Maruška Vizek, PhD
Director
Institute of Economics, Zagreb
E-mail: mvizek@eizg.hr

THE SOVEREIGN BOND MARKETS RETURN AND VOLATILITY SPILLOVERS[1]

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Abstract

The aim of this paper is to apply the spillover index methodology developed by Diebold and Yilmaz (2009, 2012) to investigate the role individual sovereign bond markets play in international sovereign bond market volatility spillovers. Daily data for 19 developed and developing countries from four continents is used in order to estimate fixed and time-varying return and volatility spillovers index for sovereign bond markets during post-Lehman Brothers bankruptcy period. In addition, we decompose the overall sovereign bond markets return and volatility spillover index into specific country-to-country spillovers to detect individual countries that explain the majority of detected spillovers. We find that innovations to the US sovereign bond market have the biggest influence on the return and volatility variance in other sovereign bond markets across the globe. In addition, spillovers are more intensive for the sovereign bond returns than for volatilities in the observed period. European debt crisis seem to be the cause of surges in return and volatility spillover in the observed period.

Keywords: volatility spillover index, return spillover index, sovereign bond markets

1. INTRODUCTION

In economic literature, numerous models have been developed to analyze volatility on the financial markets. In the last decade, especially

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following the 2008 crisis, interest for financial market interdependence, both in terms of returns and return volatilities has been renewed. The literature on financial linkages is based on two separate strands. The first strand has domestic transmission of asset price shocks and its determinants as the main focus. On the other hand, second strand of the literature is focused on the international linkages, mostly on individual asset prices in isolation (Ehrmann et al., 2011).

Generally, in the volatility spillover literature, the following econometric methods are most often used: multivariate Generalized Autoregressive Conditional Heteroscedasticity (M - GARCH), Regime Switching (RS) and Stochastic Volatility (SV) models. An extension of this literature, represented by Diebold and Yilmaz – DY – (2009) seminal study provided new measures of return and volatility spillovers of international stock markets based on forecast-error variance decompositions in a vector autoregressive framework (Zhou et al.,2012; Diebold and Yilmaz, 2009). Diebold and Yilmaz (2009) discussed a broad set of global equity returns and to show that spillover intensity is indeed time-varying, and the nature of the time-variation is strikingly different for returns vs. volatilities. More importantly, Diebold and Yilmaz (2012) later improved the DY 2009 method and used the upgraded model in order to examine the spillover among American stocks, foreign exchanges, bonds, and commodities markets, thereby paying particular attention to the volatility interaction during the subprime mortgage crisis.

Building on DY (2012) approach, Claeys and Vašíček (2014) measured the strength and direction of linkages between 16 EU sovereign bond markets. More specifically, they showed substantial spillover, with accent on EMU countries. Distinctions in bilateral linkages are result of fiscal trouble and a large banking sector, as Belgium, Italy and Spain are in midway of the shock transmission during the financial crisis. Antonakakis and Vergos (2013) examined the linkages of government bond yield spreads between Euro zone countries over the period March 3, 2007 - June 18, 2012, using DY (2012) approach. Their sample is split into Eurozone periphery and core countries. They conclude that in average government bond yield spreads shocks influence on future bond yields spreads rise, and are connected with news announcements and policy changes. Also, they found that bond yield spreads spillovers among Euro zone countries are highly pleached, mainly appearing from the periphery (Greece, Ireland, Italy, Portugal and Spain) and to a lower intensity from the core (Austria, Belgium, France and Netherlands). Other applications and extensions of this methodology also emerged since the original publication of the DY methodology in 2009. Alter and Beyer (2014) extended the DY methodology to quantify spillovers between sovereign credit markets and banks in the euro area. Diebold and Yilmaz (2014) use the same methodology as in DY (2012) to test for connectedness of financial firms. Awartani and Maghyereh (2013) to investigate the dynamic spillover of return and volatility between oil and equities in the Gulf Cooperation Council Countries. Corbet et al (2018) explored the dynamic relationships between cryptocurrencies and the variety of other financial assets, while Antonakakis et al (2015) examined the dynamic link between tourism and economic growth.

On the other side, Christiansen (2007) studies volatility spillover from the US and aggregate European bond markets into individual European bond markets using a GARCH volatility-spillover model. It is shown a strong statistical evidence of volatility spillover from the US and aggregate European bond markets. Results suggest that the US volatility-spillover outcomes are weak for EMU countries in economics terms, while the European volatility-spillover effects are strong. Skintzi and Refens (2006) investigate the dynamic linkages among the US and European bond markets. Using an EGARCH model, they suggest that significant volatility spillovers exist from both the aggregate Euro area bond market and the US bond market to the individual European markets. They also show that introduction of the Euro has consolidated the volatility spillover outcomes and the cross-correlations for most European bond markets.

De Goeij and Marquering (2006), for example, explore the conditional volatility of bond returns influenced by the impact of macroeconomic news announcements. Using daily returns on the 1, 3, 5 and 10 year US Treasury bonds, they conclude that announcement shocks have a powerful influence on the dynamics of bond market volatility. They ensure empirical evidence that bond market incorporates the implications of macroeconomic announcement news faster than other information. A step further in the literature of government bond spillovers is ensured by Brooks et al. (2004) and Gande and Parsley (2005). They find asymmetric international spillover effects on sovereign debt markets. Brooks et al. (2004) confirm that in general, only sovereign ratings downgrades transfer information to the market. Gande and Parsley (2005) propose evidence of spillover effects and they conclude that a ratings change in one country has a significant effect on sovereign credit spreads of other countries.

We follow the return and volatility spillover literature in order to examine the role individual sovereign bond markets play in return and volatility spillovers internationally. Thereby, we focus on global sovereign bond market return and volatility spillovers in the post-Lehman Brothers bankruptcy period. Unlike other studies, we opt for a broadly defined country sample and thus include 19 developed and developing sovereign bond markets from 4 continents in the analysis in order to capture the wider range of possible volatility origins. Besides calculating the return and volatility spillovers for the entire period, we also calculate rolling – window estimates of these indices in order to detect how post-Lehman events are reflected in return and volatility spillover changes. We want to test the main hypothesis that both return and volatility spillovers are unstable throughout the observed period. We focus solely on post-Lehman period because Lehman bankruptcy in 2008 is considered as a structural break which cannot be accounted for within DY (2012) approach. The contribution of this research to the body of literature lies in very broad sample of countries included into the analysis, along with calculating the time-varying value of return and volatility spillover indices for sovereign markets of analyzed countries.

Our results suggest that in the observed period spillovers are more important for the sovereign bond returns than for sovereign bond volatilities. However, return spillovers are relatively stable, while volatility spillovers exhibit large shifts connected to European sovereign debt crisis. Innovations in the US sovereign bond market have the biggest influence on the return variance in other sovereign bond markets. Time-varying estimates for international sovereign bond volatility spillover index detect significant upsurges in volatility spillovers which can mostly be attributed to European debt crisis. However, most of the time, volatility spillover index value is still lower when compared to return spillover index value.

The rest of the paper is organized as follows. Section two defines the data used in the analysis, while section three explains the methodological approach. Section four discusses the findings, while the last section concludes the paper.

2. DATA

In order to construct and estimate a basic spillover index we use daily data of government bond yields. Our sample includes nineteen countries. Our model includes nine Old Member States of European Union (OMS): Germany, Austria, Denmark, Finland, Greece, Spain, Ireland, Sweden and United Kingdom and four New Member States of European Union (NMS): Croatia, Czech Republic, Romania and Poland. Also, we examine six non-EU developed markets: United States, Switzerland, Hong Kong, Japan, Australia and Canada. For all countries daily data cover the period from the 22 September 2008 to the 31 January 2017. For this purpose we employ daily data on government bond yields collected from the Eurostat and Bloomberg databases.

Following Parkinson (1980) and Diebold and Yilmaz (2012), we calculate daily variance of those 19 markets using daily high and low prices. For market *i* on day *t* we get:

$$\tilde{\sigma}_{it}^2 = 0.361[\ln(P_{it}^{max}) - \ln(P_{it}^{min})]^2 \quad (1)$$

where P_{it}^{max} is the maximum (high) price in market i on day t, and P_{it}^{min} is the daily minimum (low) price. Taking into account that σ_{it}^2 is an estimator of the daily variance, the corresponding estimate of the annualized daily percent standard deviation (volatility) is $\acute{\sigma}_{it}^2 = 100\sqrt{365} * \tilde{\sigma}$.

3. EMPIRICAL MODEL

In the empirical analysis, we assess the return and volatility spillovers on sovereign bond markets by using the forecast error variance decomposition obtained after estimating the VAR model. This methodology was originally developed by Diebold and Yilmaz (2009) and we apply it in order to estimate return and volatility spillover indices for sovereign bond markets over the entire sample. Then we use the rolling VAR estimates to obtain the time-varying estimates of both indices.

Diebold and Yilmaz (2009) start from covariance stationary N - variable VAR (p), $x_i = \sum_{i=0}^{\infty} \Phi_i x_{t-i} + \varepsilon_t$ where ε ~(0, Σ) is a vector of independently and identically distributed disturbances. This VAR can be turned into a moving average (MA) representation, which is $x_t = \sum_{i=0}^{\infty} A_i \, \varepsilon_{t-1}$ and where N × N coefficients matrix, Ai, obey $A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + \ldots + \Phi_p A_{i-p}$, with A_0 an N × N identity matrix and A_i=0 for i<0. The moving average is used in order to forecast the future with the H-step-ahead. Because of variance decompositions, it is necessary to assess the fraction of the H-step-ahead error variance in forecasting x_i that is due to shocks to x_j, $\forall\, j \neq i$ for each i.

Also, it is important to receive orthogonal innovations for variance decomposition, which could be accomplished by the identification schemes of Cholesky factorization. Consequently, variance decompositions results depend on the ordering of the variables. Diebold and Yilmaz (2012) avoid this problem employing the generalized VAR framework of Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998), hereafter KPPs, which generates variance decompositions invariant to ordering. We use this generalized VAR approach in our own analysis. Furthermore, Diebold and Yilmaz defined their own variance shares as the fractions of the H-step-ahead error variances in forecasting xi due to shocks to x_j for i,j = 1,2,..,N, such that $i \neq j$.

Defining the KPPS H-step-ahead error variance decompositions by $\theta_{ij}^{g}(H)$ for $H=1,2\ldots.$we get

$$\theta_{ij}^{g}(H) = \frac{\sigma_{ii}^{-1} \sum_{h=0}^{H-1} \left(e_{iA_h} \Sigma \, e_j \right)^2}{\sum_{h=0}^{H-1} e_i A_h \Sigma \, A_h^{`} e_i} \tag{2}$$

where ∑ is the variance matrix for the error vector ε, σ_{ii} is the standard deviation of the error term for the ith equation, and e_i is the selection vector with 1 as the ith element, and 0 otherwise. As it can be seen from the equation above, the sum of the elements is not 1: $\sum_{j=1}^{N} \theta_{ij}^{g}(\mathrm{H}) \neq 1$. Accordingly, we normalize each entry of the variance decompositions matrix by the row sum as:

$$\tilde{\theta}_{ij}^{g}(H) = \frac{\theta_{ij}^{g}(\mathrm{H})}{\sum_{j=1}^{N} \theta_{ij}^{g}(\mathrm{H})} \tag{3}$$

Further, it is possible to construct a total volatility spillover index:

$$S^{g}(H) = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \tilde{\theta}_{ij}^{g} H}{\sum_{i,j=1}^{N} \tilde{\theta}_{ij}^{g} H} \cdot 100 = \frac{\sum_{\substack{i,j=1 \\ i \neq j}}^{N} \tilde{\theta}_{ij}^{g} H}{N} \cdot 100 \tag{4}$$

This index presents the KPPS analog of the Cholesky factor based measure used in Diebold and Yilmaz (2009) and it is used to measure the contributions from the spillovers of volatility shocks across various financial markets to the total forecast error variance.

4. RESULTS

Table 1 displays the decomposition of the spillover index for global sovereign bond markets returns as well as the estimate of the returns spillover index value, which can be found in the lower right corner of the table. As the value of the index for the period from September 2009 to January 2017 is estimated at 44 percent, we can conclude that 44 percent of forecast error variance of all 19 sovereign bond markets included in the sample comes from spillovers. From the table we can infer that innovations to Austria, Canada, and the US sovereign bond market have the biggest influence the variance of returns in other bond markets. For example, the US sovereign bond market is responsible for 19.2, 17.8, and 23.9 percent of error variance in forecasting 10-days-ahead variance of bond returns in Honk Kong, Australian and Canadian bond markets respectively. Innovations in Canadian sovereign bond returns spillover to the US, Hong Kong, Australian and the UK sovereign bond returns. However, when subtracting the US spillover contribution received from other countries (59 percent) from spillover contribution given to other countries (101 percent), the US sovereign bond market has the biggest net return spillover contribution when compared to other countries, suggesting it is the most focal sovereign bond market, driving the spillover return dynamics globally.

Innovations in Japanese, Australian and Swiss bond markets on the other hand do not explain larger proportions of error variances of bond returns for other countries in the sample. Unexpected changes in sovereign bond market in the UK, affect the most the error variance in the Canada, and to a lesser degree US and Austrian bond markets. UK sovereign bond market in that regard appears relatively insulated from sovereign bond markets of European Union countries (with the exception of Austria). Interestingly enough, the innovations in German sovereign bond market do not seem to matter much for explaining error variance in other countries, including Eurozone countries. In addition, spillover from other countries does not explain a large portion of German sovereign bond return variance.

On the other hand, innovations in sovereign bonds of Ireland, Spain, Finland, Denmark and Austria do explain a non-negligible portion of each other’s forecast error variance. This could suggest that continental EU countries form a cluster within which the spillover dynamics are more intensive. This cluster is probably facilitated by deep trade and financial market integration. All the countries belonging to such a cluster (except Denmark) are also member of the European Monetary Union, while Denmark I s permanently in the European Exchange Mechanism II.

Countries where return spillovers from other countries (i.e. sovereign bond markets) explain the most of return variance are Austria, Australia, UK, and Finland where spillovers from other countries account for 72, 71, 67, and 66 percent of the overall sovereign bond return variance. Error variance of Romanian and Croatian sovereign bond market returns, which exhibit lesser degree of integration with global bond markets (Posedel et al, 2016) are almost entirely explained by innovations in their own bond markets. Very similar behavior patterns of the US, the UK and Eurozone sovereign bond markets were detected by Basrak et al (2016) in the examination of extremal dependence of sovereign bond returns.

Table 2 displays the decomposition of the spillover index for global sovereign bond markets volatilities as well as the estimate of the volatilities spillover index value. As the value of the spillover index for volatilities is estimated at 26.2 percent, we can conclude that in the period under the examination the spillover are more important for the returns than for volatilities. One may speculate why this is the case, with the most likely explanation being the quantitative easing program implemented throughout the examined period by the central banks in many of the observed countries which enabled government bond markets to swell, with converging yields that were either approaching zero or even turning negative . In case of decomposition of volatility spillovers displayed in the Table, we can observe that volatility spillovers are much less frequent when compared to returns spillovers, however, the same patterns of country-to-country spillovers emerge. The US sovereign bond market is responsible for 5.9, 9.2, and 8.2 percent of error variance in forecasting 10-days-ahead variance of bond volatilities in UK, Canadian and Australian bond markets respectively. Spillovers from Canadian market spillover to the US, and the UK market. Sovereign bond markets mostly exposed to volatility spillover contribution from other countries are Finish and Austrian Sovereign bond markets, followed by Canada and the UK. Surprisingly, sovereign bond volatilities from Greece and Spain did not contribute to other markets much in terms of volatility spillovers, eventhoug they very the focal point of the European debt crisis. It would appear that continental European (without Germany) countries were more responsible for volatility spillovers during that period, eventhoug the crisis originated in Greece (and to a lesser degree Spain).

Table 1

Spillover of Global Sovereign Bond Markets Returns

	From																		
To	US	HK	JP	AU	CA	UK	CH	DE	SE	DK	FI	AT	IE	ES	EL	PL	CZ	RO	HR	Contribution from others
US	40.4	0.6	0.1	1.2	26.8	13.0	0.9	2.0	3.0	2.0	3.2	3.6	1.5	0.2	0.3	0.3	0.5	0.0	0.1	59
HK	19.2	45.9	0.2	2.6	12.2	6.8	0.6	0.9	2.2	1.5	1.9	2.6	1.3	0.4	0.1	0.7	0.8	0.1	0.0	54
JP	2.7	0.4	82.8	1.3	3.2	2.1	0.2	1.4	0.4	0.2	0.6	1.4	1.1	0.8	0.1	0.8	0.4	0.1	0.0	17
AU	17.8	1.7	0.5	28.7	16.1	11.5	1.0	1.8	4.4	2.2	3.9	4.9	2.4	0.7	0.3	0.9	1.0	0.0	0.0	71
CA	23.9	0.3	0.2	1.1	36.1	14.2	0.9	2.8	3.5	2.4	4.7	5.2	2.5	0.5	0.3	0.7	0.6	0.0	0.1	64
UK	11.6	0.6	0.1	1.3	13.5	32.5	0.8	3.0	6.5	4.1	7.8	10.0	4.3	1.0	0.1	1.0	1.5	0.0	0.1	67
CH	2.9	0.6	0.2	0.9	2.7	2.3	82.2	0.6	1.2	0.7	0.6	1.3	1.2	0.4	0.3	0.8	1.0	0.1	0.1	18
DE	2.4	0.2	0.1	0.3	3.7	4.5	0.3	70.8	1.8	2.5	2.1	4.3	4.7	0.6	0.0	0.7	0.9	0.1	0.0	29
SE	4.7	0.4	0.1	0.8	5.9	9.4	0.5	1.5	37.2	4.1	10.6	14.5	6.5	1.4	0.1	1.1	1.0	0.0	0.1	63
DK	2.4	0.4	0.0	0.8	3.2	5.9	0.3	3.6	5.3	46.8	11.5	11.8	5.6	1.4	0.0	0.5	0.5	0.0	0.0	53
FI	2.8	0.2	0.0	0.2	4.4	7.9	0.2	1.6	7.0	6.8	33.9	19.8	9.8	2.9	0.0	0.8	1.5	0.0	0.0	66
AT	2.8	0.3	0.1	0.4	4.3	8.7	0.3	2.6	9.1	7.1	17.4	28.5	11.1	3.7	0.0	1.7	1.9	0.0	0.0	72
IE	1.4	0.1	0.1	0.2	2.5	4.6	0.4	3.7	4.5	4.1	10.5	13.6	35.4	12.4	1.0	3.4	1.9	0.1	0.0	65
ES	0.8	0.2	0.1	0.0	1.0	1.6	0.0	0.5	1.4	1.6	4.8	7.0	18.1	53.7	2.8	5.1	1.1	0.1	0.1	46
EL	0.8	0.0	0.1	0.8	1.0	1.3	0.5	0.3	0.4	0.1	0.1	0.1	2.2	5.0	84.5	1.4	0.5	0.4	0.4	15
PL	1.7	0.2	0.2	0.1	2.4	2.3	0.6	1.0	1.5	0.8	1.9	3.9	6.5	6.5	1.0	67.0	2.3	0.2	0.1	33
CZ	2.4	0.6	0.6	0.3	2.3	3.6	1.0	1.1	1.5	1.7	3.8	5.2	5.0	2.2	0.1	4.1	64.0	0.2	0.2	36
RO	0.2	0.5	0.1	0.1	0.3	0.4	0.2	0.1	0.3	0.1	0.2	0.5	0.6	0.4	0.2	0.5	0.2	95.1	0.2	5
HR	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.5	98.5	2
Contribution to others	101	7	3	13	106	100	9	29	54	42	86	110	84	41	7	25	18	2	2	835
Contributions including own	141	53	86	41	142	133	91	99	91	89	120	138	120	94	91	92	82	97	100	**44.0%**

Source: Calculation of the authors

Table 2

Spillover of Global Sovereign Bond Markets Volatilities

	From																			
To	US	HK	JP	AU	CA	UK	CH	DE	SE	DK	FI	AT	IE	ES	EL	PL	CZ	RO	HR	Contribution from others
US	65.2	1.1	0.0	6.1	14.8	5.9	0.0	0.0	0.1	0.3	0.5	1.3	0.1	2.8	0.0	0.3	0.5	0.7	0.2	35
HK	3.1	80.9	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.1	0.0	0.2	0.1	12.3	2.3	19
JP	0.0	0.0	76.4	0.0	5.6	2.9	0.1	0.0	0.3	1.9	0.3	3.2	5.0	0.6	0.0	0.3	3.2	0.0	0.0	23
AU	8.2	0.1	0.2	80.9	2.4	0.4	0.1	0.0	0.0	0.1	0.6	1.1	1.0	0.6	0.1	0.1	1.3	2.4	0.3	19
CA	9.2	0.1	2.4	0.7	51.8	8.6	0.7	0.1	0.6	3.6	4.0	12.2	2.6	1.8	0.0	0.7	0.7	0.0	0.0	48
UK	5.9	0.0	1.7	0.7	11.1	51.0	0.1	0.0	2.1	0.8	2.5	17.1	2.0	3.2	0.0	0.3	1.4	0.0	0.0	49
CH	0.1	0.1	0.0	0.0	0.7	0.0	95.4	0.0	0.0	1.4	0.1	0.0	1.3	0.0	0.0	0.9	0.0	0.0	0.0	5
DE	0.1	0.0	0.1	0.0	0.6	0.4	0.0	98.0	0.0	0.1	0.1	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	2
SE	0.2	0.0	0.6	0.1	1.2	1.1	0.0	0.0	56.5	3.3	15.1	19.6	1.0	0.0	0.0	0.0	1.2	0.0	0.0	43
DK	0.1	0.0	1.0	0.1	2.5	1.4	0.1	0.1	0.3	79.3	2.3	11.6	1.0	0.1	0.0	0.0	0.1	0.0	0.0	21
FI	0.2	0.0	0.5	0.2	1.1	0.8	0.0	0.0	2.8	38.2	33.9	21.1	0.8	0.2	0.0	0.0	0.1	0.0	0.0	66
AT	0.6	0.0	1.6	0.3	3.4	5.0	0.0	0.0	4.5	7.5	23.4	50.0	2.2	0.5	0.0	0.1	0.8	0.0	0.0	50
IE	0.2	0.1	5.4	0.3	2.3	1.2	0.4	0.1	0.3	9.8	1.8	0.7	75.3	0.3	0.0	0.0	1.7	0.0	0.1	25
ES	3.0	0.1	0.9	0.5	4.2	3.5	1.9	0.4	0.1	0.3	0.4	2.1	0.7	71.1	6.8	2.7	1.3	0.1	0.0	29
EL	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	90.2	0.2	0.0	0.0	0.1	9
PL	1.5	0.3	0.5	0.4	2.1	0.5	1.6	0.2	0.0	0.1	0.1	0.2	0.0	3.7	0.1	88.5	0.1	0.2	0.0	12
CZ	0.1	0.1	3.8	0.3	1.5	1.2	0.1	0.0	0.4	1.2	1.9	3.9	2.6	1.2	0.0	0.1	81.6	0.1	0.0	19
RO	0.6	4.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	89.9	4.0	10
HR	0.3	1.1	0.0	0.5	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	12.4	85.2	15
Contribution to others	33	7	19	12	54	33	5	1	12	69	53	94	21	24	7	6	13	28	7	497
Contributions including own	98.6	88	95	92	106	84	101	99	68	148	87	144	96	95	97	94	94	118	92.2	**26.2%**

Source: Calculation of the authors

Figure 1 displays the rolling-sample estimates of international return and volatility spillover indices. We used 200-days rolling samples in order to assess time-varying properties of two indices whose full-sample values were reported in Tables 1 and 2. What we can observe from the Figure 1 is that return and volatility spillovers indices exhibit high degree of co-movement, evethough the amplitude of changes is far greater for volatility spillover index. In other words, return spillover index value is more stable and mean-reverting almost throughout the entire period (i.e. until the beginning of 2016), while the value of volatility spillover index is prone to sudden swings. In addition (and as noted by the results of Table 1 and 2), returns spillover index value is almost always greater than volatility spillover index value.

The exceptions to this rule are evident in the spring of 2010 when Greece first requested the assistance of the IMF to the end of that year, then again in the second part of 2011 when Greece was going through the political turmoil related to the austerity packages proposed by The Troika, and then again during the last quarter of 2014 and early 2015 when the premature snap parliamentary election were called by the Greek parliament caused the Troika to suspend all scheduled remaining aid to Greece under its current program, which in turn created havoc on financial markets. This suggests that European debt crisis had a large role in determining the dynamics of return and volatility spillovers during the observed period. One also has to note that both return and volatility spillovers decreased significantly starting in early 2016, after the European debt crisis subsided.

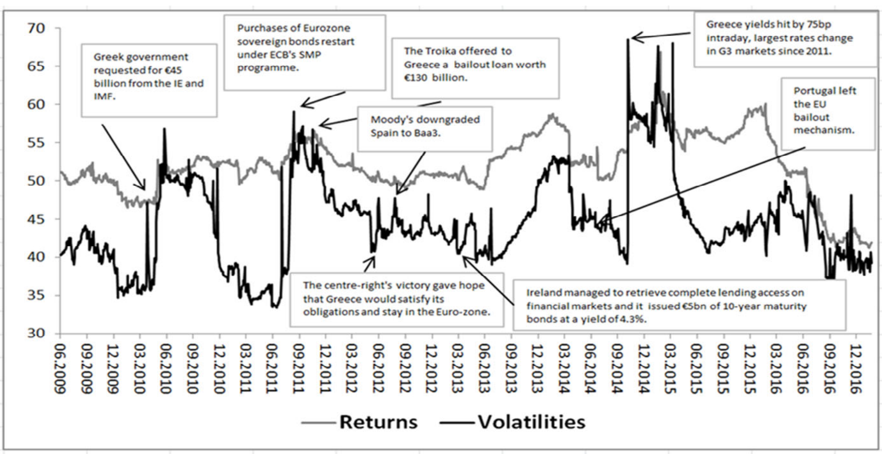

Figure 1 International Sovereign Bond Markets Returns and Volatility Spillover Index (rolling-sample)

Source: Calculation of the authors

5. CONCLUDING REMARKS

We apply the spillover index methodology developed by Diebold and Yilmaz (2009, 2012) to investigate the role individual sovereign bond markets play in volatility spillovers taking place on globally. We estimate international sovereign bond market return and volatility spillover indices for a broadly defined country sample of 19 developed and developing sovereign bond markets from 4 continents.

The results suggest that the value of return spillover index is relatively stable throughout the observed period until 2016, when they start to decrease. On the other hand, the value of volatility spillover index exhibit large shifts related to the crucial events in the European debt crisis. On average, returns spillovers are larger than volatility spillovers for sovereign bond markets which can probably be attributed to quantitative easing implemented by central banks throughout the observed period. Innovations to the US sovereign bond market have the largest net impact on sovereign bond market returns. Innovations in Japanese, Australian and Swiss bond markets on the other hand do not explain larger proportions of error variances of bond returns for other countries in the sample. UK sovereign bond market seems relatively well insulated from sovereign bond markets developments of European Union countries, while innovations in German sovereign bond market do not seem to matter much for explaining error variance of bond returns in other countries, including Eurozone countries. The opposite also applies; return spillover from other countries does not explain a large portion of German sovereign bond return variance. Finally, both return and volatility spillovers of two least developed countries in the sample – Romania and Croatia – are almost entirely explained by innovations in their own bond markets, suggesting that spillover varies with the degree of sovereign bond market integration between developing and mature market economies.

The most important policy implication stemming from this research is that possibilities for portfolio diversification within sovereign bond markets of developed countries are relatively limited, but can still be achieved if individual country performances are taken into account. This is especially the case within European Monetary Union, but not so much in two European developing countries – Romania and Croatia. The most obvious limitations of this research relate to the fact that it does not allow for asymmetric spillovers of positive and negative shocks, and that it does not take into account that both return and volatility spillovers can exhibit heavy tails. In addition, sovereign bond markets should also be examined together with other financial markets like equity, money market or foreign exchange market to get a more comprehensive picture of return and volatility spillovers on sovereign bond markets. These limitations can be dealt with within DY (2012) methodology, but since they are beyond the scope of this paper, we leave them for future research.

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Dr. sc. Maruška Vizek
Ravnateljica
Ekonomski institut, Zagreb
E-mail: mvizek@eizg.hr

PRELIJEVANJA POVRATA I VOLATILNOSTI NA TRŽIŠTIMA DRŽAVNIH OBVEZNICA

Sažetak

Cilj je ovog rada primijeniti metodologiju izračuna indeksa prelijevanja, koju su razvili Diebold i Yilmaz (2009, 2012), kako bi se istražile dinamika i uloge pojedinih tržišta državnih obveznica u međunarodnim prelijevanjima povrata i volatilnosti na tom tržištu. Koriste se dnevni podaci za 19 zemalja u razvoju i razvijenih zemalja s četiriju kontinenata kako bi se procijenila fiksna i u vremenu promjenjiva prelijevanja povrata i volatilnosti na tržištima državnih obveznica u razdoblju nakon bankrota investicijske banke Lehman Brothers. Ukupno se prelijevanje pri tome dekomponira u prelijevanja između pojedinih zemalja u uzorku, a sve s ciljem utvđivanja onih zemalja koje generiraju većinu uočenih prelijevanja. Rezultati istraživanja sugeriraju da promjene na tržištu državnih obveznica SAD-a imaju najveći utjecaj na prelijevanja prinosa na tržištima državnih obveznica. Također, istraživanje je pokazalo da su u promatranom razdoblju prelijevanja bila učestalija pri prinosima državnih obveznica nego pri njihovoj volatilnosti. Razdoblja izraženijih prelijevanja u promatranom razdoblju bila su uzrokovana Europskom dužničkom krizom.

Ključne riječi: indeks prelijevanja volatilnosti, indeks prelijevanja povrata, tržište državnih obveznica.

JEL klasifikacija: G10, G15.