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CAPITAL MARKET INTEGRATION

Evaluation and Measurement: Sovereign Bond Market

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ABSTRACT

The paper focuses on capital market integration at sovereign bond market in eleven selected euro zone countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain). The first main objective is to test the degree of capital market integration before and after the crisis using Germany as a benchmark country and also among them as well. Secondly it evaluates and provides reasons of capital integration in time. The examination is applied through i) sigma convergence ii) yield spreads iii) correlation matrix iv) cointegration tests. I found almost zero yield differences before crisis. After 2008 results show segmentation in euro zone countries with certain special characteristic for countries with high credit ratings.

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1 INTRODUCTION

The European countries have been going through very difficult and dramatic situations throughout history. Numbers of wars were distressing European population therefore original intention (besides others) of integrating hostile countries was to avoid wars. The hope that policymakers will deal with the economic integration process instead of war time came true. After that first treaties in Paris and Rome were signed and that were the steps that helped creating opportunities for investors, free trade areas and so on. In several following decades huge progress was made and the level of policy and market integration reached very high degree. Thus it can be seen that this work focuses on the "tip of the iceberg" of European integration process. However stage of integration evolution and its direction can be still questioned and supplemented by normative economists. I am also pleased that this paper can examine important topic which is necessary to monitor with taking into account that Europe made extensive progress in terms that war is not the most discussed topic nowadays.

Integration of capital markets plays important role in European monetary union. Monetary policy is more effectively conducted through financial system if markets are integrated at high level. When financial but also capital markets have strong positions in the economy, which they have in Europe, then their instability has real effect on the whole economy. Thus this paper discusses problematic nature of capital market integration. Then it empirically examines the level of sovereign bond integration. It uses price-based measures like sigma convergence, also correlations and cointegration tests are provided in order to give deep explanations over the integration.

Intention of this paper aspires to reasonably evaluate sophisticated period of last decade at government bond market, especially the crisis and after crisis period.

The research paper is organised as followed: second chapter discusses and describes benefits and problems with capital market integration, chapter three elaborates various measurement techniques, then methodology of selected tests for this paper is presented and the last and most important part presents empirical results with evaluations

2   OVERVIEW OF CAPITAL INTEGRATION

Complete international financial integration has been viewed for many decades as unilateral mainstream which brings benefits only. However, the merits of integration have been argued by prominent economists such as Jagdish Bhagwati (1998), who points out that increasing capital market integration even with IMF operations will not rule out financial crises. The costs of integration were not taken into account when cost and benefit analyses were provided. In order to see the broader reasons why this topic is important to monitor, its economic benefit and problems will be outlined succinctly.

2.1   Definitions

First defining the terms will provide a framework for this topic. Financial markets are integrated when certain conditions hold. According to Baele *et al.* (2004) markets are integrated completely if all market participants

   i)   face uniform rules when choosing to deal with financial services or instruments;
   ii)   have identical access to a set of instruments and services;
   iii)   are treated equally when they are active in the market.

A different well known definition is closely linked to the law of one price (Jappelli & Pagano, 2008), which means that identical assets should have the same price regardless of where they are traded. Nonetheless, the definition based on the law of one price is not as broad as the first one, thus achievement of it does not necessarily have to mean full integration automatically.

To be more specific this paper deals with capital market integration which is a subset of financial market integration. Therefore, focus is put only on certain markets that have maturity exceeding one year. This includes equity markets and bond markets. However, this paper is limited to sovereign bond markets with 10-year maturity.

2.2   Benefits

In theory the elimination or reduction of barriers to capital mobility allows investments and savings to look for the market that will provide the lowest cost and highest returns. Thus capital will be allocated in the most efficient way, which will subsequently increase competition among financial agents. To be more specific, international capital markets allow

the sharing of a range of different risks. Households and residents can diversify their assets in the world market which decrease risks that arise from the specificity of particular country's shocks. It also applies for financial institutions therefore shocks should bring less consumption variability in the economy. This benefit is discussed and supported by Japelli and Pagano (2008). Even though that increased international risk sharing is correlated with reduction of equity home country bias (Sørensen *et al.*, 2007) for OECD countries, results are weaker for EU countries. In addition, unrealistic assumptions such as the homogeneity of the population within a country, also draws attention to the fact that we need to be cautious about final conclusions. On the other hand it also provides more space for further research.

The second benefit comes from the dynamic environment. If perfect foresight is assumed now in the world, reallocation between two periods is possible and it can improve efficiency, because entities participating in financial markets prefer to have a stable consumption path and stable capital flows without fluctuations. Deepening capital market integration allows countries whose output is low over the interim to borrow money from countries that are endowed with capital exceeding their present needs, and repay later when output increases. Moreover, developing countries can have the opportunity to accelerate their development process by taking advantage of foreign lending. Countries with abundant savings will enjoy prospects for investment that will be able to flow to the areas with highest returns. Also countries with low savings but with abundant investment possibilities will benefit from these capital flows. Gains will be on both the borrowers' and lenders' side. Higher effectiveness will be reached by this intertemporal trade accompanied by consumption smooth out. Even in case of uncertain conditions, countries may avoid idiosyncratic shock to national output by insuring on international markets. (Obstfeld & Taylor, 2004)

If developing countries have low savings because of low incomes then free capital mobility could help to decrease this limitation under certain assumptions. If marginal return on investment is at least equal to the cost of capital, then net inflow of foreign resources can increase local savings, the level of physical capital per worker and help the receiving country increase economic growth so that living standards are raised. Those potential advantages can be especially significant for a certain type of capital inflow - foreign direct investments (Agénor, 2003). By liberalization of capital flows, positive economic growth can also be achieved because it potentially speeds up the development of home stock markets and by this it raises overall productivity (Edison *et al*., 2002).

Another benefit is related to the removal of institutional barriers which hinder entrance to individual markets. In case of removal of these barriers this accomplishment can support competition and can increase supply of financial products and services. After all it contributes welfare to consumers or to the clients of financial institutions. International capital markets provide investment opportunities for small investors from various countries especially through collective investments.

A lesser but probably not the smallest benefit is political discipline. There is a chance that integrated markets will influence governments in order not to engage in over-expansionary fiscal or monetary policies. Huge public deficits may be prevented by the risk that interest rates will rise. Investors' reactions in the form of capital flight or exchange rate speculation all influence monetary policy, which should be restrained and controlled by this capital mobility. The economic history of the 20th century also supports this statement, however, it seems to be insufficient to prevent undesirable behaviour. Capital markets can withstand unwelcomed policies for long periods and until then they punish governments harshly. (Obstfeld & Taylor, 2004)

The paper from Bakaert *et al.* (2007) supports and summarizes these benefits finding out that capital market openness contributes to future economic and investment growth.

2.3   Theoretical objections

Obstfeld and Taylor (2004) describe the two most common problems, the first significant problem with interrelated capital markets is obvious from the enforcement of pecuniary contracts. In vigorous financial markets the fulfilment of obligations is crucial. A participant in a trade who receives reimbursement first has little motivation to carry out its own part of the deal afterwards. This is why query of confidence is the base for international transactions. The enforceability problem is also fundamental and present within one country but it is more risky when dealing with cross-border transactions. A second problem arises because in international transactions different regulations, business customs, and a lack of information deepens the problem of information asymmetry.

In case of market integration among different currency areas exchange rate fluctuations generate extra risk and investors will demand compensation for holding foreign assets. Even if taking no account of different currencies, there are still transaction costs which

need to be considered (Jappelli & Pagano, 2008). Both these barriers reduce the positive effect of integration.

An apparent and often mentioned problem is known as the "macroeconomic policy trilemma" that every national policymaking entity has to face. They are confronted with three objectives:

- stable exchange rate
- free international capital mobility
- monetary autonomy oriented towards domestic goals

Since only two out of those aims can be achieved reciprocally, policymakers have to decide which one to forsake. Therefore, empirical studies are needed to provide underlying background for a suitable decision (Obstfeld et al. 2004). Capital mobility is not always that easy to measure, there are a number of methods and indices for reporting correlations between various markets, thus this paper will this problem in more detail.

Obstfeld and Taylor (2004) mention the problem of tax competition. Capital will seek the highest returns after tax deductions and this will motivate the movement of capital to the most beneficial countries. Government will be motivated to decrease capital taxes below the optimum which causes a "race to the bottom". In this non co-operational behaviour overall tax revenues collected will be lower.

Probably the most problematic issue with free capital mobility is that it generates financial crises as Jagdish Bhagwati (1998) argued decades ago. He perceived that the public sees free capital mobility as a free trade phenomenon, both bringing mutual-gains only. And vice versa, restrictions on capital mobility were seen as protectionism. He pointed out that the cost of crises was not taken into account at all. Moreover, proponents of free capital mobility not only have not measured the costs of crises but they could not even estimate the gains they expect to objectify. In principle when a crisis strikes an economy, the drawback of free capital mobility is revealed. In order to ensure that capital inflows will come back, countries have to raise investors' confidence. This usually means increasing interest rates, which causes huge debts for the home country, then selling domestic assets under the tightening conditions required to obtain loans which are undervalued because of it. The alert sale to foreign buyers closes the dangerous circle where the crisis will harm the economy more. Although some economists recommend the very opposite, to restrict overseas access to assets if local credit

has shrunk. And finally contagion effects will emphasize losses from crises. This problematic issue could be summarized from two points of view. First, as was already mentioned, through of integration process crises hit even prosperous economies because of greedy foreign market enterprisers are allowed to operate globally. On the other hand, the second view is that crises grew at home and the global market just disciplines those policies. The opposite point of view was brought up Kose *et al.* (2006) in their paper. They showed that there is very little evidence that financial globalization alone leads to costly crises. In spite of the heavy weight of argument describing huge potential costs, the conclusions remain indecisive.

On the contrary to benefit which showed effectiveness of capital integration because of accessibility to capital, a publication of World Bank (2001) claims that private capital flows are present only for developed countries, gaining financial sources for countries with low GDP per capita is difficult. Moreover, access to capital is often asymmetrical. Many developing countries are only able to borrow on the global market during "good times" whilst in "bad times" they face credit limitations. Frankly put, the advantage of consumption smoothing access to the global market can be considered most likely as fiction. This pro-cyclicality may have an adverse effect on macroeconomic stability.

After all, the fundamental challenge for leading authorities is to minimize these negative problems of capital market integration without lessening the benefits.

3 MEASURING FINANCIAL INTEGRATION

This work focuses to a greater extent on the asymmetric impact of barriers to the intermediation process in varied regions through indirect measurement. The more symmetric those impacts are the more integrated markets are. The most appropriate way to measure the present degree of integration would be to look at all barriers and frictions and verify whether they do not hold anymore. But it is not possible to create such a list. For that reason we will use the definition based on the law of one price which should incorporate all market information. This curtailed definition of capital market integration built on the law of one price has few measures how to assess integration on various markets. There is more than one way in which to measure capital market integration. Various techniques can be especially useful if some data are not available. Moreover, on some markets a particular type of test is necessary.

Price-based measures

The first one is a price-based measure which implies that assets with identical attributes ought to have the same return, at least the expected return, transacted in any residence of the issuer or holder. In other words markets are integrated when the stochastic rate at which cash flows are discounted is identical across markets. However, returns on specific assets in one country can be different from returns on the same sort of assets in other countries if there is characteristic risk. Baele *et al.* (2004) point out exchange rate risk as the characteristic one. These measures are using interest rate or asset return differentials as indicators of integration. These indicators are used for example by technique beta-convergence. The concept of beta-convergence originally comes from growth literature (Barro & Sala-i-Martin, 1992). The following approach is advocated by Adam *et al.* (2002). It enables identification of the speed at which differences in yields are eliminated on individual capital markets. This measure entails estimating the regression:

$$\Delta R_{i,t} = \alpha_i + \beta R_{i,t-1} + \sum_{l}^{L} \gamma_l \Delta R_{i,t-1} + \varepsilon_{i,t}$$

where $R_{i,t}$ denotes the return spread of specific assets between country i and the benchmark rate at time t. More formally $R_{i,t} = Y_{i,t} - Y_{i,t}^B$ where B is a benchmark and the asset return is calculated as $Y_{i,t} = \left[ln(A_{i,t}) - ln(A_{i,t-1}) \right]$, where A is the price index of the relevant asset expressed as a basic index. Δ represents difference operator, $\alpha_{i,t}$ is the country specific

constant, and $\varepsilon_{i,t}$ is white-noise disturbance. L denotes the lag length which is based upon the Schwarz information criterion. Coefficient β measures speed of convergence in the overall market. The β coefficient can take values ranging from –2 to 0. The closer the value of β coefficient to -1, the higher the speed of convergence. If $\beta = -2$ or $\beta = 0$, no convergence is observed. β's values from -1 to 0 indicate monotonous convergence, while oscillating convergence occurs for values from –2 to –1 (Babecký *et al.*, 2010).

Even though β-convergence shows the speed of convergence, it does not measure what is the degree of integration of markets. Therefore, a useful measure is sigma-convergence, which Adam *et al.* (2002) proposed. Sigma-convergence shows dispersion of the differences between returns on the same assets in different countries at the moment (Barro & Sala-i-Martin, 1992). A more precise explanation will be provided in a later section. Another eligible technique is cointegration analyses as Taylor and Tonk (1989) applied in the UK after exchange control abolition.

News-based measures

These measures originate in Baele *et al.* (2004) and monitor the sensitivity of asset prices to global news in comparison to the impact of local news. The information arriving from local capital markets should not be significant in comparison to global markets. The fundamentals of these measures lie on assumptions that in full market integration all portfolios are diversified perfectly, thus local shocks are insignificant. In other words this test is based on the assumption of identical systematic risks across countries. For government bond markets it can be quantified by this equation:

$$\Delta Y_{i,t} = \alpha_{i,t} + \gamma_{i,t}\, \Delta Y_{b,t} + \ \varepsilon_{i,t}$$

where $Y_{i,t}$ represents individual asset return in country i at time t, and b denotes the benchmark country. $\alpha_{i,t}$ is a particular countries' constant, Δ represents the difference operator and $\varepsilon_{i,t}$ is random term. Deep or absolute market integration requires α converging to zero, γ to converge to one, and the proportion of the variance of coefficients γ to be close to one, higher values of gamma indicate greater integration, if gamma is more than one it signals a multiplication effect which is a bigger repercussion of the price of a regional asset relative to a benchmark asset.

Quantity-based measures

This approach compared to previous ones in not based on the law of one price and it examines cross-border barriers, studying the activities of market participants. Quantities of assets and flows are observed, if markets are integrated there is an expectation that countries will have higher flows of foreign capital and higher stocks of foreign investments as well. These measures deal with home bias, financial integration is complete only if in the home country there is no tendency to hold more domestic assets when risk is the same abroad (Baele *et al.*, 2004).

A famous example of the quantity-based test can be found in a Feldstein and Horioka (1980) paper. The main conception of their test focuses on the relationship between local savings and investment. If there is no relationship between them then capital is mobile. The model is:

$$(^I/_Y)_{it} = \alpha + \beta(^S/_Y)_{it} + \varepsilon$$

where I, Y and S represents investment, output and savings respectively. i denotes individual sample and t represents time. α is the intercept, β is the regression coefficient, and ε is the error term. If capital moves easily between the countries which are observed, then regression coefficient β is close to zero, and when β is converging to one that indicates great correlation between domestic savings and domestic investment, which would conclude weak or no integration. Normally, in interconnected markets, savings look for the best opportunities in the form of highest returns. And if the beta coefficient is close to one then savings are invested at home. Feldstein and Horioka paper found evidence that OECD countries had low capital mobility at that time.

Limitations

Numerous measures of capital market integration have already been delineated and they include several specific techniques and so certain individual tests can be divided into subset measures according to the market observed or techniques used. Also for that reason there is no general agreement among economists how this topic should be tested. This is mainly because each measure mentioned has some drawbacks.

As long as the tests rely on certain assumptions, the weaknesses can usually also be found in them. For instance, perfect price convergence cannot be completed because of transaction costs, therefore the results may suffer bias.

Measurement based on the law of one price uses the ability to identify the idiosyncratic risk factors and systematic risk factors, where it is very doubtful whether the latter can be identified properly. Thus results may not be accurately comparable. Its problem is based on the correlation coefficients which hardly differentiate between common and stochastic shocks.

As was already mentioned, if markets are integrated interest rates ought to move together. Although Bodehorn (1995) argued that the previous works of Stigler and Sherwin (1985), which found declining interest rate differentials on mortgage loans in US markets, are not due to integration but due to ascending homogenous risk attributes of regional credit markets. This could also be valid for the euro zone. Therefore, it is consequential to control risk characteristics in this test.

The theory of the Current Account, which assumes perfect capital mobility, forecasts that the factors of savings and investments are not identical, thus borrowing and lending from foreign countries should not be constrained by domestic savings decisions. But this is contrary to Feldstein and Horioka's results. Because OECD countries' capital integration increased substantially in the period which was observed by their paper, while the correlation coefficient between saving and investment only barely decreased in the Feldstein and Horioka puzzle (Giannone & Lenza, 2008). Another limitation for the quantity-based measure is that if the autarky price level is equalized then this measure will not capture the degree of integration. Furthermore, cross-border capital flows or price convergences can be caused by modifications in economic structure.

An objection against news-based measures can be raised against its assumption as well. The hypothesis says that only identical systematic risk is present across countries, but in reality this condition is not always fulfilled.

Knowing of these restrictions in various measurements, the disagreement among economists that was mentioned is more comprehensible. However, usually numerous techniques are used at the same time, which increases the relevance of results. On the other hand conclusions need to be aware of the limitations.

4 METHODOLOGICAL ISSUES AND DATA

This paper tests capital markets with a focus on government bond markets. An analysis of this market has been carried out over a ten-year period, attempting to explain the not very straightforward interval of the last decade, when the financial crisis and debt crisis occurred in Europe.

The software used in this paper was Gretl, Excel and R.

σ-convergence

The σ-convergence concept was used in the neoclassical theory of economic growth, along with the beta-convergence concept. When this measure is used in capital markets, it calculates the cross-sectional variance of the yields on the same asset types in different countries at a given time. Thus the degree of integration is identified against a benchmark country at that moment; however, instead of the benchmark a cross-sectional mean is used. Quantification of σ-convergence is done according to the formula:

$$\sigma_t = \sqrt{\left(\frac{1}{N-1}\right) \sum_{i=1}^{N} (y_{i,t} - \bar{y}_t)^2}$$

where σ is standard deviation, $y_{i,t}$ is the yield on asset i at time t. $\bar{y}_t$ denotes the cross-section mean of yields at time t. Index i stands for individual countries $(i = 1, 2, ..., N)$. In this analysis $N = 11$, i.e. examination between the euro zone countries under review. Variable sigma takes positive values. The lower the sigma, the greater the degree of convergence.

Cointegration test

The concept of cointegration developed by Engle and Granger (1987) exhibits a model where the vector of the unit root process can move together and can show a long-term relationship over time. Generally, it can analyze a non-stationary series in a meaningful way.

Stationary time series have stable mean and variance over time, autocorrelation depends upon the length of the time interval only. It can also be denoted as an I(0) process. When a time series has to be differenced before it fulfils the above condition of stationarity it

is referred to integrated processes I(n) where n represents the number of differences. Estimations from stationary series have reliable results while higher integrated orders bring spurious results and thus the cointegration model can be used in the long run even with a non-stationary time series.

Therefore, a definition of the cointegration process is introduced. Let $S + 1$ be a set of random time series $Y_0, Y_1, \dots, Y_S$ where for all s, Y_s is integrated at order $d_s > 0$. Then if a vector of coefficients $a_1, \dots, a_s$ is randomly chosen, the linear combination $Y_0 - a_1 Y_1 - \cdots - a_s Y_S$ is integrated at order max d_s with probability 1. Although if coefficients $a_1, \dots, a_s$ exist such that $Y_0 - a_1 Y_1 - \cdots - a_s Y_S$ is stationary, the series are cointegrated and $1, -a_1, \dots, -a_s$ is the cointegrating vector. This definition was extended by econometricians, but for the purposes of this paper it is not necessary to go into the details of the extended definition. So cointegration is evidence of shared random components coercing the series to develop similarly over the long term.

For detecting cointegration we can choose two techniques either the Johansen test or the Engle-Granger test; the latter is used in this paper. The first step we need to take is to regresses one series over another one and check for variables such as trend or seasonal effects. Then we check for unit root, by means of the Augmented Dickey-Fuller (ADF) test for instance. This manner tests stationarity of residuals. Then if two conditions are fulfilled one can conclude cointegration:

- the unit-root hypothesis is not rejected for the individual variables
- the unit-root hypothesis is rejected for the residuals from the cointegrating regression

In the process of cointegration modelling, I will use maximum lags of 12 as the sample of observations is on a monthly basis. This test will serve as an extensional explanation for sub-period after 2008, but only for selected countries that will provide interesting conclusions.

4.1 Government bond market

Focusing on the sovereign bond market, the degree of integration can be calculated by examining the difference between local yield and the yield that would be on a market which is perfectly integrated (Beale *et al.* 2004). However, it is not directly available and so the German government bond yield can simply be used. Formally it can be written down as $r - r^*$ where this expresses the domestic long-term nominal interest rate differential between

home and a foreign country. If perfect capital mobility prevails then $r - r^* = 0$. The equation excludes currency depreciation as long as countries are in one currency area. The risk premium is a measure of the extent of the lack of capital market integration. It implies that in an integrated market there ought to be low dispersion because a high premium which compensates for the risk of idiosyncratic shocks will not be demanded by investors. On the other hand in fragmented markets dispersion will be greater.

Comparing the yields on government bonds across countries is a very good measure based on the law of one price if these assets are homogenous enough throughout the market. And it is achieved due to the same maturity and relatively similar risk structure. However, after the financial crisis the national risk on governments bonds has been revealed to be significant. Thus the assumption is that the same degree of systematic risk has gained greater significance over the last five years, and therefore this must not be overlooked in further analysis.

Barr and Priestley (2004) have shown that the German sovereign bond is very well integrated in the world market, therefore it is reasonable to consider it as the degree which would prevail in a fully integrated market notwithstanding the fact that it is not totally the same to the one that would be in a completely integrated market. Also in this analysis, German government bonds are used as a benchmark.

This test can be considered as almost ideal for measuring integration on this specific market and it is also fairly easy to show it either graphically or in a table. In the section with empirical results it is showed and explained. However, it is more difficult to interpret results during an era of financial instability and therefore explanations might not be straightforward.

Besides the yield spread test, a sigma-convergence, correlation matrix and conventional cointegration test are provided in order to give a clearer picture of the evolution of capital market integration on bond markets.

Data

The data used for the sovereign bond market in this research are 10-year yields on government bonds acquired from a Eurostat database. Yields were carried out using monthly data covering the period from January 2003 until July 2013. The year 2005 - set equal to 100 - served as a proxy year for these indices. Monthly prices were sufficient for this analysis because a long-term trend is being observed so that more frequent data would cause extra

information, which could create too much noise in a time series. This paper examines 11 euro zone countries including core and also peripheral countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, and Spain). The bond yield samples have 127 observations each; all values were available for the given countries. The intersection of trading hours in observed countries on their stock exchanges is approximately the same so there was no need to deal with time overlap. Taylor and Tonks (1989) explained that if two markets are situated in different time zones results will stay the same because the index of one country is cointegrated with itself and therefore the same inferences can be made when we are testing numerous time series. In the end it may cause some problems with the direction of causality but significant results will not be affected.

The data for sovereign credit ratings for the 11 countries were compiled from the latest release of complete sovereign rating history from the Fitch rating agency.

5 EMPIRICAL RESULTS AND EVALUATIONS

Graph 1 shows the spread between yields in euro area countries and the German government bond from January 2003 to July 2013. During the first subset period from 2003 to 2008 until the financial crisis hit the economy, large convergence was achieved. This trend started even sooner as previous studies reported, for example the ECB (2005) report. The beginning of this very close convergence can be dated from 1998. This trend of narrowing yields spread over time is due to further convergence in economic policies and also monetary policies which have caused that inflationary expectations draw nearer across countries. The second fundamental that caused this trend can be found in the Stability and Growth Pact that set limits for deficits. In spite of the fact that SGP is often criticized, it helped to perceive credit risk as small for investors. However, these two reasons can be seen as deepening capital market integration, but the low yield spread especially in the first time period was due to the fixity of exchange rates and sequent euro launch rather than pure capital market integration. The subset period after 2008 will be discussed more later on.

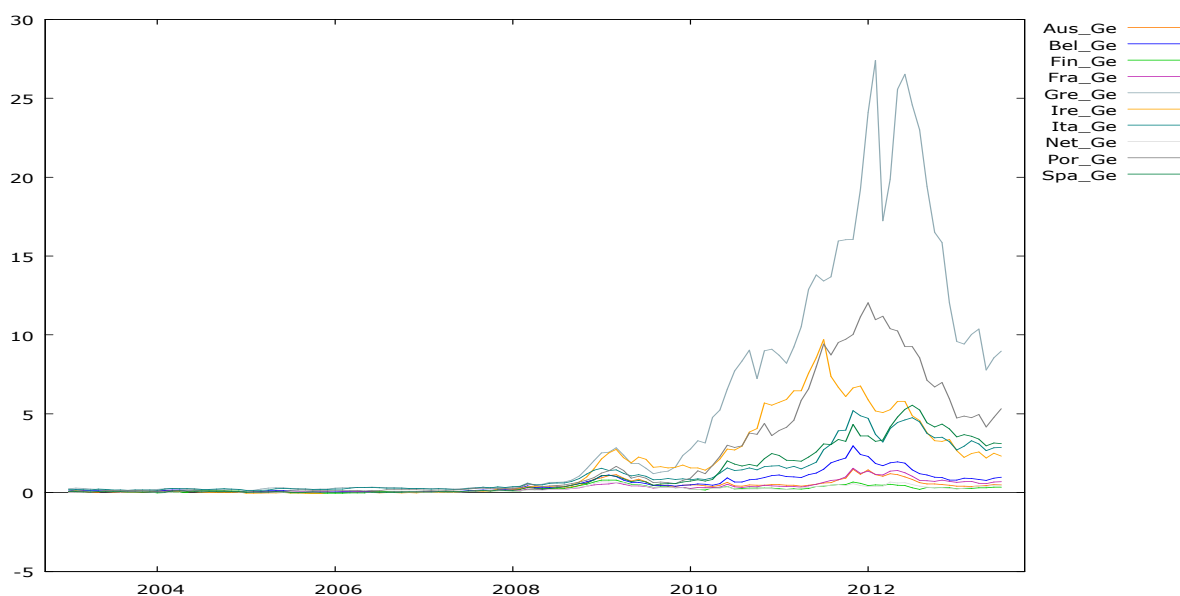*Graph 1: Yield spread for 10-year government bonds relative to Germany*

Table 1 reports averages in yield spreads, but relative to Germany. Some studies are more focused on dispersions including Germany, this paper will also provide this test, but it is also important to compare bond evolution vis-à-vis Germany in order to remove potential interest rate fluctuations that tend to be positively correlated with the level of interest rates.

Table 1 below emphasizes the level of convergence which is remarkable in the period from 2003 up to 2008. Market integration in the sense of yields of sovereign bonds can be seen as it reached complete integration within countries that share very good triple AAA credit ratings: Germany, Finland, Austria, Netherlands, France, and Spain as well. Even Belgium whose rating is somewhat lower seems to have converged almost perfectly. As regards the rest of the countries they reached a very deep level of integration according to this measure. Thus this period in European history of integration is an era of further deepening process, as the European community set it as one of its targets. Although on the one hand deeper convergence occurred, on the other hand it is questionable whether these results which were shown are based upon the profound integration or rather on the fact that markets at that time were experiencing growing economy, and also the introduction of the euro currency in the beginning which might have caused to a certain extent illusion on the bond markets.

Table 1: Average yield spread for 10-year government bonds relative to Germany

	Austria	Belgium	Finland	France	Greece	Ireland	Italy	Netherlands	Portugal	Spain
2003	0,07	0,11	0,06	0,06	0,20	0,06	0,18	0,05	0,11	0,05
2004	0,09	0,12	0,07	0,06	0,22	0,04	0,22	0,06	0,11	0,07
2005	0,04	0,08	0,00	0,06	0,23	-0,02	0,20	0,02	0,08	0,03
2006	0,04	0,05	0,02	0,03	0,31	0,00	0,28	0,02	0,15	0,02
2007	0,08	0,11	0,08	0,09	0,28	0,09	0,27	0,07	0,21	0,09
2008	0,37	0,43	0,31	0,25	0,82	0,54	0,70	0,24	0,54	0,38
2009	0,71	0,68	0,52	0,43	1,95	2,00	1,09	0,46	0,99	0,76
2010	0,48	0,72	0,27	0,38	6,35	3,00	1,29	0,25	2,65	1,51
2011	0,71	1,63	0,40	0,71	13,14	6,99	2,82	0,38	7,63	2,83
2012	0,88	1,51	0,39	1,04	21,00	4,68	4,00	0,44	9,05	4,35
2013	0,45	0,87	0,30	0,66	9,24	2,42	2,91	0,38	4,79	3,34

It will be clearer when the next sub-period from 2008 to 2013 is evaluated and analyzed. This period is significant because this time era represents a shock to the economy. From it, it is possible to observe whether the previous deep integration will continue in times of shocks, or whether it will become evident that those numbers were not because of impressive integration. During the last five years government bond markets in the euro zone showed rising yield differences. Increasing yield differences began in 2008 because of the impact of the global crisis and continued more severely in 2010 when the sovereign debt crisis came. The maximum monthly average difference was reach at the end of 2011 excluding Greece, and at the beginning of 2012 including Greece. The highest difference is 3,58 basis

points in monthly average for selected countries without Greece. This divergence is a little bit distorted because core countries kept their economies stable relative to Germany, and vice versa, peripheral countries diverged more. However, the level of spreads for France, Spain and many other countries (but not all) was lower than could be observed before the introduction of the euro. But as Graph 2 on page 20 shows the overall dispersion after 2008 was at comparable levels to that which prevailed in the mid 1990s.

Before providing conclusions about the evolution of integration the question arises as to what the necessary levels of differences would need to be in order to conclude that the euro zone had disintegrated. In other words did this spread dispersion signalize real capital market disintegration in the period from 2008 until 2013 or were these spreads before 2008 priced incorrectly because of discrepancies in fiscal positions?

Therefore, one aspect of the capital market integration process, on sovereign bond markets, is the co-movement of yields. In particular, if the spreads react in reciprocally comparable ways to situations that occur, i.e. to important information or a significant event. Thus if they co-move even not completely at the same levels it implies that the idiosyncratic effect is still low, which is the sign of a deep level of integration. If this is true then the suggested reason of mispricing would be a plausible conclusion. Otherwise it must be concluded that after 2008 disintegration occurred to a certain degree.

Before showing the relations of co-movement let us look back to sigma convergence coefficients. Graph 2 plots sigma coefficients in time according to methodology described in the previous chapter. Here, Germany does not figure as a benchmark country but is incorporated in the average. Results support the previous yield difference. Sigma which represents dispersion in yields is at very low levels for the period before the sovereign debt crisis and then it increases. The increase which occurred only after 2010 and not after 2008 is because bonds reacted very similarly to the global financial crisis and thus dispersion stayed very low, but it can be explained because of the time lag. It also implies that the integration at least was not shallow. There are obvious outlier values originating from Greece. If the sigma includes Greece the whole plot is very different. Greece's fiscal positions were very unhealthy. The only reason why low spreads before 2010 were maintained was due to the ability to lock into the high credibility of Germany with its low inflation record. However, after the new government in Greece announced a revised budget deficit in 2009, the debt crisis started. Rating agencies lowered credit ratings for several countries. But in rough

numbers, looking at Graph 2, many countries kept movements of bond yields in line with Germany and therefore dispersion did not increase abnormally, if Greece is excluded from the sample. For this reason this analysis will distinguish core countries from peripheral countries.

Graph 2: Sigma coefficients in time
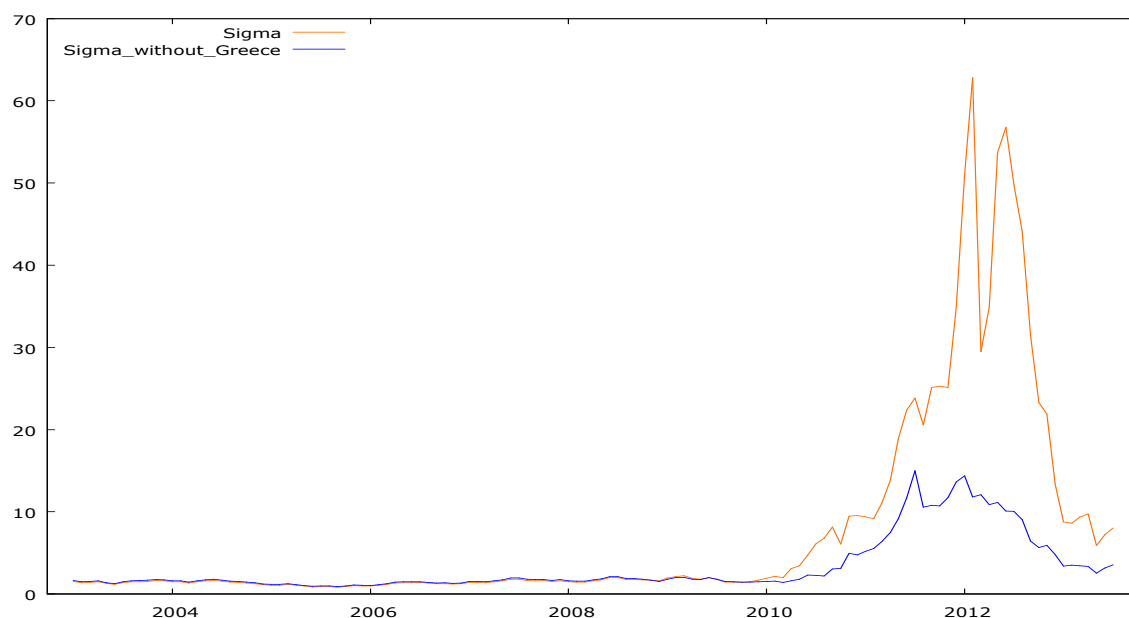
It is evident even from sigma coefficients but also from Graph 1 which shows yield spreads of those peripheral countries (Spain, Italy, Ireland, Portugal, and Greece). They caused an increase in dispersion and also it is evident from Table 1 that these countries diverged the most. As it was suggested there could be some asset mispricing especially for peripheral countries before the crisis but introducing yields for core countries (Austria, Belgium, Finland, France, Germany, and the Netherlands) in Graph 3, it also shows the certain divergence process after the major events hit Europe. These countries can be considered to some degree to have similar fiscal positions. Consequently, it can be concluded that on one hand there is a divergence period even in core countries, and on the other hand it is clear that the co-movement of yields is present among these yields on government bonds. But it still needs to be tested by the unit root test either by the Engle-Granger or Johansen procedure to prove the cointegration relation. Overall it can be concluded that divergence after 2008 began and after 2010 intensified even in core countries. Although after mid 2012 government bonds started to converge to some smaller extent again.

Graph 3: Yield for 10-year government bonds
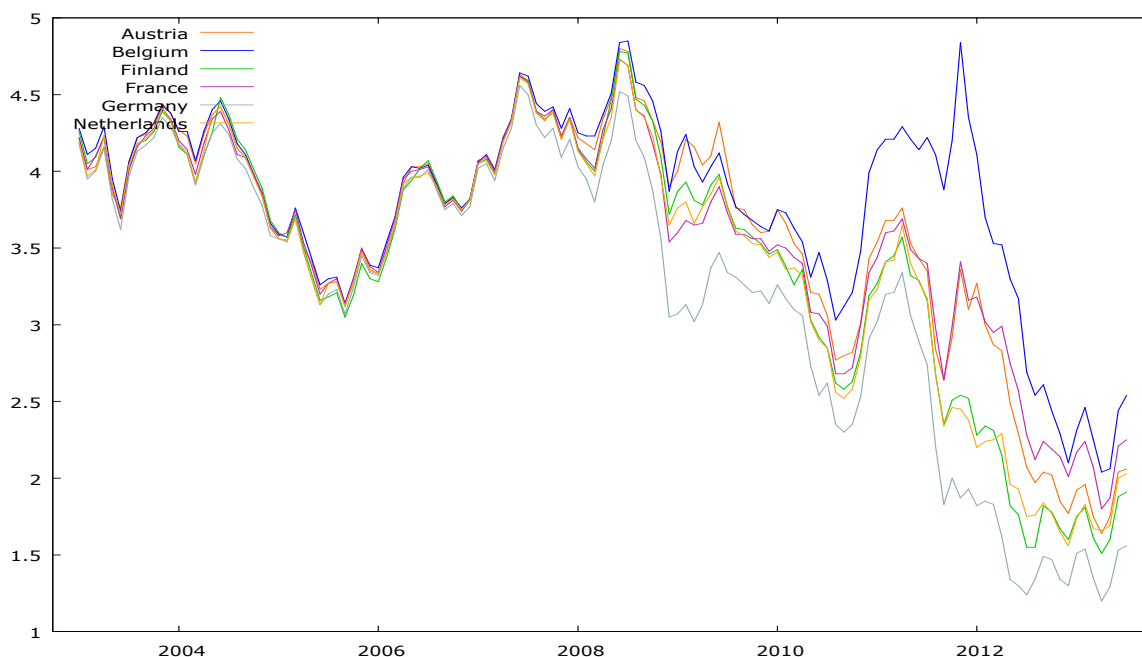
Because of the evidence discovered by this paper so far, it is reasonable to divide our sample period into two subsets, as already mentioned. In addition, the rest of the research focuses on the second subset period from 2008 to 2013 as the period before was very stable and has been explained. From now on analysis evaluates and tests the second period.

Reasons and evaluations

Sovereign markets are influenced by multiple factors. A long-term risk-free interest rate, the perceived credibility of the issuer, liquidity, and trading strategies play the most important role in general. The first one is, however, the same for all sovereign bonds in the euro zone. The most important role has two factors: the credibility or quality of the issuer and liquidity. But seeing as this paper is focused on the long-term bond market it will not deal with the influence of liquidity. Moreover, I perceive that credit risk and the disintegration of the bond markets in the euro area have the strongest relationship.

The perceived credit risk factor of assets on the bond market can account for the divergence in yield spreads from Graph 1. This kind of risk affects real yield on a bond. It is also affected if the investor holds it to maturity. One of the determinants that assesses issuer quality is credit rating. Graph 4 provides the sovereign rating over a ten year period according to the Fitch rating agency. The financial and debt crisis that brought a negative shock had a huge influence on economic determinants such as growth potential, and the limitation of the

income of national budgets. This shock was further strengthened by the transfer of the risk burden from banks to public budgets during the financial crisis (Ejsing & Lemke, 2011). Therefore, the fiscal situation in euro zone countries worsened. Especially countries that had substantial debts and deficits before the crises were affected the most and then their perceived creditworthiness deteriorated. It played a role in the dispersion of yield spreads. Only a few countries kept the best AAA rating, even France's rating was downgraded. The very useful tabular Graph 4 shows this relationship with Graph 1, which shows yield differences. Thus decreased creditworthiness leads to increased spreads in bond yields. Moreover, after a detailed study of debt ratings there is also a division of countries whose ratings stayed very stable after the crises and those that changed a lot.

Graph 4: Sovereign debt ratings
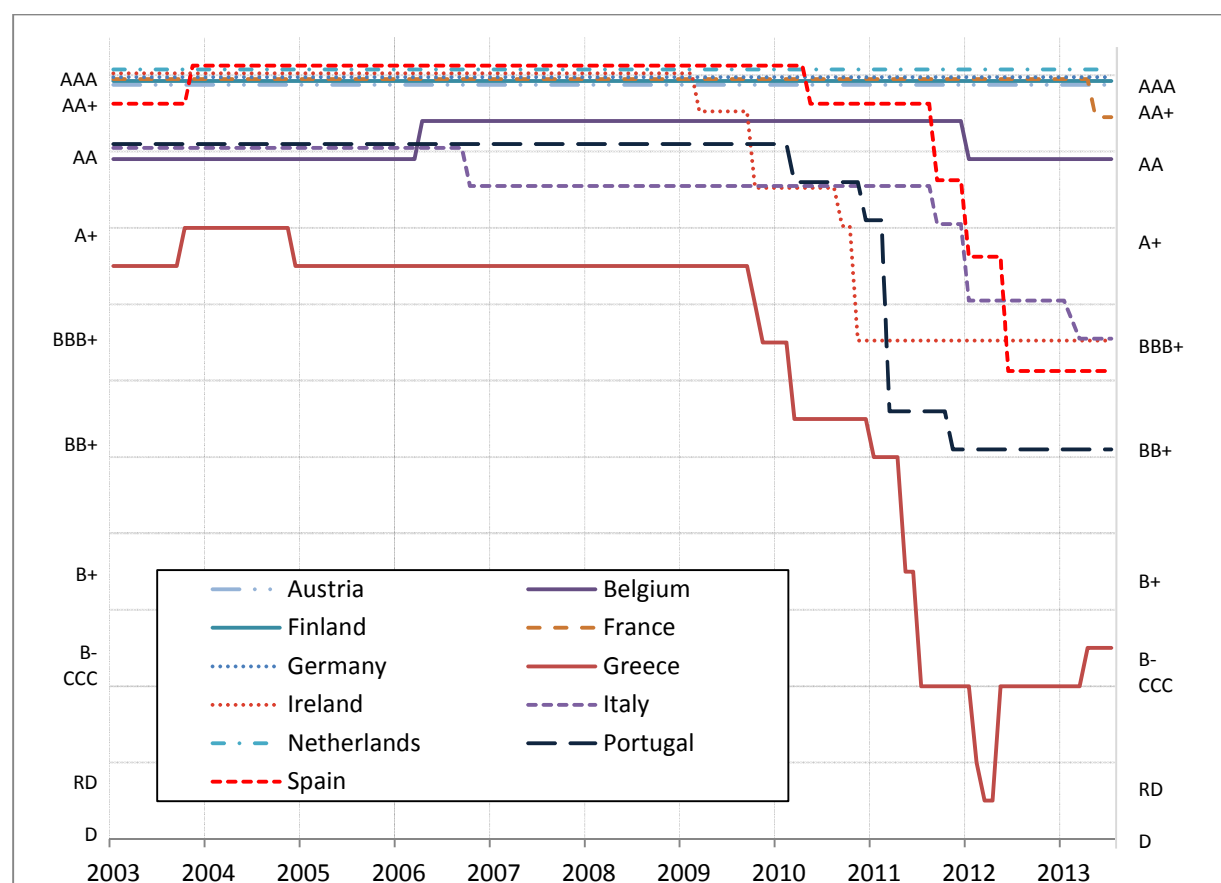
Data source: Fitch Ratings (2013), Sovereign historical ratings. Own calculations.

A second reason which intensified the ongoing trend after 2008 was the dubious methods of fiscal statistics presented by the national government of Greece. The engagement of mispricing of bonds or increased attention to fiscal figures both indicated higher

vulnerability to shocks when investors realized sudden risk which has arisen. Yield dispersion was a consequence of sensitivity that arose after a long period of tolerant pricing for risk premium.

When more realistic figures appeared, the market started to respond sensitively to information about public finances. In the last quarter of 2009 information sensitivity started to play an important role. When the new government of Greece announced the revised budget deficit in October the sovereign yield spread against Germany started to rise. All other significant information downgraded the rating of Greece bonds. A similar but milder situation with a sensitive reaction to information was applicable to all peripheral countries. Even Spain and Ireland whose fiscal positions looked relatively healthy suffered from fiscal changes. These two countries would probably have been able to absorb a medium-size crisis but they could not withstand the European sovereign debt crisis. This is one of the reasons why some economists argue that the risk premiums were exaggerated during the crisis period, but I believe their statement remains ambiguous.

Another significant reason in the divergence of sovereign bond yield was due to liquidity problems. When investors realized the tension on markets they reorganized their portfolios and ran to safer markets such as Germany. This just increased spreads between peripheral and core countries. All these mentioned factors above contributed to the loss of confidence in the euro area.

To sum up so far, the increased dispersion in 2009, 2010, 2011, and 2012 was due to large differences between two groups of countries. However, the culminating dispersion point reached its peak at the end of 2011 and began decreasing after several events. When the Outright Monetary Transaction (OMT) programme of September 2012 was introduced by the ECB, market participants reacted by a slight reduction in the yield gap. With the decision that the ECB took when Mario Draghi stated in his speech *"Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough."* and the consequent formation of the European Stability Mechanism (ESM) that makes direct equity injections to problem banks, overall it limited divergence in the euro zone and restored some confidence. Because OMTs allow unlimited interventions it has a relevant role that started the reverse trend in the end of 2012 - improving market integration. Plus the agreement of the prime finance ministers of EU member states on establishing a banking union that unifies regulations, and centralizes all key competencies in case of the failure of any bank. And the

Fiscal Compact Treaty that is a stricter version of the SGP which entered into force at the beginning of 2013 requires the implementation of fiscal principles into national legislature.

All those steps explain why after a period of divergence in the euro zone, the integration process in 2012 came about again. These events are real steps to deeper integration and therefore price-based measures merely respond to these facts, even if sometimes with some lags. Yield spreads declined in the last year of the sample in the period which this paper examined.

Correlation matrix

The last decade has been examined already. In addition to that, this paper looks more deeply into the evaluations that have been pronounced. The correlation of cross-sectional data of euro zone countries from 2008 to 2013 in some way diverged from each other and I have already explained that countries' yield spreads were divided into two groups: peripheral and core. However, this is not sufficient for the whole picture of integration. This conclusion revealed a certain level of absolute disintegration, but the correlation matrix and cointegration test partial correlations and thus they will show component states' interdependence more precisely. Furthermore, it can either support the previous conclusion about division between individual countries according their credit risks or refute them.

Table 2: Correlation matrix of bond yields

Sample: 2008:01 to 2013:07, number of observations: 67

Correlation Matrix

	Austria	Belgium	Finland	France	Germany	Greece	Ireland	Italy	Netherlands	Portugal	Spain
Austria	1,000										
Belgium	0,895	1,000									
Finland	0,980	0,829	1,000								
France	0,986	0,911	0,968	1,000							
Germany	0,951	0,785	0,986	0,952	1,000						
Greece	-0,610	-0,293	-0,720	-0,564	-0,736	1,000					
Ireland	0,025	0,370	-0,056	0,044	-0,084	0,504	1,000				
Italy	-0,141	0,224	-0,277	-0,076	-0,336	0,734	0,489	1,000			
Netherlands	0,975	0,819	0,997	0,966	0,988	-0,718	-0,058	-0,283	1,000		
Portugal	-0,448	-0,055	-0,567	-0,393	-0,599	0,918	0,681	0,811	-0,573	1,000	
Spain	-0,499	-0,183	-0,183	-0,420	-0,575	0,858	0,519	0,783	-0,563	0,814	1,000

The results from Table 2 clearly show that correlation coefficients between some individual countries are very distant. Many countries share a negative level of correlation. The first group: Austria, Belgium, Finland, France, Germany and the Netherlands all share strong positive correlation. Out of this group of six countries Belgium's correlation relative to the others can be considered the lowest, but is still very strong. This first list of countries share negative correlation coefficients with the rest of the countries apart from a few exceptions. But these exceptions such as the correlation between Belgium and Italy, which have a positive coefficient, indicate very small interdependence. Then the second set of countries also share positive correlations, but not as strong as the first set of countries share. Interpreting the previous section of yield spreads and their dispersion in light of correlation coefficients provides a justified argument to claim capital market disintegration, but only if all sample countries are considered. Partially, the level of integration in core countries even intensified according to this correlation matrix, which is in compliance with the present economic discussions about two phases of the euro zone. Nevertheless, steps that lead Europe to deeper fiscal integration were made and thus capital markets started expecting more confident conditions to put trustworthiness in government bond markets again. Also because of this markets started to be more integrated again and this integration seems to lay on a more stable

foundation than before. Though it is too soon to judge, and complete fiscal integration is still far away and it is not yet assured that it will be completed one day.

Cointegration tests

For detecting capital market integration from a slightly different perspective I test selected bond yields for cointegration. The correlation matrix showed quite clear results. Here, focus is placed on core countries, because it is interesting whether these countries have stable long-term relationships. The aim is to support or disprove the results that were gained from correlation coefficients. The tested sample begins in 2008 and ends in 2013.

First, unit root tests are presented in Table 3. All time series for six countries have non-stationary series according to the Augmented Dickey-Fuller test.

Table 3: Unit root tests

Unit Root Tests						
	Austria	Belgium	Finland	France	Germany	Netherlands
Level form						
ADF-test						
with constant	-0,68	-1,23	-1,33	-1,19	-1,61	-1,43
with constant and trend	-3,37*	-3,38*	-2,97	-2,49	-3,79**	-3,62**
First difference						
ADF-test						
with constant	-4,92***	-5,94**	-3,05**	-4,49***	-3,35**	-2,84*
with constant and trend	-4,81***	-5,93***	-2,93	-4,43***	-3,23*	-2,72

Note: Critical values Augmented Dickey-Fuller statistic at 1% 5% and 10% levels are -3,43 -2,86 and -2,57 (regression including constant), and -3,96 -3,41 and -3,12 (regression including both constant and trend) respectively (Cheung & Lai, 1995). ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

Then Table 4 records values of ADF statistics for residuals in pairs of variables that were tested. For example the cointegration test for Austria and Belgium is listed in the first row and second column. The cointegration test for Belgium and Austria is listed in the second row and first column. All other results are shown in the same logical sequence as was explained.

Table 4: Test for cointegrating relationship

	Austria	Belgium	Finland	France	Germany	Netherlands
Cointegration: ADF Test for Residuals						
Austria	N/A	-1,25	-2,64	-1,38	-3,15*	-2,31
Belgium	-2,29	N/A	-1,25	-1,71	-2,12	-1,19
Finland	-2,42	-1,28	N/A	-2,26	-3,05	-5,87***
France	-1,57	-1,72	-2,28	N/A	-2,15	-2,03
Germany	-2,19	-1,26	-3,02	-2,08	N/A	-3,60**
Netherlands	-2,16	-1,22	-5,99***	-2,03	-3,70**	N/A

Note: Critical values for regression-residual based cointegration tests at 1% 5% and 10% levels are -4,07 -3,37 and -3,03 (Engle & Yoo, 1995). ***, **, * denote statistical significance at 1%, 5% and 10%, respectively.

The majority of results show no cointegration and therefore no long term stable relationships. This was not anticipated after the results from the correlation matrix. Only the Netherlands and Finland from both directions show significant results at a 1% level of confidence. Then only two countries, Austria and the Netherlands are in some way cointegrated with Germany, when the Austrian yield bond is a dependant variable and the German yield bond is an independent variable there is evidence of a cointegrating vector at 10% significance level. But between the Netherlands and Germany for both directions evidence is at a 5% significance level.

To summarize, the results from cointegration tests did not show as many relationships between the six core European countries as one might have anticipated. But from the whole research of this paper it does not signalize complete disintegration in the period between 2008 and 2013 but it gives evidence that core countries are integrated at some significant level. But there is not complete among them, and also it is not as intense as it was before crises. The results from cointegration tests refute apparent very strong integration and make them milder. After all, capital markets after 2008 for the six core countries diverged a little bit, but remained integrated at a significant level.

6 CONCLUSION

This paper used several measurement techniques to test for capital market integration of sovereign bond markets between 11 euro zone countries from January 2003 to July 2013. All selected government bond markets converged very tightly in the period before the financial crisis. Both yield spreads and the level of convergence measured by sigma proved very close interdependence. Since the beginning of the financial crisis and consecutive debt crisis the markets diverged significantly. Large dispersion was observed because peripheral countries' yield spreads against German bond yield increased noticeably. Also correlation coefficients emphasized negative correlation between core and peripheral countries and showed strong relationship between core countries. Then this research analyzed and discovered through cointegration tests that even though the six core countries diverged to a certain extent, in absolute values their bond yields stayed integrated at significant levels.

In this analysis the divergence in the sovereign market is explained by worsened perceived credit risk. I showed that this reason had a very important role, but was not the only reason. This paper could not determine precisely what proportion of the reason of disintegration is accounted for by credit risk. I also draw on the idea that broadening of bond spreads during crises was increased due to the exaggeration of sensitivity to information after the mispricing of bonds that occurred to a certain extent.

The last year of the time period observed indicated a return of the integration process in the euro zone due to several steps that would lead to deeper fiscal union, although this is not necessarily a definite trend in Europe. Therefore, further monitoring of capital market integration would be more than appropriate.

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[1] Data can be downloaded only after registration on the website.