suformuoti optimalų investicijų portfelį. Nepaisant to, šioje srityje yra vis dar neatsakytų klausimų. Dažniausiai formuojamas mišrus investicijų portfelis iš akcijų ir obligacijų, todėl siekiant diversifikuoti riziką, svarbu iširti šių vertybinių popierių indeksų priklausomybę atskirose rinkose.

Paplitusi mintis, kad turto klasių su skirtingomis rizikos-gražos charakteristikomis tarpusavio priklausomybė yra silpna bei suteikia galimybę uždirbti iš rizikos mažinimo diversifikuojant. Nepaisant to, ankstesnių mokslinių tyrimų analizė parodė, kad ši priklausomybė nėra stabili ir keičiasi priklausomai nuo ekonomikos ciklo. Tai ypač pastebima ekonomikos nuosmukio laikotarpiu. Pastaroji bankų sistemos krizė, kartu su ją lydėjusiu Europos Sąjungos šalių vyriausybės nemokumu, atskleidė, kad finansų rinkų tarpusavio priklausomybė yra daug stipresnė nei buvo manyta iki šiol, o tai didina riziką ir mažina investicijų grąžą.

Šio tyrimo naujumas pasireiškia tuo, kad ankstesni, akcijų ir obligacijų rinkų tarpusavio priklausomybės tyrimai, dažniausiai buvo atlikti JAV bei keliuose kitose, didžiausiose šalyse (dažniausiai priklausančiose G7). Akcijų ir obligacijų rinkų tarpusavio priklausomybė visose Europos Sąjungai (ES) priklausančiose šalyse iki šiol nebuvo tirta. Mokslinis naujumas pasireiškia ir tyrimo metodologijoje: tyrimas apima finansų rinkų tarpusavio priklausomybės vertinimą keliais skirtingais metodais bei periodais.

Tyrimo objektas: ES šalių akcijų ir vyriausybės obligacijų rinkos.

Tyrimo tikslas: įvertinti ES šalių akcijų ir vyriausybės obligacijų rinkų tarpusavio priklausomybę ir pateikti rekomendacijas investicijų portfeliui diversifikuoti visu tiriamuoju bei ekonomikos nuosmukio laikotarpiu.

Tyrimo tikslui pasiekti buvo išskirti šie uždaviniai:

1. Išanalizuoti ir apibendrinti ankstesnius akcijų ir vyriausybės obligacijų rinkų tarpusavio priklausomybės tyrimus bei jų rezultatus.
2. Sukurti metodologiją akcijų ir vyriausybės obligacijų rinkų tarpusavio priklausomybei vertinti visu tiriamuoju bei ekonomikos nuosmukio laikotarpiu.
3. Įvertinti ES šalių akcijų ir vyriausybės obligacijų rinkų tarpusavio priklausomybę tiriamuoju laikotarpiu.
4. Įvertinti ES šalių akcijų ir vyriausybės rinkų tarpusavio priklausomybę ekonomikos nuosmukio laikotarpiu.
5. Pateikti rekomendacijas investicijoms į skirtingas turto klases diversifikuoti.

Tyrimo metodai: mokslinės literatūros analizė ir sintezė, palyginimo metodas, koreliacinė analizė.

Pagrindiniai informacijos šaltiniai: Thomson Reuters, Pasaulio Banko bei Europos vertybinių popierių rinkų federacijos (FESE) duomenų bazės.

Tyrimo laikotarpiai: 1993–2013 ir 2008–2013 metai.

Ankstesnių akcijų ir obligacijų rinkų tarpusavio priklausomybės tyrimų analizė atskleidė, kad ši priklausomybė yra reikšminga, tačiau nestabili – ekonomikos nuosmukio laikotarpiu pastebimas jos sustiprėjimas. Šis reiškinys dažnai įvardijamas „skrydžio į kokybę“ tarp akcijų ir vyriausybės obligacijų terminu, kai investuotojai, siekdami investicijų saugumo, parduoda rizikingesnius vertybinius popierius (akcijas) ir investicijas perkelia į saugesnius vertybinius popierius, dažniausiai vyriausybės obligacijas. Tokia tendencija dažniau pastebima didžiausiose finansų rinkose, nuošalyje paliekant mažesnes, menkiau išvystytas finansų rinkas.

Tyrimai atlikti, siekiant nustatyti ES šalių akcijų ir vyriausybės obligacijų rinkų priklausomybę. Tyrimo imtį turėtų sudaryti 54 rinkos indeksai, tačiau Estijos ir Maltos vyriausybės nėra išleidusios vertybinių popierių, atitinkančių ilgalaikių vyriausybės obligacijų apibrėžimą, todėl šiose rinkose nėra ir vyriausybės obligacijų indeksų. Dėl šios priežasties, tyrimui naudoti 25 ES šalių 50 indeksų duomenys. Tyrimui pasirinkti lyginamieji (płg. angl. benchmark) akcijų rinkų indeksai, prioritetą teikiant kainos indeksams. Skolos vertybiniai popieriai išleidžiami tam tikram laikotarpiui, todėl ir atskiri indeksai yra skaičiuojami pagal šių vertybinių popierių laikotarpius. Atsižvelgiant į ankstesnių autorių atliktus tyrimus, nuspręsta pasirinkti 10 metų vyriausybės obligacijų indeksus, nes šios obligacijos savo terminu iki išpirkimo yra artimesnės akcijoms bei yra mažiau veikiamos trumpalaikių monetarinės politikos operacijų. Indeksų pokyčiams skaičiuoti yra pasirinktas mėnesio dažnumas. Tyrimo naudoti eurais išleistų vyriausybės obligacijų indeksai.

Nepaisant nusistatytų kriterijų, tyrime susidurta su tam tikrais skirtumais. Pirmasis skirtumas pasireiškė tuo, kad nors tyrimui pasirinkti akcijų bei obligacijų kainų indeksai, kai kuriose šalyse tokie indeksai nėra skaičiuojami. Tokiu atveju naudoti gražos indeksai. Antrasis skirtumas yra susijęs su jau minėtu Estijos bei Maltos finansų rinkų duomenų trūkumu. Trečiasis skirtumas pasireiškė tuo, kad nors daugumos naudotų vyriausybės obligacijų indeksų valiuta buvo euras, keliose šalyse populiariausi lyginamieji indeksai skaičiuojami nacionaline valiuta, tad šie indeksai ir buvo naudoti. Galiausiai svarbiausias tyrimo skirtumas yra faktas, kad ne visų šalių akcijų ir obligacijų indeksų istoriniai duomenys buvo prieinami visam tyrimo laikotarpiui. Tokiu atveju, esant duomenų trūkumui, indeksų tarpusavio priklausomybę vertinta naudojant turimus trumpesnio laikotarpio duomenis.

Tyrimo metodologija sudaryta, siekiant patvirtinti arba paneigti šias iškeltas hipotezes:

1 Hipotezė: ES šalių akcijų ir vyriausybės obligacijų rinkų indeksų tarpusavio priklausomybė yra stipri. Ši hipotezė patvirtinama, jei priklausomybė tarp akcijų ir obligacijų indeksų yra vidutinė ir stipresnė daugiau nei 50 proc. tirtų ES šalių.

2 Hipotezė: ES šalių akcijų ir vyriausybės obligacijų rinkų indeksų tarpusavio priklausomybė sustiprėjo ekonomikos nuosmukio laikotarpiu (2008–2013). Ši hipotezė patvirtinama, jei priklausomybė tarp akcijų ir obligacijų indeksų ekonomikos nuosmukio laikotarpiu sustiprėtų daugiau nei 50 proc. tiriamų ES šalių.

Tyrimas atliktas naudojant logaritmuotus rinkos indeksų pokyčius ir skaičiuojant Pirsono koreliacijos koeficientus indeksų tarpusavio priklausomybei vertinti. Gautų koreliacijos koeficientų statistinis reikšmingumas tikrinamas testuojant Fišerio nulinę hipotezę su pasirinktu 0,05 reikšmingumo lygmeniu. Norint įvertinti priklausomybės tarp tiriamų rinkos indeksų pastovumą, taip pat skaičiuoti ir dvylikos mėnesių slenkantys koreliacijos langai (płg. angl. Rolling Correlation Windows).

ES šalių finansų rinkų tarpusavio priklausomybės tyrimas atskleidė, kad dauguma koreliacijos koeficientų tarp akcijų ir vyriausybės obligacijų indeksų buvo maži bei statistiškai nereikšmingi, o tai lėmė pirmosios hipotezės atmetimą. Nepaisant to, kaip išimtį būtų galima paminėti Graikijos, Vengrijos, Lietuvos bei Rumunijos finansų rinkas, tarp kurių užfiksuota silpna arba vidutinė, statistiškai reikšminga koreliacija. Akcijų ir vyriausybės obligacijų rinkos šiose šalyse yra labiau susijusios nei kitose ES narėse. Tokie rezultatai gali būti nulemti duomenų trūkumo, naudotų indeksų skirtumų arba fakto, kad visos šios šalys, išskyrus Graikiją, yra naujosios ES narės. Nepaisant pirmosios hipotezės atmetimo, reiškiančio, jog ES šalių akcijų ir vyriausybės obligacijų rinkos yra susijusios mažiau nei tikėtasi, 1993–2013 m. nebuvo užfiksuota statistiškai reikšmingų neigiamų koreliacijos koeficientų tarp šių rinkų indeksų. Taigi, negalima teigti, kad diversifikavimas šiose rinkose visu tiriamuoju laikotarpiu galėtų padėti sumažinti riziką ir „skrydis į kokybę“ visu tyrimo laikotarpiu negali būti patvirtintas. Negana to, slenkantys koreliacijos langai dar kartą įrodė priklausomybių nepastovumą. Pastebėta tendencija, kad neigiama indeksų koreliacija sustiprėja ekonomikai pereinant į nuosmukio laikotarpį, tad šis fenomenas ištirtas atskirai.

Finansų rinkų tarpusavio priklausomybės ekonomikos nuosmukio laikotarpiu (2008–2013) analizė atskleidė, kad 19 iš 25 šalių, finansų rinkų tarpusavio priklausomybė sustiprėjo, todėl antroji hipotezė buvo patvirtinta. Nepaisant to, dauguma apskaičiuotų koreliacijos koeficientų buvo teigiami, o tai investuotojams nėra naudinga: diversifikacijos privalumai išnyksta tada, kai yra labiausiai reikalingi. Kaip išimtį galima paminėti Skandinavijos šalis (Danija, Suomija ir Švedija), kuriose reikšmingi neigiami koreliacijos koeficientai tarp akcijų ir vyriausybės obligacijų rinkų ekonomikos nuosmukio laikotarpiu, gali būti traktuojami kaip „skrydžio į kokybę“ įrodymas. Kitų šalių rinkų indeksų priklausomybė minėtu laikotarpiu buvo per silpna, kad šis reiškinys būtų patvirtintas visai tyrimo imčiai.

Tyrimo rezultatai yra reikšmingi, nes suteikia galimybę palyginti akcijų ir vyriausybės obligacijų rinkų priklausomybę visose ES šalyse. Iš tyrimo pradžioje išsikeltų dviejų hipotezių patvirtinta tik viena. Taigi, ES šalių finansų rinkos yra priklausomos viena nuo kitos mažiau nei buvo tikėtasi ir vis dar egzistuoja galimybė diversifikuoti investicijų portfelį, formuojant jį iš skirtingų finansinio turto klasių. Tokie tyrimo rezultatai iš dalies sutampa su kitų mokslininkų tyrimų rezultatais, tačiau jie turėtų būti interpretuojami atsargiai, nes ne visi naudoti duomenys visiškai atitinka nustatytus kriterijus.

Raktažodžiai: *finansų rinkos, vyriausybės obligacijų indeksai, akcijų indeksai, tarpusavio priklausomybė, ekonomikos nuosmukis, Europos Sąjunga.*

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