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EUROPEAN FINANCIAL MARKET INTEGRATION: A CLOSER LOOK AT GOVERNMENT BONDS IN EUROZONE COUNTRIES

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Abstract: *This research aims to test the interdependencies between the Eurozone, US and Japanese debt markets, through the yields of 10-year sovereign bonds. The sample covers the period from 2002:01 to 2019:07. The analysis aims to provide answers to two questions: Has the global financial crisis accentuated the interdependencies in the Eurozone debt markets? If yes, how did it influence the movements in sovereign bond yields? The results suggest that the global financial crisis did not accentuate the levels of interdependence between the main Euro zone debt markets. In addition, the results suggest the existence of high movements in periods of crisis and not crisis. We also found that yields on PIIGS sovereign bonds decreased their interdependencies with their peers in the years 2002 to 2019, with the exception of the Greek debt market.*

Keywords: *Interdependencies, Eurozone Debt Markets, Global Financial Crisis.*

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1. INTRODUCTION

The Eurozone was created to strengthen financial integration among its members. Part of this integration was the harmonization of sovereign debt markets, which resulted in high levels of integration and sharp movements between sovereign bond yields (Gilmore, Lucey and McManus, 2008), (Dajcman, Festic and Kavkler, 2012).

After the fall of Lehman Brothers Bank, the financial and banking crisis spread globally, calling into question existing theories of risk management. Greece, a member state of the Euro Zone, admitted that the budget deficit was 12.5% of GDP. In addition, it was revealed that the Greek public accounts had been falsified, and that the real volume of public debt was systematically hidden in order to guarantee accession to the euro. These events caused the European peripheral countries to have called for foreign aid, namely Spain, Portugal, Italy, Ireland and, finally, Cyprus. The financial crisis has shaken the confidence of creditors, and the disclosure that Greece's public accounts had been distorted, has had a suspicious effect on European Union (EU) countries. Suddenly, the yields on loans made through sovereign bonds became higher because, from the investors' perspective, the assumption that the sovereign bonds of EU countries were less risky led to uncertainty (Smolik and Vacha, 2015).

This research adds two relevant contributions to the literature.

The first contribution refers to the study of the interdependencies between the Eurozone debt markets, using as benchmarks the US and Japanese markets, through the analysis of sovereign bond yields. As far as we know, the authors, Kim, Lucey and Wu (2005), Abad, Chuliá and Gómez-Puig (2010), Volosovych (2011), Pozzi and Wolswijk (2012), Claeys, Moreno and Suriñach (2012), Dragomirescu-Gaina and Philippas (2013), Sibbertsen, Wegener and Basse (2014), Răileanu-Szeles and Albu (2015), Ehrmann and Fratzscher (2017), Kim, Lucey and Wu (2018) analysed the interdependencies in the EU sovereign bond markets, but the approach was essentially different from the one followed in this study.

The second contribution is related to the methodology used, sovereign yields, as regime change processes, can accommodate a unitary root regime during normal periods and a second regime as a reversion to the average, in turbulent periods. These findings should also be taken into account when examining sovereign bond yields. Specifically, as spreads constitute parity relations between yields and their underlying securities, the level and possible changes in the autoregressive parameters of the series have information related to their deterministic processes (Ang and Bekaert (2002); Ang and Bekaert (2002a)). Lanne (2001) shows that short-term and long-term interest rates have characteristics of unitary roots and that conventional cointegration tests tend to overrule the null value of integration, i.e. non-cointegration.

Thus, when we compare the results of work on sovereign bond yields according to the sample range, the data provide evidence of non-linearity. In addition, panel data techniques widely used in sovereign yield studies may not be the most efficient, as they incorporate effects on the average in their results and do not allow the disclosure of country-specific properties. This may restrict the differences in the results of studies that have examined the determinants of spreads since the Eurozone debt crisis. Specifically, on the one hand, part of the literature argues that spreads are related to fiscal conditions in Eurozone economies (see, for example, Manganelli and Wolswijk (2009); Schuknecht, von Hagen and Wolswijk (2009); Bernoth and Erdogan (2012)). On the other hand, in other studies, market sentiment and the process of expectation formation are more impor-

tant than fiscal effects (e.g. Favero and Missale (2012); Favero (2013); Georgoutsos and Migiakis (2013); Favero and Missale, 2016).

In terms of structure, this research is organized in 5 sections. Section 2 presents an analysis of the state of the art in relation to articles on integration and interdependencies in the Eurozone sovereign bond markets. Section 3 describes the methodology. Section 4 contains the data and results. Section 5 concludes.

2. LITERATURE REVIEW

The topic of financial integration in European securities markets has attracted a very relevant interest in empirical research. The authors Baele, Ferrando, Hördahl, Krylova and Monnet (2004) show a rule to evaluate the degree of integration in European financial markets that is based on the concept of parity, i.e., the exogenous factors must cause equal and unidirectional movements on prices in the markets so that the markets are fully integrated. His analysis showed that yields on Eurozone sovereign bonds show high levels of financial integration.

The authors Babecký, Komarek and Komárková (2017) consider that the analysis related to financial integration, nowadays, is relevant from the point of view of cost versus benefits analysis. The literature commonly agrees that financial integration brings benefits in less turbulent periods. However, in times of crisis, high financial integration increases the probability of contagion, due to the close interrelationship between financial markets through their proximity. Globally, and in the long run, the benefits of financial integration are expected to outweigh the costs.

Sosvilla-Rivero and Morales-Zumaquero (2012), Santis (2012), Antonakakis and Scharler (2012), Bhanot, Burns, Hunter and Williams (2014), Claeys and Vašíček, (2014), Christiansen (2014) analysed the independence between the Eurozone debt markets in the context of the global financial crisis and showed mixed results. Sosvilla-Rivero and Morales-Zumaquero (2012) find evidence of interdependencies in the yields of the sovereign bonds of 11 EMU countries in the period from 2001 to 2010. Santis (2012) considers that, between 2008 and 2011, the risk on sovereign bonds in the PIIGS countries is higher and statistically significant. The author shows that the shocks from Greece to the peripheral countries of the Eurozone, as well as to Belgium and France, point to contagion and not interdependence. Antonakakis and Scharler (2012) argue that shocks in sovereign yields between Eurozone countries are highly synchronized, however, shocks in sovereign bond yields of peripheral countries cause very strong shocks in non-peripheral Eurozone markets. Bhanot, Burns, Hunter and Williams (2014) show significant interdependencies between Greek sovereign spreads and Eurozone debt markets, however, reject the contagion hypothesis. Claeys and Vašíček, (2014) suggest that shocks between sovereign bond yields have increased considerably since 2007, but their importance is heterogeneous across countries. In addition, the results show that the effects of volatility influence the domestic fundamentals of EMU countries. Christiansen (2014) shows that the integration of sovereign debt markets is stronger in EMU than for non-EMU members and stronger for old members than for new EU members. During recent periods of crisis, integration is weaker, especially for EMU countries.

A common evidence in the post-crisis empirical literature is the reversal observed in financial market integration in European Union countries as a consequence of the crises of 2008 and 2010 (Pungulescu 2013). This phenomenon is also known as weak integration (Islami and Welfens, 2013) or even estrangement (Răileanu-Szeles and Albu, 2015). However, the most recent studies show signs of recovery in financial integration, for example, based on evidence from Eurozone

markets (ECB, 2016). However, there is also evidence of financial fragmentation in the euro area (Lucotte (2015); Mayordomo, Abascal, Alonso and Rodriguez-Moreno, (2015)).

Yang and Hamori (2013), Orlowski and Tsibulina (2014), Deltuvait (2015) and Babecký et al. (2017) studied the interdependencies between the debt markets of Central and Eastern Europe and some Eurozone countries. The authors argue for differentiated evidence. Yang and Hamori (2013) analysed the interdependencies between the bond markets of the CEEC-3 countries (Poland, Czech Republic and Hungary) and Germany in the period from 2000 to 2013. The authors argue that financial integration was already significant before the adoption of the euro in 2004 in the Czech Republic, while the process of financial integration continues in Poland, but not in Hungary. The bond markets in Poland and Hungary decreased their interdependence with Germany during the period of the global financial crisis. Orlowski and Tsibulina (2014) examined the interdependencies between the sovereign bond markets and the stock markets of Germany and those of Poland, the Czech Republic, Hungary, as well as Slovenia and Slovakia. Sovereign bond yields in the Czech Republic and Poland show high interdependence with the German market. Slovenian and Slovak stock yields do not show interdependencies with German yields, while the markets of Poland, the Czech Republic and Hungary show very significant interdependencies. Deltuvait (2015) studied the interdependencies in the sovereign bond markets of Central and Eastern European countries (CEEC-3). The author shows that the interdependencies of the CEEC – 3 bond markets are higher than when compared to the other markets analysed. Babecký et al. (2017) analyzed whether financial integration was resumed, focusing on the period from 2002 to 2015. The analysis covers the economies of Central Europe (Czech Republic, Hungary and Poland), the new countries of the euro area (Slovenia and Slovakia) and Western Europe (Austria, Germany, Portugal). The results show that the global financial crisis mainly caused a temporary disintegration in the financial markets analysed in relation to the Eurozone markets. In 2015, the situation in financial markets gradually returned to the degree of pre-crisis integration, however, there are signs of segmentation in sovereign securities markets.

3. METHODOLOGY

Economic time series are often affected by events that destabilise the permanence of their parameters. In this sense, Inclán and Tiao (1994) proposed the CUSUM test to test a change in the variation of the normal distribution. The CUSUM and CUSUMQ tests are examples of suitable tests to determine a possible temporal location of structure breakdowns, so they will be used as an indicator of a possible breakage. Based on the results found, we will use the Bai and Perron test (2003) to detect the multiple structural breakdowns in the data series in each sub-period.

In order to analyze the long-term interdependencies between the yields of Eurozone sovereign bonds, we will use the methodology of Gregory and Hansen (1996). To study the short-term relationships between the Eurozone sovereign debt markets, we will use the impulse-response functions (IRF) methodology, with Monte Carlo simulations. These models provide a dynamic analysis (variable over time), based on the estimates of the VAR model, making it possible to study the causality relationships found, even when Granger's causality relationships between the variables are not previously detected (Lütkepohl and Saikkonen 1997).

In this article, we chose to use generalised impulse-response functions, introduced by Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998), and to choose the Monte Carlo simulation procedure, with 1000 repetitions. This analysis differs from the traditional impulse-response-orthogonalised analysis, because it does not depend on the ordering of the variables in the VAR

model. The traditional approach, such as that based on Cholesky's factoring, for the orthogonalisation of VAR innovations, leads to different results, depending on the ordering of variables.

4. DATA AND RESULTS

4.1. Data

Sovereign bond yields are daily and comprise the period from January 1, 2002 to July 2, 2019 (4566 observations). It was decided to divide the sample into three subperiods, one Pre-CFG which corresponds to the subperiod from 1 January 2002 to 31 July 2007, one crisis subperiod, which we refer to as Global Financial Crisis (GFC) which covers the subperiod from 1 August 2007 to 14 December 2014 and a third subperiod which contains the period from 1 January 2015 to 2 July 2019, which we refer to as the Post-GFCG subperiod.

Table 1. Sovereign Debt Markets
Source: Own elaboration

Countries	Index
France	France Govt – 10YR
Germany	Germany Govt – 10YR
Greece	Greece Govt – 10YR
Ireland	Ireland Govt – 10YR
Italy	Italy Govt – 10YR
Japan	Japan Govt – 10YR
Portugal	Portugal Govt – 10YR
Spain	Spain Govt – 10YR
US	US Govt – 10YR

4.2. Results

The interdependence tests, referring to the yields of 10-year sovereign bonds in the pre-crisis global financial sub-period, show 52 pairs of integrated markets, with breakdown of structure (out of 64 possible). It is easy to see that the debt markets of Ireland and Portugal are the most cointegrated in this period of non-crisis. These results are corroborated by authors Yang and Hamori (2013), Orlowski and Tsibulina (2014) and Deltuvait (2015), which show interdependencies in sovereign debt markets.

In the period of the global financial crisis, the results suggest 53 integrated markets, with a breakdown in structure (out of 64 possible). Japanese and Spanish sovereign bond yields are the most interdependent debt markets. France, Germany, Ireland and Portugal have 6 integrations, while Italy, Greece and the USA have 5 and 4 integrations, respectively. When compared with the previous period, we can see that the yields of sovereign bonds of Greece, Ireland, Italy and Portugal fell significantly, while Japan, Spain and the USA increased considerably the level of integration with their peers, namely Japan, which doubled the level of integration. The results obtained suggest that, in the sub-period of the global financial crisis, the long-term interdependencies between sovereign bond yields, under analysis, did not rise when compared to the previous period, in global terms. These results are corroborated by the authors, Sosvilla-Rivero and Morales-Zumaquero (2012), Antonakakis and Vergos (2013), Bhanot, Burns, Hunter and Williams (2014), Claeys and Vašíček (2014) and Christiansen (2014), which show the existence of interdependencies, during the global financial crisis, in these Eurozone debt markets.

Yields on 10-year Treasury Bonds cointegrated 35 times (out of a possible 64) in the post-global financial crisis period. The debt market with the most integration is that of Greece. The remaining markets decreased significantly their levels of integration with their peers, namely those of France, Germany, Italy, Japan and Spain. Yields on US sovereign bonds are not integrated with their peers. The results obtained suggest that in this period of non-crisis there has been a significant reduction in the interdependence between the yields of Eurozone, US and Japanese sovereign bonds. These results are corroborated by the studies of the authors Lucotte (2015) and Mayordomo et al. (2015) which show a financial fragmentation in the Eurozone debt markets.

The impulse response functions for the first pre-crisis sub-period, calculated on the basis of the autoregressive vector model, made it possible to identify 64 cases of statistically significant reactions to shocks from the markets under analysis. In this non-crisis period, it was possible to assess the existence of 406 shocks (out of 800 possible). Spain is the market that causes the most shocks (49), causing the largest number of reactions in the markets of France and Japan (8 out of 10 possible). Ireland and the USA cause 48 reactions, while Germany, Italy, France, Portugal, Japan and Greece cause 46, 45, 43 and 42 shocks in their peers, respectively.

During the sub-period of the global financial crisis, relations between the markets studied were, in general, significant. Of particular note were the 378 shocks between the yields of Eurozone sovereign bonds. Japan caused 46 shocks in its peers, having had a greater relevance in the German market (9 out of 10 possible). The USA and Spain caused 44 reactions, while Germany, Ireland, Italy, Greece, Portugal and France caused 42, 40 and 38 shocks to their peers, respectively. Eight shocks had statistically significant effects during only one period (10 days), in particular those resulting from the impulses caused by the Irish, Spanish and US securities markets, in the sovereign bonds of the countries of Greece, the US and Ireland, respectively. In this period of crisis, France, Germany, Greece, Ireland, Italy, Portugal, Spain and the USA decreased their movements, while Japan increased its movements with its peers. In addition, the shocks were, in general, less persistent in this period of crisis.

As in the previous two sub-periods, there were 392 reactions between markets in this non-crisis period. Spain shows 49 reactions with its peers, with a greater emphasis on the markets of Ireland, Japan and Portugal (7 out of 10 possible). Italy, USA, Portugal, Ireland, France, Greece, Germany and Japan caused 48, 47, 45, 44, 43, 42 and 37 shocks in their peers, respectively. The Portuguese market caused 9 reactions in Ireland, while the USA caused 8 shocks in Japan. The number of statistically significant shocks in the three sub-periods was 406, 378 and 392, respectively, reason to conclude that the global financial crisis did not increase the movement between the yields of Eurozone sovereign bonds.

5. CONCLUSION

The conclusion to be drawn, based on econometric models, is that the global financial crisis has not accentuated the levels of interdependence between the main debt markets of the Eurozone. In turn, the impulse/response functions showed the existence of positive movements, with statistical significance, with persistence of more than one week. We can therefore infer that the assumption of the hypothesis of market efficiency is questionable, since the forecast of the movement of a given market can be improved if we consider the lagged movements of other markets, enabling the occurrence of arbitrage operations. In conclusion, the yields of PIIGS countries' sovereign bonds decreased their interdependencies with their peers in the years 2002 to 2019, with the exception of the Greek debt market.

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