ATHENS UNIVERSITY OF ECONOMICS AND BUSINESS

Contributing Factors of Spreads Differentiations in Eurozone Between PIIGS Countries and Germany

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Abstract

On the current thesis is studied the spread between the yield curves between PIIGs countries and Germany as well as the factors that impact the spreads. The selection of the variables and the regressions were based on the works of Lorenzo Codogno, Carlo Favero and Alessandro Missale (2003) and Athanasiadis (2010). Panel data methodology was used for the computation of the regression and the data cover the time period between 2000 and 2016. The results of the research indicate that global financial crisis, domestic risk and corporate risk impact positively and increase the spread between PIIGs and Germany.

Introduction

As a result of economic globalization and the rapid rise in public debt in many countries, the government bond market has emerged as the most important sector of international markets. Today, more than ever before, yield spreads between government bonds reflect the assessment of markets for the short and long-term prospects of countries: they reflect estimates for the country's fiscal and monetary policy, are directly affected by new rumors, while they are monitored closely in the context of risk-free investment opportunities. As a matter of fact, the yield spreads on government bonds became particularly important in the light of the Maastricht Treaty: the Protocol laying down the convergence rules for a country's accession to Economic and Monetary Union. According to this, 10-year bonds of an EMU member state should not have an interest rate that exceeds 200 basis points the average interest rates of the three best eurozone countries. The aim of this approach is to achieve price stability and the homogeneity of the European market.

Euro area bond yield differentials are investigated by many researchers, and the common fact in most of the papers is that before the global financial crisis the euro area bond markets shared a high degree of financial integration. The critical point that this was not the case any more was at the end of 2009. This was when Papandreou`s government in Greece announced that the country`s finances were far worse than previously announced. At that point, the bond yield differentials, especially in Eurozone, started having great deviations. Empirical evidence from many authors shows that, macroeconomic factors and fiscal imbalances, that were not taken in consideration when examining the yield differentials (spreads) before the euro area crisis after 2009 played an important role in determining the bond yield deviations. This happened because of the fact that a country, part of EMU, going bankrupt was not a possibility before the crisis emerged.

The aim of the current Thesis is to study the difference of spreads of certain economies in the Eurozone as well as the origins of these differences. The economic environment and condition of Europe have changed greatly over the past years in the PIIGS block in relation to fundamentals like external debt, fiscal and current budget deficits. Consequently, the current thesis attempts to

examine the yield differential of the PIIGS countries in relation to the German economy, based on the research of Lorenzo Codogno, Carlo Favero and Alessandro Missale (2003) and Athanasiadis (2010).

Introduction to PIIGS

PIIGS is an acronym referring to a group of countries in the European Union that were considered to be weaker economically after the financial crisis. These countries are Portugal, Italy, Ireland, Greece and Spain. Several officials from PIIGS have protested strongly enough about the acronym, arguing that it is deceptive and does not really help in recovering and strengthening the confidence of the five countries. However, many financial journalists continue to refer to these states with the so-called acronym (Jimei,2016).

During the global financial crisis that began in 2008, these five countries began to emerge as nations of great concern in the European Union, due to the large amount of debt they carried. By 2010, it was obvious that remedial action was necessary and that many of these countries may not be able to come back without significant help. On May 10, 2010, European leaders approved a package of € 750 billion to support these states. The economic problems of the PIIGS overturned the debate on the effectiveness of the single currency used among the eurozone nations. Critics point out that continuing economic imbalances could lead to the break-up of the eurozone. In response, EU leaders proposed an inspection system for approving national budget spending in an effort to promote closer economic integration between EU Member States.

The European debt crisis began in late 2009 and early 2010 when investors began to worry that levels of public debt in Europe have become unsustainable. As a result, they began to look for higher returns to offset the highest risk of bankruptcy. This has led to higher interest rates for these governments and the start of a vicious cycle.

In the European Union, the Portuguese economy is ranked 17th in size. Although the country's debt is less than that of the United States, debt levels have risen by about 20% in recent years. In addition, its unemployment is 10.4% and its population at 10.6 million. Portugal exports more than 75% of its agricultural products. Although it is one of the smallest economies of PIIGS, it has the same symptoms as the other Mediterranean countries, meaning slow economic growth , high unemployment and high debt in terms of GDP (Jimei,2016).

The Italian economy holds the fourth place in the EU, while in 2009 it shrunk by about 4.8%. The country's debt amounts to 115.5% of GDP and the unemployment rate exceeds 7.5%. About two-thirds of the 60 million people work in the service sector, which is partly the reason for high

unemployment. Tourism, which is the driving force of the country, has been negatively affected by the global economy and has started to decline significantly since 2008. Italy boasts a very high standard of living but it has led it to be one of the largest European offenders in terms of public debt (Kazemi and Sohrabji,2012).

Ireland has a population of about 4.5 million, and it is a small economy that puts it close to Portugal in its ranking in the European Union. Despite the fact that Ireland was in 15th place in terms of economic size in the EU, its indexes suddenly fell by 7.5% in 2009. Over the past three years, its debt has tripled since the 25th, 4% while the unemployment rate reached 13.3%. Thus, the country joined the PIIGS team. Ireland participated in the economic boom in the 1990s and 2000s but suffered from the same symptoms that affected many other countries, such as the real estate bubble. It was the first eurozone country to fall quickly in recession in 2008. In order to avoid collapse, Ireland needed considerable assistance including massive injections into banks and major efforts to oversee the government of the country for reconstruction (Brazys AMD Hardiman,2015).

The case of Greece is the most controversial one. Although its economy is ranked 13th in terms of its economic size, its GDP debt is at an impressive 125%. From 2010 onwards, the Greek government has begun to cut budgets, equal to 10% of its GDP. Greece hosts about 20 million tourists a year, which is almost double the size of its real population. Greece joined the EU. in 2001, and its government began to build a debt mountain that exceeded its GDP before the other countries of the European Union. Greece also suffers from slow economic growth and high unemployment rates, but it differs in its economic structure compared to other European countries. Greece lists a very large workforce in the public sector that costs about half of its GDP. This in itself limits the economic recovery of the country to some extent, as the public sector is notorious for its characteristic slow reaction. From the end of 2009 to 2011, Greece is the most popular, and most problematic, member of PIIGS, with the biggest signs of corruption and political unrest (Kazemi and Sohrabji,2012).

Spain holds the 5th largest economy in the European Union and the 12th largest in the world since 2010, with the lowest GDP debt from all PIIGS countries. However, its gross domestic product is at 66.3% low, while unemployment is 20%. For the time being, the country's authorities are going to implement some tough fiscal measures. The Spanish economy relies

heavily on tourism. With over 45 million inhabitants and a large area of land, Spain is an important part of the EU but has been hit by one of the worst financial losses. The reason Spain was placed in PIIGS was its dramatic economic downturn, which began in the late 2000s. Spain for 15 years had GDP growth above average and started to stumble in 2007 as a result of the bubble real estate, high unemployment and the large trade deficit (Kazemi and Sohrabji,2012).

Convergence in EU Member States

Government Bonds Demand

Geographical differentiation

An indicator of the convergence of the bond market in the euro area is the breadth of prejudice in favor of domestic investors of the market. The term "national" refers to the national market boundaries in the euro area in which investors are placed and owned. Geographical diversification is related to the rescheduling of bond portfolios denominated in national currencies in the euro area, rather than to diversification into debt securities denominated in third currencies. The percentage of government bonds held by domestic investors (residents of the same member country as the issuer) declined markedly after the introduction of the euro. The share held by non-residents (including non-euro area residents), on the contrary, increased. On the basis of the available data, it is noted that the above changes are mainly due to the transactions of investors of the euro area member countries.

The fact that differentiation is supported first and most importantly by risk and performance factors serves to interpret the slowness of the process in part. Indeed, from the point of view of the management costs resulting from diversification (in terms of the need to acquire legal and technical knowledge of the particular environment of other market segments in the euro area), there is an expectation of significant alternative returns to lure investors out of the domestic market. In the earlier years of the introduction of the euro, such alternative returns were pushed forward by the prospect of reducing significant spreads of yields among the various government bond classes. Possible alternative returns resulting from geographical differentiation are becoming less attractive. Due to the budgetary obedience guaranteed by the Stability and Growth Pact, all euro area governments enjoy high and relatively homogeneous ratings (Árvai and Heenan, 2008).

The relative homogeneity of different securities reflects relatively limited and steady yield spreads, thereby reducing incentives for diversification. Based on the budgetary discipline provided by the Stability and Growth Pact, all governments in the euro area enjoy high and relatively homogeneous credit ratings. Consequently, a large share (over 80%) of private sector bonds also gained a high level of creditworthiness. The relative homogeneity of the different

securities leads to relatively limited (and stable) spreads of yields and therefore reduces the incentive to differentiate.

However, some differentiation takes place in favor of government publishers with relatively low ratings and high returns. This is reflected in the increase in the percentage of government bonds held by foreign investors in Spain, Belgium, and Italy. Meanwhile, the tendency for a small widening of the spreads of yields between French and German government bonds is attributed to the removal of the barriers to diversification following the introduction of the euro, allowing French corporate investors' demand to be directed away from the frontier of the domestic market (Arnone and Ugolini, 2005)

Another incentive that encourages differentiation is the preference for liquidity. On this issue, German government bonds are attractive to many investors because of their perception of their credibility and their feasibility in relation to the highly liquid futures contracts Eurex. The preference for liquidity and the importance of delivery compared to high liquid future contracts are reflected in the observed premium of current issues in Germany, while this franchise is limited in France or Spain. Another element in favor of German government bonds is the fact that, due to the benchmark regime before the introduction of the euro, their characteristics (legal and technical) are better known on a wider investment base than the bonds of other governments. This shows the importance of the management costs to diversification, which are expected to decrease gradually as investors become familiar with the different types of securities and as the standardization of bond features widen (Árvai and Heenan, 2008).

Credit Differentiation

Prior to the introduction of the euro, investors looking for higher expected returns, accepting the higher risk costs, often diversified their capital with government bonds across the domestic market boundary. Differing yield curves and exchange rate movements ensured a possible alternative return. However, these opportunities ceased to exist when the euro was introduced. This encouraged diversification into alternative asset classes, potentially providing alternative returns. The most noteworthy of these is the diversification of bond portfolios in securities with credit risk, the so-called credits. Unlike bank bonds and Pfandbriefe, credits include corporate bonds and a wide range of 'structural products' (asseted backed securities, debit liabilities, etc.).

The trend towards diversification of credits was also strengthened, on the supply side, by the relative shift in the bond market structure from public issues to private issues. In particular, shifting towards a lower government bond yield makes diversification to other classes of debt indispensable. By contrast, if the reduced government bond yield leads to a large shortage, which reduces their yields relative to private bonds, then this could increase the incentive for diversification (Ferrari et al.2018).

Government Bonds Supply

The convergence of national capital markets has had the effect of stronger competition among publishers. At this point, it is necessary to mention the fact that national government bond markets were already developed before the European Monetary Union came into being, which is not the case for the other markets. Euro area government bond issues have benefited from the upcoming convergence of national capital markets. Following the introduction of the euro, foreign exchange risk was eliminated and as a result financial costs declined to a different extent for individual euro area government issuers. Differences in yields between euro area government bonds have been strong since the previous announcement in May 1998 of the irrevocable fixing of the exchange rates of future euro area currencies. In addition, the likelihood of a relative shortage of government bonds - as a result of the Stability and Growth Pact and the relative decline in overall supply and the likely increase in corporate issuance - contributed to the downward trend in government bond yields compared to other asset classes, , hence further to the financing costs for governments.

The fact that until the beginning of Monetary Union individual euro area national economies competed greatly for access to a common investment base was reflected in the introduction of a number of changes in the structure of their publications in order to cope with new situations and basically to attract funding under the best possible conditions. Investors were increasingly focusing on liquidity, and the status of establishing a benchmark proved to be a matter of increasing materiality. The above benefits were, essentially, the biggest government publishers. The immediate effect of this was the fact that the pressure of increased competitiveness was intensified for smaller issuers. In the context of increased competition, there has been a need to harmonize publishing practices, leading to convergence towards best practice (Faini,2006).

The main changes observed in government publishing methods since the beginning of the Monetary Union are analyzed below. Initially, the size of the editions increased to a large extent. Government publishers focus their efforts on policies aimed at creating distinct benchmark versions, especially where the overall range of government debt is particularly small to ensure adequate liquidity through the entire yield curve. Interest is usually focused on specific market segments, ie the commitment to issue only large liquid issues of three, ten and thirty years of maturity. The most typical example of a political benchmark in the euro area is followed by Ireland, which completely restructured the outstanding debt in some liquid benchmark versions. Other countries like Spain and the Netherlands introduced exchange programs for old non-cash bonds in new benchmark bonds. In general, government publishers have promoted and improved market transparency. Efforts in this area include prior announcement of auction dates and accompanying details and commitments (Arnone and Ugolini, 2005).

Also, governments are trying to focus on specific investment needs to break the market position based on innovations. France and Spain are initially more active in this area, as they pushed the fixed maturity market and inflation-protected alternative securities into their normal bonds. Finally, governments tried to find ways to boost the liquidity of their secondary bond markets. Important in this regard is the promotion of a new liquidity-enhancing technology. A first attempt was made by the Italians who promoted MTS, a single electronic network for the purchase of government bonds. By June 2000, four other countries had adopted the same network (Netherlands, France, Belgium, Portugal). In April 1999, EuroMTS was launched, in which benchmark government bonds of euro area countries are being exchanged.

The bond market was the financial market sector in which the impact of the single currency was faster and clearer. In many respects this was caused by the fact that the government bond market was international in nature even before the introduction of the euro. Euro-area government bonds have in the past been the main way of international diversification for private equity portfolios, which were limited by legal and other constraints in terms of size and composition of foreign exchange and credit risk (Consigli, 2013).

The European Monetary Union was seen as the catalyst that would transfer government euro bonds to the global financial market to such an extent that they could trigger the US government's top US government bonds in the benchmark battle. This view was based on the

fact that the common currency and the single monetary policy established under the European Monetary Union could eliminate the most important factors that traditionally differentiated national bond markets. Consequently, it was expected that the conversion of the whole stock of outstanding issues into the new currency would increase the attractiveness of investors due to the greater liquidity of broader government bonds.

Performance Curve

Since the early 1980s, long-term government bond yields in the euro area have fallen and aligned with those of the other industrialized countries. Indeed, since the introduction of the euro in 1999, long-term government bond yields in the euro area have sharply matched that of Germany (the largest economy in the euro area). In general, the convergence of national yields to a stable level of reduced risk helps the economy as a whole, allowing for cheaper access to debt financing, with less uncertainty about the value of such funds at the end of the year (De Grauwe,2013).

This, in turn, strengthens investment and product in converging countries. The recent enlargement of the bond market in the euro area has beneficial effects in the above process. Given the stabilization effect of the financial system resulting from convergence at fixed and projected interest rates, it is important to recognize the factors that bring about this convergence and maintain it over the long term. Reports from the European Central Bank give a possible explanation for the convergence of euro area yields. During the Third Phase of the European Monetary Union, which began on 1 January 1999, there was a significant convergence of the long-term government bond yields of the countries that adopted the euro. This convergence was triggered by the expectation of the introduction of the euro and by the self-addressed elimination of exchange rate risk in the euro area. Long-term government bond yields have been unlikely to converge over the last 20 years.

It is well known that the decline in government bond yields has three different effects on yield levels. Initially, it may reduce yields as a result of improving government credit standing. It can also increase or introduce a default premium and finally it can increase the liquidity premium. The first two effects result in a reduction in yield, while the latter has the opposite effects. The effects on yields from the relative reduction in government bonds were limited in the euro area compared to the US. This result is not surprising given the fact that, unlike in the US, in the euro

area, the stock of government bonds has continued to increase and will follow this path in the future (Gilmore et al., 2010).

Monetary policy in the euro area countries has, however, achieved a remarkable deflationary start in the early 1980s. To the extent that inflation movements are reflected in nominal interest rates, national yields of the ten-year government bond have also fallen due to convergence between countries. On the budgetary side, the general government balance and debt levels began to improve following the introduction of the Maastricht Treaty. By reducing both the net offer of issued bonds and the probability of insolvency, such progress in fiscal positions is expected to reduce the equilibrium return and the risk premium associated with returns on long-term government returns. Indeed, national government credit assessments in the euro area have improved overall, reflecting a lower risk of default. Consequently, fiscal policy also contributed in turn to the convergence of long-term government bond yields for euro area countries.

Regulatory changes characterize the most vigorous periods of convergence of government bond yields. For the moment, the decline in the mid to late 80's coincided with the signing of the Single European Act in February 1986 and their entry into force next July. The objectives of this Act - achieving a single market for goods and services, labor and capital within five years - have unleashed a renewed impetus to general economic and financial convergence among the members of the European Union.

This reduction of barriers between countries has therefore strengthened the convergence of financial markets, including the bond market. Also, an upward movement is visible in 1992, triggered by the September crisis. Soon, there has been a strong trend towards convergence since the entry into force of the Maastricht Treaty in November 1993. Investors have taken note of low inflation, improved fiscal positions and lower risk premia consistent with the convergence criteria. However, in the mid-1990s, it was a period of uncertainty over compliance with the Maastricht Treaty. As national governments tried to meet the necessary criteria, relatively long-term returns entered a final period of rapid convergence during the last years of the 1990s (Bernoth et al, 2012).

The convergence of long-term government bond yields since 1980 is also characterized by increased parallel movements between national yields. An increase in the correlation between

country long-term government bond yields and German yields has been observed. On average, the correlation increased from 0.69 for the period 1980-1991, to 0.97 for the period 1991-2002, with all countries showing an increase in the correlation between the two periods. Interestingly, Austria and the Netherlands maintain a very high correlation with the German performance over the period because both countries tied their currency with the German mark and were therefore heavily influenced by German monetary policy.

Simple correlations also help to promote primary evidence on how monetary and fiscal policy alignment has an impact on the convergence of long-term government bond yields in the euro area. Fischer suggests that expected inflation should have a positive one-to-one relationship with long-term nominal yield. Indeed, the expected inflation is strongly positively correlated with the yield of the long-term bond. In addition, this correlation is stronger in the first period, indicating that expected inflation better explains the movements in nominal returns during the general deflationary period in the 1980s than in the period of relatively low and stable inflation over the next decade .

The correlation between the general government balance as a percentage of GDP and bond yields is generally negative, validating the theory that positive balances (ie income surpluses) effectively reduce bond yields and hence their yields, as well as the risk of insolvency. While this negative relationship does not apply to all countries during 1980-1991, the opposite is the case for the second period. The general increase in the government balance (ie reduced deficits), as required by the Maastricht Treaty, leads all countries to a negative relationship between their fiscal balance and long-term returns (Codogno et al., 2003).

Under the convergence case, political harmonization in the euro area also resulted in a convergence of national yields. This harmonization was initially triggered by the Maastricht criteria, which countries had to comply with in order to adopt the euro. Given this, it is reasonable to ask why the same trend prevailed in the countries of the European Union not included in the European Monetary Union (ie Denmark, Sweden and the United Kingdom). Indeed, yields on national ten-year government bonds in these three countries converged in the same way as in the euro area. The relative relevance of long-term factors in these three countries is of the same quality as that of euro area countries, of the debt ratio. Policy variables and the world interest rate continue to account for approximately 75% of the variance in national yields.

In order to meet the Growth and Stability Pact, these three countries have independently chosen to pursue a sound monetary policy.

In terms of monetary policy, general observations are being made on the yield trend of ten-year government bonds in the euro area. In particular, the downward trend in ten-year government bond yields since the early 1980s stems from its strong relationship with expected inflation, with changes in bond yields in larger countries and, to a lesser extent, from the effects of the continuing changes in general government budgetary balances. Generally, average performance is below the voltage level. The extent to which long-term interest rates are further increased during the expected economic reversal depends on how far they are off balance-of-value. In the current environment of low inflation and small government deficits, the trend of government bond yields in the euro area and other EU countries should remain low to mitigate the adverse effects on the stability of the financial system (Ardagna et al.,2007.

Government Bonds Spreads

By eliminating exchange rate risk among the member countries' currencies, the start of economic and monetary union in January 1999 created the conditions for a substantially more convergent euro area debt market. However, the interest rates on euro bonds issued by different governments have not fully matched. Spreads between them reflect liquidity spreads, as bonds that are immediately exchanged at low transaction costs and minimal price changes can offer lower returns on equilibrium and differences in the creditworthiness of government publishers. The distinction between credit risk and liquidity, the components of interest rate spreads, has important implications for policy design and financial markets. To the extent that performance spills reflect differences in credit positions, the Growth and Stability Pact and the European Financial Framework are insufficient to ensure that all member countries have the same credit credibility in terms of the market. Differential returns are important indicators of the market perception of fiscal vulnerability and. if higher bond yields entail higher debt service costs, they obey the market (Aßmann and Boysen-Hogrefe, 2012)

The distinction between credit risk and liquidity, the components of interest rate spreads, has important implications for policy design and financial markets. To the extent that performance spills reflect differences in credit positions, the Growth and Stability Pact (80P) and the European Financial Framework are insufficient to ensure that all member countries have the

same credit credibility in terms of the market. Differential returns are important indicators of the market perception of fiscal vulnerability and. since higher bond yields entail higher debt service costs, they oblige the market for national government budgetary policies. The effect of even small deficits can of course be substantial in countries such as Belgium and Italy where debt exceeds GDP and even one tenth of the spread (10 basis points) increases government spending by more than 0.1% of GDP. The type of uncontrolled fiscal policies that SGP is trying to exclude and the resulting market reactions have not been recorded over the past few years. However, if even more limited changes in fiscal positions, such as those observed recently, affect differential returns, it is understandable that the impact of loose fiscal policies is expected to be much more pronounced. This has major political implications: it suggests that expansive fiscal policies can lead to significantly higher debt service costs and that the scope for action will be even reduced to the environment after the European Monetary Union.

To the extent that alternative yield spreads depend on liquidity spreads on government bonds, they barely reflect the relative effectiveness of debt management policies in improving both liquidity and differences in market micro-structure. The consequences of policy depend on the sources of liquidity premiums. If differential yields can be explained by the size of the total debt issued by a particular member country, then only structural convergence will be able to eliminate them. If alternative returns reflect specific types of primary markets where bonds are issued, such as the auction mechanism or the publishing log, and also the degree of efficiency of the primary and secondary markets, there is room for political action to reduce the differences and the necessary minimization of debt management costs can lead to full convergence of returns (Iara, and Wolff, 2014.

Understanding the determinants of return spreads is also crucial in identifying the prospects of the European bond market. If bonds issued by different member countries continue to be treated as incomplete substitutes, the goal of creating a market for the same bond as big and fluid as the US bond market can be abolished. However, whether this is a desired goal depends on the reason for the segmentation. If the different returns were interpreted by differences in liquidity, then their elimination would certainly be a sign of higher efficiency. If, instead, the different returns reflected a different risk of default in the countries, then indicators would be useful for

effectively allocating the funds to prevent irresponsible fiscal policies. And this can be seen as the most important goal than the creation of a single bond market.

Market participants and debt managers in the Member States argue that the different yields of the European Monetary Union are mainly due to liquidity factors. In order to reduce borrowing costs, debt managers have introduced substantial, sometimes costly, innovations, which can enhance the liquidity of their bonds. In particular, with the introduction of the euro in 1999, a number of governments widened the time available for non-competitive second-round mandates, when qualified, to buy bonds at the average price of competing auctions in the first round. Governments also introduced exchange programs to buy old non-liquid issues against benchmark bonds.

Four years after the launch of the European Monetary Union, diversity is still positive and highlights the significant differences in credit and liquidity premiums. In the period 1999-2002, the differences between the yields of ten-year government bonds in Germany and those of other member-states of the European Monetary Union were about 14 basis points on average in the case of France and the Netherlands, and amounted to 32 base points on average in the case of Italy and Portugal. Although these differences were small, they have important implications for public funding. For the moment, if they were applied to the entire Italian debt stock, the recorded spreads of returns would explain the government's alternative spending of 0.3% of GDP (Naik and Yadav,2003).

Before the European Monetary Union, the different yields in Europe were determined by four main factors: (1) expected currency rate movements and exchange rate risk; (2) different tax treatment and controls on capital movements; (3) liquidity , and 4) credit risk. Exchange rate factors disappeared in January 1999 for the countries of the European Monetary Union and tax arrangements were harmonized before the Monetary Union, as controls on capital movements were eliminated long before that. The other two factors, however, remain relevant.

With regard to liquidity, bonds that can be exchanged immediately at low transaction costs and with minimal price changes, even under unfavorable market conditions, can offer lower returns to investors in equilibrium. Liquidity varies among government publishers based on transaction volume, outstanding bond prices, market makers' trading activity, and secondary market

efficiency. Bonds, particularly in the ten-year maturity segment, are high-end products, but the outstanding amounts of outstanding debt vary considerably between government borrowers and their debt ratios. Publishing policies can therefore play an important role. The characteristics of the secondary market, such as import and trading rules or clearing and settlement procedures, are alternatively crucial for liquidity, in particular the willingness of market makers to set prices and be prepared to meet buy and sell orders. Incentives for trading and investing in specific bonds may also depend on the availability of fund hedging tools, such as liquid and effective futures contracts and effective exchange swap markets (Von Hagen et al., 2011).

As far as credit risk is concerned, meaning the risk that the country may not honor part or all of its liabilities depends critically on current and future declared and hidden debt and on debt sustainability. Sustainability of debt depends on expected income surpluses or deficits, as well as on future economic activity and interest rates, which in turn are influenced by domestic and international factors and policies. The member countries of the European Monetary Union lost the right to issue money for their debt, so credit risk became even more significant since the exchange risk was eliminated. In addition, fiscal rules such as the Growth and Stability Pact can change the market perception of credit risk and thus affect the interest rate (Von Hagen et al., 2011).

Interestingly, eliminating the foreign trade factor from return spreads in the period following the European Monetary Union, it appears that all spraying yields on the German bonds have widened. A number of factors are responsible for this event. Initially, the concentration of trading activity on the German market, at least in the segment of future contracts, and the fact that credit and liquidity components increased more intensively for debt issued and by smaller countries such as Austria, Belgium and Finland, show that differences liquidity against German bonds have widened since the introduction of the euro. Secondly, the observed changes may partly reflect the change in the market price of these Factors, perhaps as a consequence of the high degree of market convergence - ie before the monetary union, the liquidity and credit risk differences were not priced entirely in line with market segmentation. Finally, it cannot be excluded that part of the change in the components of credit risk and liquidity is upwardly biased according to the two following factors (Von Hagen et al., 2011).

Firstly, prior to the European Monetary Union, differences in the credit position were partly captured by the foreign trade agent, since governments had the possibility of monetizing domestic debt in order to avert the risk of insolvency, which is reflected in the devaluation of the domestic currency. Since the inception of the Monetary Union, this right is no longer possible given the article not providing funding for the Treaty of the European Union. Second, if the spreads between the currencies partially reflect the liquidity differences, then the calculated foreign exchange factor will be upwardly biased, so the credit and liquidity components will be downwardly biased. In any case, the increase in yield spreads for countries where the foreign-trader was not significant shows that these biases do not fully explain the increase in the price of liquidity and credit risk (Von Hagen et al., 2011).

Literature Review

Current Literature IN Economic Convergence

From time to time, many cases of possible convergence of economies of different individual states or groups have been studied, depending on the economic, political, social and other circumstances prevailing at the time. Even geographic coexistence has contributed to the examination of such cases. The cases of Germany and the United States have been especially examined as leaders in their continents, while with the addition of Japan and other economically powerful countries in the global economy, it has also been examined the possibility of a global convergence of economies. Still, there have been cases of Asian developing countries in relation to Japan, such as the Philippines, Thailand, Singapore, and others, and the countries of the North or South America, among others, and many other combinations, depending on the interests, motives and in general the criteria that lead each analyst.

A very typical and interesting example of such economic convergences is a case of the European Union (EU) in its present form, which had begun as an economic community of a handful economically developed Western European countries. A few decades later, it had grown into an economic-political union of 28 countries with completely different economic and political characteristics, and, most importantly, had introduced a new common currency, the Euro, which is one of the world's strongest if it is not already the strongest from those. The Euro began as a European Monetary Mechanism (ERM), which evolved into the European Currency Unit (ECU) to bring to the physical the existence of a new common European currency from 2001 onwards regarding Greece and since 1999 for the rest of the countries.

Ever since 1992, there are certain necessary conditions that need to be fulfilled from any country that wants to join the common European currency and which were adopted in the Belgium city n of Maastricht. The criteria established in 1992 for the entry of a country into the Eurozone, or the Maastricht criteria as it was known, are summarized as follows (Mosley, 2004):

1. Inflation: The average inflation rate of the country under review (Harmonized Index of Consumer Prices - HICP) must not exceed by more than 1.5 percentage points the average inflation rate of the three lowest inflation countries in the EU.

2. Interest rates: The average long-term interest rate should not exceed by more than 2 percentage points the average of the long-term interest rate of the three countries with the lowest inflation in the EU.
3. Public Deficit: It must not exceed 3% of Gross National Product (GDP) at market prices.
4. Government Debt: It must not exceed 60% of GDP. An exception can be made for countries whose debt is falling at a rate that can be brought close to the 60% threshold.
5. Exchange rates: The exchange rate of the applicant country's currency must remain for at least two years within the normal fluctuation margins provided for by the European Exchange Rate Mechanism (ERM II).

As can be seen from the analysis of the economies of the Eurozone countries, the above criteria lead or impose a nominal convergence as a kind of initial (common) conditions. Thus, questions of the type are born if there is real convergence, how can this be achieved, with what policies, even if there are other types of convergence. In addition, we can mention legal convergence. By this, we mean the adaptation of national legislation and the provisions governing the operation of the Central Bank in order to comply with the European System of Central Banks. More generally, convergence of this type addresses issues such as the independence of the National Central Banks and their integration into the ESCB.

As it can be easily seen, the often painful process of convergence of economies has given rise to the existence of vast literature, as many scientists have tried to confirm or reject convergence, explain it, and even predict its course. An important role in the development of the literature was played by the move towards the integration of international financial markets and the move, in 1973, towards a more flexible exchange rate system. The almost complete absence of institutional and governmental restrictions on the movement of capital between developed industrialized nations has created the expectation that their interest rates for the same duration will be determined by similar rules and will follow similar paths. The research effort was also helped by the development of new methods of econometric analysis and control of time series as it became apparent that traditional statistical tools could not be applied when the time series studied are not stagnant. Even looking at the differences from the average, a method historically used in the past to make the time series stagnant, seemed no longer sufficient to ensure stagnation (Landon and Smith, 2007).

Initially, Bruneau and Jondeau (1999) examined the existence of a link between the short and long-term interest rates of Germany, Switzerland and the USA for the periods 1974-1979 and 1979-1984. According to their results, using Granger spectral analysis and tests of causality , in the first period there is little connection to short-term and zero-long-term interest rates. On the other hand, there is a significant connection in both cases.

Katsimbris and Miller (1993) examined the course of short-term nominal interest rates between Germany and other member states of the European Monetary System (EMS) for the period 1979 to 1988. They found that each time series had a unitary root, that is, non-stationary. Conversely, convergence tests did not show that there is any systematic relationship between Germany's short-term interest rates and each of the other countries. However, following Granger's causality tests, they find a one-way causal link between German interest rates and those of other EMS countries (except Ireland), in order to arrive at a more general finding of Germany's dominant role in the EMS, irrespective of any particularities or restrictions on capital movements.

Bremnes et al. (1997), questioned these conclusions with the addition of short-term US interest rates and for the same period, they highlighted the limitations of the Karfakis and Moschos method. They have concluded that the US also plays an important role in shaping European interest rates and that this causal relationship is in many cases two-way. These conclusions are in line with those of other researchers at that time (De Grauwe and Vanhaverbeke, 1993) that monetary policy within the EMS is influenced by both endogenous and exogenous factors, especially if the different regimes exchange rates.

At the same time, Hsu and Kugler, (1997) analyzes short-term interest rates for Germany, Switzerland and the US. For all time series, the zero root cause case cannot be rejected except for Switzerland in the period 1974 - 1978. Thus, it is generally concluded that interest rates are non-staged in terms of levels but stagnant in their first differences, which is attributable to the divergent approach of the three countries in the conduct of their monetary policy.

DeGennaro et al in 1992 also looked at short-term interest rates in six European countries and found that when they were considered individually they had a single root, while when they were examined together they were related, with a balanced relationship. This shows that short-term interest rates between countries show similar behavior due to market arbitrage. Shortly

afterward, Fung and Isberg in 1992 investigated the relationship between interest rates on deposit certificates between the US dollar and the Eurodollar for the period 1981-1988. They conclude that by 1983 the dollar was affecting the other markets, and afterward 1984 is the opposite, highlighting the growing importance of non-US markets.

Fauve et (1999) analyzed long-term bond rates for five different countries. For each time series, it found exactly one unit root. Unlike previous surveys on short-term interest rates, stock, and foreign exchange rates, etc., the controls concerned showed little coincidence in the long-term interest rates of the five countries. Similar results have been achieved by Meese and Rogoff since 1988.

The strong correlation of long-term interest rates internationally is also observed by Kazemi et al in 1993. According to his results, there is a single common factor affecting them. Shortly thereafter, Fase and Vlaat in 1999 examines the recent changes in interest rates within the area of the European exchange rate mechanism and, while admitting the convergence of short-term interest rates, attributes it to changes in the exchange rate framework and the evolution of macroeconomic conditions and not only to financial integration. In 1999, Booth and Tse examined the interest rates on US Treasury bills and forward contracts on Eurodollars and found that the short-term interest rates for both products are related and are moving together from 1982 to 1991.

Lastly, in 2003, Chinn and Frankel published a major paper reviewing nominal interest rates on euro deposits for different maturities and inflation from 1974 to 1995 in various countries, ten in total, from Europe, America and Asia. They used cointegration tests to look at the interaction of economies and their results were varied. When all ten countries were examined at the same time, there was some degree of integration of interest rates, but few signs of convergence, except in the late 1980s when the European Monetary System was at its peak. In terms of inflation, either for the ten countries at the same time or for some subgroups such as the European countries or Canada with the US or the US, Germany and Japan, there are signs of convergence. Overall, the differences in the results between interest rates and inflation indicate that the correlation with interest rates reveals the existence of other factors affecting it, such as exchange rates. In other words, a common long-term balance of financial markets, as measured by nominal interest rates, is achieved faster than inflation measurements would indicate.

Apart from the nominal ones, studies were also made that related to real interest rates. During the 1980s, Mark (1985) published major empirical studies examining the evolution of real interest rates in seven major economic powers of the OECD since 1967, using regression methods. Its results largely rejected the equality of real interest rates as predicted by the theory as well as earlier investigations. This did not necessarily mean the existence of unexploited arbitrage opportunities or the lack of rational behavior of the markets. It was attributed to the existence of different risk margins for each country and fluctuating over time in foreign exchange futures or in bonds with different currency currencies. Of course, this finding of real interest rate inequality did not rule out the possibility of a trend of equalization over the years, opening up a brilliant research field for the next few years, in order to investigate questions such as what is the "balance" rate, if there are individual groups of countries with converging interest rates, etc.

Arrieta in 1988 used unit-level controls in annual, quarterly and monthly data on interest rates and price indices in many countries. The results showed that all-time series had a unitary root. But what was not proven by the evidence was that if inflation and nominal interest rates had a single root at the same time, then real interest rates had such a root. Kirchgässner and Wolters used the quarterly euro rates and domestic interest rates for the same countries in 1990 (Germany, Switzerland and the USA) for the period 1974-1988. Looking at the stagnation of real interest rates, they found that short- nominal interest rates in different countries are non-stop, unlike their first differences. At the same time, nominal interest rates and inflation do not seem to correlate, while for real interest rates there are some signs of non-stagnation, which confirms earlier surveys.

In 2009, Arghyrou et al studied real interest rates in the European Union, examining whether the principle of equivalence of (real) interest rates applies. For this purpose, he even used the same method to be used in this work: the analysis of panel elements. To this end, they analyzed data from nine countries within and outside the EU: Belgium, France, Germany, Italy, the Netherlands, the United Kingdom, Canada and the USA for the period from 1979 to 1998 and Germany as reference country. It creates subgroups, one with the countries of the "hard core" of the euro (Belgium, France, the Netherlands), a second with the addition of Italy and the United Kingdom, countries with a turbulent relationship with the European Monetary System, and a Tuesday with outside the EU. Its results show that the principle of equivalence of interest rates

with respect to Germany is indeed strong for the larger EU countries since the second half of the 1980s, and especially for Belgium, the Netherlands and France this is particularly evident from the in the mid-1990s. On the other hand, in the case of non-EU countries, this principle does not seem to be valid, showing that increased capital movements and the attempt to meet the Maastricht criteria have played an essential role in the trend of equalizing European interest rates.

Lorenzo Codogno, Lucas Favero and Alessandro Missale (2003) investigated the yield differentials in Eurozone and concluded that they exist mostly due to credit risk-related domestic and international factors. This conclusion, contradicted the common belief at the time that traditional liquidity indicators, such as bid-ask spreads, trading volumes and outstanding amounts, as well as the presence of liquid future contracts explain a substantial part of yield differentials in the European Monetary Union. Codogno et al. used as their model the following

〖RAS〗_(t,T)^i=(R_(t,T)^i-R_(t,T)^GER)-(〖RSW〗_(t,T)^i- 〖RSW〗_(t,T)^GER)

Where :

〖RAS〗_(t,T)^i are the yield differentials not related to exchange rate factors

R_(t,T)^i is the yield-to-maturity of 10-year bonds issued by country i

R_(t,T)^GER is the yield-to-maturity of 10-year bonds issued by Germany

〖RSW〗_(t,T)^i is the 10-year fixed interest rate on swaps denominated in currency i

〖RSW〗_(t,T)^GER is the 10-year fixed interest rate on swaps denominated in Deutsche marks

Codogno et al. note that RAS, the relative asset swap, coincides with the yield differential in the EMU period.

As observed by Favero et al (1997) and Blanco(2002), the exchange rate factor heavily affected yield differentials in the pre-EMU era. So, after filtering out the exchange rate factor from yield differentials they could pool data from the pre-1999 and the post-1999 regimes. Then ,they implemented the following empirical model on monthly data:

〖RAS〗_(t,t)^i=λ〖RAS〗_(t,t-1)^i+(1-λ)[(d_(i,t))(β_1+β_2 Z_t)+β_3 Z_t]+(1-λ) β_o+u_(i,t)

Where:

〖RAS〗_(t,T)^i is the relative asset swap spread for country i

d_(t,T)^i , is the (log)deviation of country i debt-to-GDP ratio from Germany's debt-to-GDP ratio

Z is a vector containing exogenous variables measuring or approximating risk premiums. Their baseline specification for Z includes (R_t^US-r_t^US) , the slope of the US yield curve as measured by the difference between the yield-to-maturity of 10-year US government bonds and the 3-month interest rate on euro-Dollars, 〖(R〗_t^(SP,US)-R_t^US), the spread between 10-year fixed interest rates on US swaps and the yield on 10-year US government bonds, and (R_t^(C,US)-R_t^US) , the spread between the yield on Moody's Seasoned AAA US corporate bonds and the yield on 10-year US government bonds.

They enter the variables in Z both linearly and interacted with the deviation of country i debt-to-GDP ratio from Germany's debt-to-GDP ratio. This interaction allowed them to assess the risk-relevance of debt indicators. A significant interaction means that when global risk increases, all spreads increase but proportionally to fiscal fundamentals. Hence higher-debt countries are riskier from this perspective. Note that in our specification the effect of debt indicators becomes zero when country i fundamentals are in line with Germany's fundamentals. In line with this assumption, we identify the interaction term as capturing the credit risk.

They also, allow for the variable in Z to enter linearly into the model to test the importance of international factors independently from debt ratios. The consideration of this linear term is necessary as international factors might affect the relative asset swap spread either because of 'structural' differences in liquidity or differences in non-varying unobservable fundamentals, such as the reputation of the issuing governments.

So the from the evidence of the daily data they conclude to the following model after the EMU-period which will be used as a base in the current paper:

〖RAS〗_(t,t)^i=λ〖RAS〗_(t,t-1)^i+(1-λ)[(d_(i,t))(β_1+β_2 〖(R〗_t^(SP,US)-R_t^US)+β_3 (R_t^(C,US)-R_t^US)]+(1-λ)[β_4 (R_t^(SP,US)-R_t^US)+β_5 (R_t^(C,US)-R_t^US)]+(1-λ) β_(0+) u_(i,t)

-Athanasiadis (2010) used the following model

$$RAS_t^i = \alpha + \beta_1 RAS_{t-1}^i + \beta_2\left(RDG_t^i - RDG_t^{GER}\right) + \beta_3\left(RDTG_t^i - RDTG_t^{GER}\right) + \beta_4\left(R_t^{SP,US} - R_t^{US}\right) + \beta_5\left(R_t^{C,US} - R_t^{US}\right) + u_t^i$$

Where:

- RAS_t^i is the relative asset swap for country I
- $(RDG_t^i - RDG_t^{GER}$)is the deviation of country's deficit-to-GDP ratio from Germany's deficit-to-GDP ratio
- $(RDTG_t^i - RDTG_t^{GER})$ is the deviation of country 's debt-to-GDP ratio from Germany's debt-to-GDP ratio
- $\left(R_t^{SP,US} - R_t^{US}\right)$ is the spread between 10-year fixed interest rate on US swaps and the yield on 10-year US government bonds
- $\left(R_t^{C,US} - R_t^{US}\right)$ is the spread between the yield on Moody`s Seasoned BAA US corporate bonds and the yield on 10-year US government bonds

He used the method of Seemingly Unrelated Regressions (SURE) for the period of 1996-2009 and he concluded that the main driving factor behind the evolution of government bond yield spreads are the international risk factors as they are captured by the difference of Moody's Seasoned BAA corporate bonds relative to US Treasury bond yields. The proxies who represent idiosyncratic risk factors in the model, namely deficit-to-GDP ratio and debt-to-GDP ratio, affect the assessment of yield spreads, especially the deficit-to-GDP ratio, however in a smaller degree.

Methodologies Used

The concept of convergence covers a very wide range of narrower concepts in many areas of economic and even social life. There are the individual concepts of interest rate convergence, exchange rates, industrial derivation, wages and more. Generally, any measurable financial size has been the subject of analysis and study, since comparing its behavior with another that is considered to be ideal or simply a point of reference has obviously been of great interest. Individual concepts could be combined under the growth umbrella, for which many theories and methods developed: In the 1950s, the neo-classical model was developed (Solow, 1956),

according to which, given the technical specifications and preferences of an economy at microeconomic level, its per capita product will reach the same level, regardless of the original conditions. By comparing different countries, this means that any differences between economies of the same technological level and preferences will simply be transitional.

Later, in the 1980s, and in view of the persisting differences between the economies of developed countries and those of the developing countries, and the failure of the neoclassical model to explain the fact that the growth rates of the developing countries were significantly lower than those of their respective counterparts developed countries, leading to the lack of convergence, some researchers were led to formulate the model of new growth (Grossman and Helpman 1990). According to this, there is a stable and lasting relationship over time between the initial conditions of an economy and its level of production. Recent research has shown that complementarity in production coupled with market incompetence creates long-term multiple points of equilibrium, which means that the economies under consideration do not have to converge.

Naturally, these two so different theories about the convergence of economies have led to the formation of many empirical controls used by the warriors and their followers. These tests are divided into two major groups:

1. The first includes those examining the correlation between the initial level of per capita production and the growth rates that follow, for a group of countries. In this case, a negative correlation implies a convergence of economies, as countries starting from lower production levels are growing faster than others starting higher. Thus, convergence of two economies between two-time points t1 <t2 occurs when the difference in output at time t2 is less than the difference at time t1. A precondition for applying these controls is that the data analyzed are from emerging economies that have not yet reached their equilibrium. So these controls are best suited to such economies.
2. The second group looks at long-term behavior with the time of production differences for different countries. Here, these differences are considered transitional as they tend to zero as the forecast horizon increases. Convergence means that there can not be a single root or some trend over time, and the levels of production of two economies need to be correlated. In other words, there is a convergence between two economies when long-

term forecasts at some point in time for production are the same, with no regard for the initial situation of each. Here the assumption is that the economies under consideration have reached a steady state in terms of production.

The results of the controls of these two groups are quite contradictory to each other. The first group seems to reject the null hypothesis of non-convergence in the case of advanced economies in general (Lucas, 1988) but also of North America in particular (Mauro, 1995), examining parameters such as population growth and savings rates. On the other hand, the second time series method seems to accept the zero hypothesis of non-convergence (Quah 1992, Bernard 1992, Quah ,1995).

The usefulness of integrated time series in econometrics has been extensively investigated over the past decades, resulting in rich bibliography. In the analysis of a variable, the approach of Box and Jenkins (1970) to study ARMA stagnant models, has shown that a strong and consistent methodology is required to ensure the existence of a single root. Generally, however, such controls do not have normal marginal distributions, such as the basic and well-developed Dukki-Fuller tests (DF 1979, DYNAMY 1981), which, in quite general circumstances, converge to a function characteristic of Brown's movement (Said and Dickey, 1984). Later, semi-parametric control procedures were proposed (Phillips 1987, Phillips and Perry 1988) which, under specific circumstances, showed improved properties for their probative power (Diebold and Nerlove 1990).

In finite samples, it is known that these unit root control procedures have limited power over the alternative hypothesis, exhibiting significant deviations from the equilibrium position (Campbell and Perron 1991). Thus, the need for simultaneous examination of a set of time series as a means of controlling the existence of a unitary root with greater probative power was born. These checks are designed to look at the zero hypothesis that each individual time series in the panel converges to a specific value, against the alternative hypothesis that all individual time series are stationary. It is logical that simultaneous control of all time series has greater probative value than checking each time series individually.

At this point, the first assumptions were made, for example that the remarks show the same distribution for each member of the set. Kyan (1990, 1994), looking at a panel with IID

disorders, showed that the statistic test of DF shows a normal distribution at the limit when the number of panel members and the number of observations are randomly large. This method did not leave many degrees of freedom as it did not allow for some characteristic qualities in any panel member, nor the existence of any general factor that would affect the conscience of all members. One step forward was the work of Breitung and Meyer (1991), which consider a panel with a large number of members for a small and stable number of observations over time. This method, although allowing for the effect of time on observations and a higher order linear relationship, provided that this correlation is the same for all members of the panel, can not be applied to a panel with heterogeneous errors.

Levin, Lin and Xu (2001) allowed several degrees of freedom with particular characteristics to members, influencing the observations from time, and the error variable and the upper-order linear association changed freely among panel members. The result was that they demonstrated that this method presents a dramatic improvement in the probative power, relative to the separate control of the unit root for each time series of each member of the panel. Even in this case, however, there were limitations as their method was highly dependent on the requirement of independence between panel members and could not be applied when there was a correlation between them. It was also quite restrictive that all members of the panel were identical in terms of the existence or absence of a single root.

As has been shown above, an important element of the method that has been quite concerned with the literature is the number of observations and the number of panel members. Older works looked at a stationary panel with specific time observations, and the number of members could be as large as possible.A similar method, however, for non-stationary panel was used by Levin et al (2002). On the other hand, Black (1995) examined the case of a panel where both the number of observations and the number of members approached, under certain constraints, infinity. Indeed, the latter applied a method that did not require the existence of an identical first order association among its members.

Generally, when the number of observations is too large, then routine unit root checks can be considered powerful enough to apply to each member of the panel individually, and the combination for a small number of members can yield trusted results. Accordingly, for very few observations and for a very large number of members, routine checks are appropriate. However,

if we have a medium-sized panel with 10 to 250 members and 25 to 250 observations for each, as is the case for most industry and econometric analyzes of the sizes of different countries, more flexible methods are needed, with more degrees of freedom, as mentioned above.

In recent years, at least in terms of panel analysis, some models have prevailed, the main ones being outlined below. This description also shows the most important differences between them:

- Levin, Lin and Chu (LLC 2002): This method assumes that there is a common process of finding the unit root for all members of the panel. Although some particularities are allowed between the members as well as trending over time, the basic prerequisite is that all members of the panel have identical first-degree autocorrelation. Conversely, all other error function parameters and higher order autocorrelation change freely. The basic ADF regression equation for the panel with members is as follows: $\Delta y_{it} = \delta_i y_{it-1} + \sum_{L-1}^{P_i} \theta_{iL} \Delta y_{it-L} + a_{mi} d_{mt} + \varepsilon_{it}$ with the third term showing the exogenous parameters of the model. The zero assumption for this method is that each panel member has a non-staggered time series, rather than the alternative that all members have stagnant time series.
- Breitung and Pesaran (2008): This method is similar to LLC as it starts with the same basic ADF equation and also contains a number of steps until it reaches the approximate equations to be used to control the assumptions which are the same here as LLC : zero, that each time series has a single root, against the alternative that none has a single root. A difference with LLC is that for the creation of standard approximation equations, only the part of autocorrelation is subtracted and not that which corresponds to the effect of exogenous factors. Then, from these equations, rows without time trends are produced to combine both of them into an equation of the form Δyit = αyit + vit with α converging asymptotically into the form of standard normal distribution. As with LLC, one has the option not to include extraneous factors in the model or to include stable terms and time trends depending on the particular panel member.
- Hadri and Guermat (2003): This method is based on the single-regression residues using the least squares method and uses a Lagrange (LM) multiplier to control the zero hypothesis that the individual time series are stationary around a plane or linear trend,

against the alternative, ie the existence of a unit root in a panel time series. The Lagrange multiplier is given by the format: $LM = \frac{\frac{1}{N}\sum_i^N \frac{1}{T^2}\sum_{t-1}^T s_{it}^2}{\sigma_\varepsilon^2}$,where sit is the sum of the residues and σ2 with a consistent estimator of the standard deviation of the error. The asymptotic distributions of any such control are shown to be normal. The most generic model that describes elements of a panel and can be applied to these controls presents particular features, trends and heterogeneity among members, but linearly unrelated errors over time. Even in this case, however, Hadri presents a way to apply, and the only way to apply the method is to determine the shape of the regression.

- Im, Pesaran and Shin (IPS 2003): This method, also starting from the basic ADF regression equation, allows for linear correlation of residues and heterogeneity among panel members, as opposed to LLC. The initial equation of IPS is: $\Delta y_{it} = a_i + \beta_i y_{i,t-1} + \varepsilon_{it}$, while the null hypothesis is H0: βi = 0 for all n against the alternative H1: βi <0, i = 1,2, ..., N1 and βi = 0, i = N1 + 1, N1 +2. N, which is also a significant difference with LLC. Then, after calculating the regression ADF t - statistic for each panel member, the t - bar statistic is calculated as the average of the above. This method requires the determination of time lags (the greater number than does not adversely affect the method as opposed to the smallest), while we can also choose whether or not there are fixed features for each member of the panel and time trends.
- Fisher - ADF (Levin, Lin and Chu, 2002) and Fisher - PD (Baltagi, and Kao,2001): Both methods are based on Fisher's work and combine p values with single root unit tests. Calculation of the statistic panel is non-parametric and does not show a normal distribution as in other methods. Here is a distribution of χ2 with 2N degrees of freedom and is in the form of $-2\sum_{i=1}^{N}\log(p_i)$. The zero hypothesis is that all rows are not stationary, with the alternative that some of them are stationary, as in IPS. For both forms it is possible to determine the exogenous variables of the equations in any form: existence of characteristics in individual members, temporal trends or their complete absence. A distinction is that in the case of Fischer - ADF, the number of time lags should be set, while in the Fisher - PA case an estimation method should be defined.


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Methodology

Data Collection

The methodology that will be used on this thesis will be based on the research of Athanasiadis (2010). The current model takes into consideration five European countries: Greece, Ireland, Italy, Portugal, and Spain. With the exception of Ireland, they are part of the European South who, along with Ireland, faced the most severe shrinkage on their economies since the creation of Eurozone, especially after the global financial crisis of 2018.

The sample under examination covers the time period between 2000 to the second quarter of 2017, and the data are expressed on a quarterly basis. The specific time period offers many benefits to the quality and validity of the research. The lower interval of the sample is the first quarter of 2000. This way is covered the whole period from the start of Eurozone, as most of these countries adopted euro currency on 1999, with the exception of Greece that joined on 2001, and thus is studied the country spreads since the very beginning of Eurozone.

Moreover, the time period covers the financial turmoil that started in July 2007 and its escalation in September 2008 after the collapse of the Lehman Brothers. Finally, the large number of observations ensures an amplified explanatory power for our model. All the data were collected from the databases of Eurostat and Datastream

Model Variables

The selected time period, covers observations from the creation of Eurozone thus, unlike Athanasiadi's research, there is no issue of exchange rate consistency regarding the pre-Eurozone area for the countries under examination.

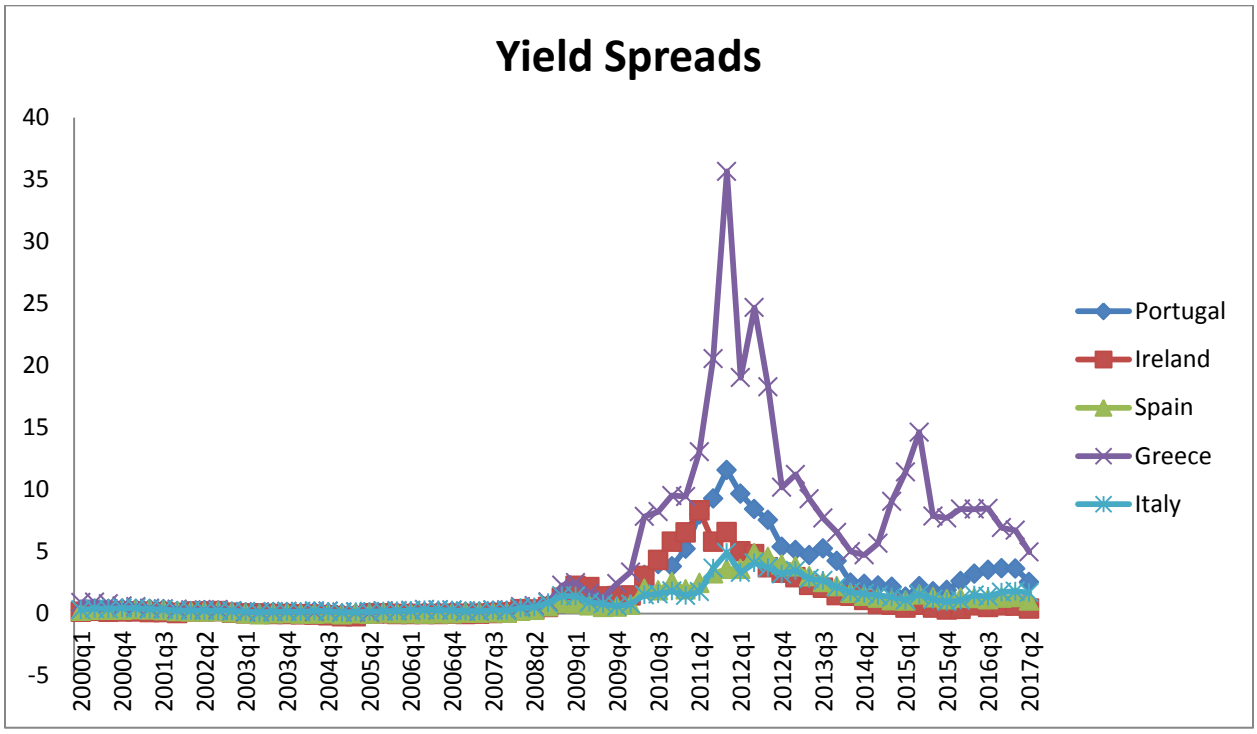
On the next graph are presented the yield spreads of the five selected European countries, from the start of Eurozone until the second quarter of 2017. As it can be seen the convergence of yield spreads was very strong for the very 8 years since the creation of Eurozone, which indicates that the countries that had entered the monetary union had managed to achieve their goal of sustaining low-interest rates.

However, after the second quarter of 2008 when the global financial crisis had reached its peak and the economic growth that had accompanied the monetary union started to turn in economic shrinking, the yield spreads of the individual countries started to diverge. More specifically, for the five countries of our sample, yield spreads started to rise at the beginning of the second quarter of 2008 and only after they reached their peaks on 2012 they begun to fall again.

Italy and Spain managed to have the lower volatility regarding their yield spreads and they managed to have the biggest convergence among them. Ireland experienced a bigger rise between 2009 and 2012 in comparison with the two above mentioned countries, however, it also followed the trend of Italy and Spain from then and on.

Portugal had even bigger volatility and only on the start of 2014 its yield spread began to converge with the others. Finally, Greece faced the most immense consequences form the financial crisis as its yield spread reached the highest point in comparison with the rest of the Eurozone countries in the second quarter of 2011 while it kept reaching very high values with intense volatility even after the yield spreads for the rest of the union countries had begun to return to their pre-crisis levels. The current empirical model will also try to take into consideration the impact of the global financial crisis.

Figure 1: Yield Spreads of the five Eurozone Countries



Based on the literature of Athanasiadis (2010), the independent variables that will be used in order to measure the components of yield spreads are the following:

- DevofDEFGDP : It is the difference between the Deficit / GDP ratio of each country relative to Germany.
- BAA10Y: Is the interest rate difference payable by US companies that are rated at the BAA level in relation to the interest rate of the US 10-year bond
- YswapUS: It is the spread between 10-year fixed interest rates on US swaps and the yield on 10-year US government bonds.
- Dev of DEB/GDP: It is the deviation of the country 's debt-to-GDP ratio from Germany's debt-to-GDP ratio.
- Rus10Rus3M: It is the slope of the US yield curve as measured by the difference between the yield-to-maturity of 10-year US government bonds and the 3-month interest rate on euro-Dollars.
- L. Spreads: It is the spread of the previous quarter.
- Crisis: It is a dummy variable that states whether or not we have a crisis in that period

From the above independent variables, DevofDEFGDP (deficit-to-GDP) and DevofDEV/GDP (debt-to-GDP) are the most frequently used variables from economic researches in order to measure the domestic risk of bond issuers.

Meanwhile, the differentials between the 10- year fixed interest rate on US swap and the yield on 10-year US government bonds as well as the spread between the yield on Moody's Seasoned BAA US corporate bonds and the yield on 10-year US government bonds are used as proxies to quantify banking and corporate risk premiums.

Panel Data

Panel analysis technique is used for the computation of the regressions regarding the European countries and examine all the selected different Eurozone countries as a whole. A panel ID is assigned for each country and the regressions are computed on a quarterly base. For each regression, fixed-effect model and a GLS random-effect model are used in STATA.

The fixed-effect model explores the relationship between predictor and outcome variables within an entity (country). Each entity has its own individual characteristics that may or may not influence the predictor variables.

When using the fixed-effect model, we assume that something within the individual may impact or bias the predictor or outcome variables and we need to control this. This is the rationale behind the assumption of the correlation between the entity's error term and predictor variables. The fixed-effect model removes the effect of those time-invariant characteristics so that we can assess the net effect of the predictors on the outcome variable.

Another important assumption of the fixed-effect model is that those time-invariant characteristics are unique to the individual and should not be correlated with other individual characteristics. Each entity is different, therefore the entity's error term and the constant (which captures individual characteristics) should not be correlated with the others. If the error terms are correlated, then the fixed effect is not suitable, since inferences may not be correct (Fernández-Val and Lee,2013).

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In the random-effect model, unlike the fixed-effect model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model.

Random effects assume that the entity's error term is not correlated with the predictors, which allows time-invariant variables to play a role as explanatory variables. In random effects, we need to specify those individual characteristics that may or may not influence the predictor variables. The problem with this is that some variables may not be available, which leads to omitted variable bias in the model (Fernández- Val and Lee,2013).

To decide between fixed or random effects, the Hausman test is used where the null hypothesis is that the preferred model is random effects, while the alternative one is fixed effects. It basically tests whether the unique errors (UI) are correlated with the repressors, the null hypothesis being they are not. Only the results of the model accepted by the Hausman test.

Empirical Results

The main linear equation that will be used for our econometric model, based on the above-mentioned variables, is the following:

Spread= b0+b1 L.Spread + b2 DevofDEBGDP + b3 DevDEFGDP + b4 yswapUS +b5 BAA10Y +b6 Rus10Rus3m+ b7 Crisis +e

First, a Hausman test is conducted in order to whether the random or fixed effect model is appropriate for the current panel regression. The results of the Hausman test are presented on the following table:

Table 1: Hausman Test

```
. hausman fe re
```

	Coefficients (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
L.Spread	.8182055	.8219939	-.0037884	.0050356
DevofDEBGDP	-.1846138	-.0118366	-.1727772	.1177603
DevDEFGDP	.5272372	.7470396	-.2198024	.3387027
yswapUS	-.2922189	-.0406646	-.2515543	.1297089
BAA10Y	.1804472	.1878105	-.0073633	.0047839
Rus10Rus3m	-.0612671	-.0337184	-.0275487	.0132173
Crisis	.8952193	.7623854	.1328338	.0817197

```
                b = consistent under Ho and Ha; obtained from xtreg
 B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         4.69
                Prob>chi2 =       0.6972
                (V_b-V_B is not positive definite)
```

The Prop > chi2 value of the Hausman test is equal to 0.6972 and much greater than 0.05. Thus, the null hypothesis cannot be rejected and the random effect model is the most appropriate one for a 95% significance level.

Moreover, in order to check the sample for autocorrelation the Wooldridge test is used the results of which are presented on the following table:

Table 2: Wooldridge Test

```
Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       4) =      6.547
           Prob > F =      0.0627

.
```

The null hypothesis under the Wooldridge Test is that there is no first-order autocorrelation on the model. The Prov> F is equal to 0.0627, which means that the null hypothesis cannot be rejected for a 95% significance level and thus the null hypothesis of no first-order autocorrelation is accepted.

After having identified the random effect model as the proper one, the results of the regression are presented in table 3:

Table 3: Random Effect Model

```
. xtreg Spread L.Spread DevofDEBGDP DevDEFGDP yswapUS BAA10Y Rus10Rus3m Crisis, re

Random-effects GLS regression                   Number of obs      =       345
Group variable: CountryID                       Number of groups   =         5

R-sq:  within  = 0.7993                         Obs per group: min =        69
       between = 0.9978                                        avg =      69.0
       overall = 0.8302                                        max =        69

                                                Wald chi2(7)       =   1647.80
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

Spread	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Spread						
L1.	.8219939	.0318886	25.78	0.000	.7594934	.8844944
DevofDEBGDP	-.0118366	.0457558	-0.26	0.796	-.1015164	.0778431
DevDEFGDP	.7470396	.3024659	2.47	0.014	.1542173	1.339862
yswapUS	-.0406646	.33966	-0.12	0.905	-.706386	.6250569
BAA10Y	.1878105	.0799315	2.35	0.019	.0311477	.3444734
Rus10Rus3m	-.0337184	.087705	-0.38	0.701	-.2056171	.1381803
Crisis	.7623854	.251273	3.03	0.002	.2698994	1.254871
_cons	-.2518912	.3009619	-0.84	0.403	-.8417657	.3379834
sigma_u	0					
sigma_e	1.5677724					
rho	0	(fraction of variance due to u_i)				

The first thing worth noticing for the current regression is the very high value of R square. More specifically, the current model has an R square equal to 0.8302 which means that 83.02 % of the changes in the dependent variable can be explained by the changes in the independent variables. The current sample has a very strong explanatory power and the chosen variable seems to explain the variation of spreads to a great extent

Regarding the independent variables, DevofDEBGDP, yswapUs, and Rus10Rus3m are not statistically significant having p-values equal to 0.796, 0.905 and 0.701 respectively and they do not seem to affect the dependent variable in any way. The difference of the countries' debt to GDP ratio relative to the one in Germany, which is one of the most important domestic risk

indicators, seems to have no true impact on the Eurozone countries. Moreover, the spread the 1-year fixed interest rate on US swaps and the yield on 10-year US government bonds, which is an indicator of banking and corporate risk and the slope of the US yield curve also leave the Eurozone spreads unaffected.

For a 5% statistical significance level, the prevalence of the Spread of the previous quarter (L.Spread), the difference in the Deficit / GDP ratio of each country relative to Germany (DevofDEFGDP), the difference in the interest rate payable US companies that are rated at the BAA level in relation to the interest rate of the 10-year American bond (BAA10Y) and the factor of the crisis (Crisis) are statistically significant for the current model

More specifically, when the previous quarter spread increases by 1%, current spread increases by 0.821%. There is a positive relationship between previous and current spreads, which indicates an intertemporal increasing trend for the Eurozone spreads.

When DevofDEFGDP increases by 1%, spreads increase by 0.75%. As the domestic risk of the European countries increases, this risk is imprinted on bigger spreads. It is also worth noticing that only the difference in the Deficit / GDP ratio of each country relative to Germany impacts the countries' spreads while the DevofDEBGDP is statistically not significant

When BAA10Y variable increase by 1%, spreads increase by 0.19%. As corporate risk increases, uncertainty increases and the European spreads increase. While the proxy for banking risk was not statistically significant, corporate risk has an expected positive impact on spreads.

Finally, the outburst of the global financial crisis also played an important role in the gradation of European spreads, as it was noticed from the graph earlier. More specifically, during the financial crisis, the spreads were 76% higher in comparison to pre-crisis levels. The financial crisis had the most important impact in relation to the other independent variables and caused spreads to skyrocket for the next 4 to 5 years.

It is also interesting to investigate the results of the econometric model when the results of the financial crisis are not taken into consideration. In that case, a new equation is used for the regression which has the following form :

Spread= b0+b1 L.Spread + b2 DevofDEBGDP + b3 DevDEFGDP + b4 yswapUS +b5 BAA10Y +b6 Rus10Rus3m+ e.

Table 4: Random Effect Model (No Crisis Dummy)

```
. xtreg Spread L.Spread DevofDEBGDP DevDEFGDP yswapUS BAA10Y Rus10Rus3m

Random-effects GLS regression                   Number of obs      =       345
Group variable: CountryID                       Number of groups   =         5

R-sq:  within  = 0.7934                         Obs per group: min =        69
       between = 0.9990                                        avg =      69.0
       overall = 0.8256                                        max =        69

                                                Wald chi2(6)       =   1599.76
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

Spread	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Spread						
L1.	.8649034	.0289258	29.90	0.000	.8082098	.921597
DevofDEBGDP	.005121	.0459611	0.11	0.911	-.0849612	.0952031
DevDEFGDP	.4917899	.2940365	1.67	0.094	-.084511	1.068091
yswapUS	-.4457644	.3160862	-1.41	0.158	-1.065282	.1737532
BAA10Y	.1384027	.0791994	1.75	0.081	-.0168252	.2936306
Rus10Rus3m	.0287071	.0862863	0.33	0.739	-.1404109	.1978251
_cons	.0663248	.2854999	0.23	0.816	-.4932447	.6258943
sigma_u	0					
sigma_e	1.5921762					
rho	0	(fraction of variance due to u_i)				

.

Once again the R-square of the model is quite high and equal to 0.8256, which means that 82.56% of the changes in the dependent variable can be explained by changes in the independent variables. The explanatory power of the model remains quite the same, regardless of the period of financial crisis is taken into consideration.

Regarding the independent variables, once again the difference between the Debt / GDP ratio of each country relative to Germany., the spread between 10-year fixed interest rates on US swaps

and the yield on 10-year US government bonds and the slope of the US yield are statistically insignificant and they do not impact the European spreads in any way. Again one of the two domestic risk implications have no effect on spreads and the same goes for banking risk.

The spread of the previous quarter remains statistically significant for a 95% significance level, which verifies the interdependence among the current and previous spread values as well as the increasing trend on the spreads of the sample. More specifically, as the previous quarter spread increase by 1%, current spreads increase by 0.86%. The impact of previous period spreads is bigger when the financial crisis is not taken into consideration.

Regardless of the other two independent variables, they are no longer statistically significant for a 95% significance level. However, DevofDEFGDP and BAA10Y are statistically significant for a 90% significance level, having p-values equal to 0.094 and 0.081 respectively.

More specifically, considering the 90% significance level, when the difference between the Deficit / GDP ratio of each country relative to Germany increases by 1%, their spreads increase by 0.49%. The effect of the current variable is much weaker when the crisis dummy is absent which implies that during the financial crisis the domestic risk played a much important role, affecting the uncertainty of the market and by extension, the Eurozone spreads.

Finally when the interest rate difference payable by US companies that are rated at the BAA level in relation to the interest rate of the US 10-year bond increases by 1%, the spreads increase by 0.13%. Again the impact of corporal risk is weaker in the current model as, when the financial crisis is included in the calculation, its impact increases by 5%.

The SURE was also used to see the results for each country separately.

The results are the following if we do not add the crisis dummy variable:

```
. sureg ( SpreadP L. SpreadP DevofDEBGDPP DevDEFGDPP yswapUSP BAA10YP Rus10Rus3mP) ( SpreadIR L.SpreadIR DevofDEBGDPIR DevDEFGDPIR yswapUSIR BAA10YIR Rus10Rus3mIR) (
> SpreadES L.SpreadES DevofDEBGDPES DevDEFGDPES yswapUSES BAA10YES Rus10Rus3mES) ( SpreadGR L.SpreadGR DevofDEBGDPGR DevDEFGDPGR yswapUSGR BAA10YGR Rus10Rus3mGR) ( S
> preadIT L.SpreadIT DevofDEBGDPIT DevDEFGDPIT yswapUSIT BAA10YIT Rus10Rus3mIT)

Seemingly unrelated regression
```

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
SpreadP	69	6	.736948	0.9255	1030.72	0.0000
SpreadIR	69	6	.5815497	0.9098	728.95	0.0000
SpreadES	69	6	.32883	0.9301	999.47	0.0000
SpreadGR	69	6	3.302033	0.7616	295.43	0.0000
SpreadIT	69	6	.3975969	0.8743	615.30	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SpreadP						
SpreadP						
L1.	.8902734	.0365361	24.37	0.000	.8186641	.9618828
DevofDEBGDPP	-.0449262	.1475942	-0.30	0.761	-.3342054	.2443531
DevDEFGDPP	-.5806459	.4462481	-1.30	0.193	-1.455276	.2939843
yswapUSP	-.6901948	.4808158	-1.44	0.151	-1.632577	.252187
BAA10YP	.0589618	.0813659	0.72	0.469	-.1005124	.218436
Rus10Rus3mP	.0095118	.0909732	0.10	0.917	-.1687923	.187816
_cons	.3804972	.4061444	0.94	0.349	-.4155312	1.176526
SpreadIR						
SpreadIR						
L1.	.8390543	.0591346	14.19	0.000	.7231526	.954956
DevofDEBGDPIR	.0089538	.1108804	0.08	0.936	-.2083678	.2262753
DevDEFGDPIR	-3.506975	1.637903	-2.14	0.032	-6.717206	-.2967437
yswapUSIR	-.4300045	.2899339	-1.48	0.138	-.9982645	.1382555
BAA10YIR	.0906124	.0644847	1.41	0.160	-.0357752	.2170001
Rus10Rus3mIR	.0923829	.0688385	1.34	0.180	-.0425381	.2273039
_cons	.0340836	.2476528	0.14	0.891	-.4513071	.5194742
SpreadES						
SpreadES						
L1.	.8831899	.0392599	22.50	0.000	.806242	.9601378
DevofDEBGDPES	.0533645	.0874619	0.61	0.542	-.1180577	.2247866
DevDEFGDPES	3.582888	4.713563	0.76	0.447	-5.655526	12.8213
yswapUSES	-.3753096	.1943842	-1.93	0.054	-.7562956	.0056763
BAA10YES	.0680789	.0375596	1.81	0.070	-.0055366	.1416944
Rus10Rus3mES	-.0126066	.0419678	-0.30	0.764	-.0948619	.0696487
_cons	-.0259084	.2868319	-0.09	0.928	-.5880886	.5362717
SpreadGR						
SpreadGR						
L1.	.758625	.0579173	13.10	0.000	.6451093	.8721408
DevofDEBGDPGR	-.3144966	.4871005	-0.65	0.519	-1.269196	.6402029
DevDEFGDPGR	1.53163	1.14926	1.33	0.183	-.7208784	3.784139
yswapUSGR	-1.443827	2.11413	-0.68	0.495	-5.587446	2.699792
BAA10YGR	.3689246	.3647162	1.01	0.312	-.3459059	1.083755
Rus10Rus3mGR	.0431556	.4174318	0.10	0.918	-.7749956	.8613069
_cons	.7205344	2.385775	0.30	0.763	-3.955499	5.396567
SpreadIT						
SpreadIT						
L1.	.8368089	.0414236	20.20	0.000	.7556201	.9179977
DevofDEBGDPIT	.0314258	.1067563	0.29	0.768	-.1778126	.2406643
DevDEFGDPIT	1.42802	3.710772	0.38	0.700	-5.844959	8.701
yswapUSIT	-.3912133	.205056	-1.91	0.056	-.7931157	.010689
BAA10YIT	.0950685	.0440867	2.16	0.031	.0086601	.1814769
Rus10Rus3mIT	-.0448814	.0501032	-0.90	0.370	-.1430819	.053319
_cons	.2679778	.1769852	1.51	0.130	-.0789069	.6148625

Where we can see that for Portugal, Greece and Spain only the spread of previous quarter is statistically significant for 95% significance level and affect the dependent variable. For Ireland except the spread of previous quarter, the deviation of deficit-to-GDP is also statisticaly significant while for Italy except, the previous quarter spread, also the interest rate difference payable by US companies that are rated at the BAA level in relation to the interest rate of the US 10-year bond is statistically significant at 5% significance level.

If we add the crisis dummy variable to the equation we have the following results:

```
. sureg ( SpreadP L.SpreadP DevofDEBGDPP DevDEFGDPP yswapUSP BAA10YP Rus10Rus3mP Crisis) (SpreadIR L.SpreadIR DevofDEBGDPIR DevDEFGDPIR yswapUSIR BAA10YIR Rus10Rus3m
> IR Crisis) (SpreadES L.SpreadES DevofDEBGDPES DevDEFGDPES yswapUSES BAA10YES Rus10Rus3mES  Crisis) (SpreadGR L.SpreadGR DevofDEBGDPGR DevDEFGDPGR yswapUSGR BAA10YG
> R Rus10Rus3mGR  Crisis) (SpreadIT L.SpreadIT DevofDEBGDPIT DevDEFGDPIT yswapUSIT BAA10YIT Rus10Rus3mIT  Crisis)

Seemingly unrelated regression
```

Equation	Obs	Parms	RMSE	"R-sq"	chi2	P
SpreadP	69	7	.6879457	0.9351	1138.40	0.0000
SpreadIR	69	7	.5756257	0.9117	728.87	0.0000
SpreadES	69	7	.3175503	0.9348	1038.60	0.0000
SpreadGR	69	7	2.852383	0.8221	411.04	0.0000
SpreadIT	69	7	.3724923	0.8897	673.99	0.0000

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
SpreadP						
SpreadP						
L1.	.8494911	.0377322	22.51	0.000	.7755373	.9234448
DevofDEBGDPP	-.3099321	.1774719	-1.75	0.081	-.6577706	.0379065
DevDEFGDPP	-.5837798	.4518648	-1.29	0.196	-1.469419	.301859
yswapUSP	-.0156604	.4917491	-0.03	0.975	-.979471	.9481502
BAA10YP	.1149778	.07934	1.45	0.147	-.0405258	.2704813
Rus10Rus3mP	-.0441309	.0881378	-0.50	0.617	-.2168778	.128616
Crisis	1.348774	.4107287	3.28	0.001	.5437606	2.153787
_cons	-.1346359	.4106398	-0.33	0.743	-.9394752	.6702033
SpreadIR						
SpreadIR						
L1.	.8439156	.0600502	14.05	0.000	.7262193	.9616119
DevofDEBGDPIR	-.0810239	.1511495	-0.54	0.592	-.3772714	.2152236
DevDEFGDPIR	-3.822014	1.716977	-2.23	0.026	-7.187226	-.4568008
yswapUSIR	.0347172	.3865766	0.09	0.928	-.722959	.7923935
BAA10YIR	.1114768	.0652635	1.71	0.088	-.0164373	.239391
Rus10Rus3mIR	.1041711	.0692879	1.50	0.133	-.0316307	.239973
Crisis	.5393147	.391367	1.38	0.168	-.2277506	1.30638
_cons	-.5212922	.4779295	-1.09	0.275	-1.458017	.4154324
SpreadES						
SpreadES						
L1.	.8217319	.0455958	18.02	0.000	.7323657	.911098
DevofDEBGDPES	.0376385	.0882442	0.43	0.670	-.135317	.2105939
DevDEFGDPES	6.560477	4.970827	1.32	0.187	-3.182164	16.30312
yswapUSES	.1200328	.2478548	0.48	0.628	-.3657537	.6058193
BAA10YES	.0952535	.0376405	2.53	0.011	.0214796	.1690275
Rus10Rus3mES	-.0012998	.0412856	-0.03	0.975	-.0822181	.0796186
Crisis	.5298543	.1751237	3.03	0.002	.1866181	.8730905
_cons	-.3844946	.306305	-1.26	0.209	-.9848414	.2158522
SpreadGR						
SpreadGR						
L1.	.609369	.065451	9.31	0.000	.4810873	.7376507
DevofDEBGDPGR	-1.852106	.5487148	-3.38	0.001	-2.927567	-.7766445
DevDEFGDPGR	2.076693	1.108425	1.87	0.061	-.0957803	4.249165
yswapUSGR	2.527762	2.158195	1.17	0.242	-1.702222	6.757746
BAA10YGR	.7100217	.3238402	2.19	0.028	.0753067	1.344737
Rus10Rus3mGR	-.1604719	.3637645	-0.44	0.659	-.8734373	.5524935
Crisis	7.02107	1.610807	4.36	0.000	3.863946	10.17819
_cons	.4756435	2.188253	0.22	0.828	-3.813254	4.764541

SpreadIT						
SpreadIT						
L1.	.7698459	.0459449	16.76	0.000	.6797956	.8598963
DevofDEBGDPIT	-.1098616	.1172206	-0.94	0.349	-.3396097	.1198866
DevDEFGDPIT	2.644226	3.789983	0.70	0.485	-4.784004	10.07246
yswapUSIT	.1675664	.2518414	0.67	0.506	-.3260337	.6611665
BAA10YIT	.1310707	.0429044	3.05	0.002	.0469797	.2151618
Rus10Rus3mIT	-.0508199	.0476862	-1.07	0.287	-.1442832	.0426433
Crisis	.7206864	.206297	3.49	0.000	.3163517	1.125021
_cons	-.4112358	.2571697	-1.60	0.110	-.9152791	.0928075

By adding the crisis variable in the Seemingly Unrelated Regressions method we can see that except the previous quarter`s spread which is statistically significant in each regression, for each country different factors contribute to their spread differentiations.

For Portugal we can see that for 95% confidence level only the crisis variable is statistically significant, while for 90% confidence level country`s deviation of debt-to-GDP compared to Germany`s is statistically significant. This means that after the crisis has emerged many investors worried about the big debt of the country and it`s sustainability so this was a contributing factor of Portugal`s spread differentiations.

For Ireland we can see that for 95% confidence level only the deviation of deficit-to-GDP compared to Germany was responsible for the widening of spreads. So investors worried about the possibility that the country could go bankrupt and they demanded higher risk premium because of a big credit risk. For 90% confidence level the interest rate difference payable by US companies that are rated at the BAA level in relation to the interest rate of the US 10-year bond which means that corporate sector`s risk premium also affected the widening of Irish spreads.

For Spain we can see that the crisis variable and the corporate risk premium are statistically significant. It is worth noting that both Ireland and Spain suffered from the real estate bubble so this might explain that both of these countries had to pay corporate risk premium that widened their spreads.

For Greece that had the most severe effects from the above mentioned countries we can see that for 95% confidence interval that crisis DevDebGDP and BAA10Y are statistically significant.

For 90% confidence level also the DevDefGDP becomes statistically significant. This means that Greece had to pay premiums because of the investor`s perception that the country`s debt was not sustainable (DevDebGDP and DevDefGDP) so it had to pay for credit risk premium because of domestic factors. Also, Greece had to pay for corporate risk premiums (BAA10Y) and after the crisis has emerged Greece`s spreads sky-rocketed.

For Italy we can see that it had to pay only for corporate premiums (BAA10Y statistically significant) and only after the crisis emerged the spreads had deviations. It is worth noting that although Italy has a high debt-to-GDP ratio the markets and investors perceived this debt as sustainable so the country did not have to pay for credit risk premiums. This explains the lower deviation of Italy`s spreads compared to Portugal, Greece and Ireland.

Conclusions

The aim of the current thesis was to study the difference of the spreads between the PIIGS countries and the spreads of Germany as well as to determine the factors impacting the convergence differences between the yield spreads. For that reason, panel data methodology was used for the computation of the regression and the sample covered the time period between 2000 and 2016. The methodology and variables that were used on the current thesis were based on the research of Lorenzo Codogno, Carlo Favero and Alessandro Missale (2003) and the research of Athanasiadis (2010).

The results of the current research implied that the difference in the Deficit / GDP ratio of each country relative to Germany, which is one of the two factors that measure domestic risk, impact positively the countries' spreads and causes a rise between the difference of PIIGS interest rates and the ones of Germany. Moreover, the difference in the interest rate payable US companies that are rated at the BAA level in relation to the interest rate of the 10-year American bond also tend to increase spreads, which menas that corporate risk has a positive effect in yield curves. Finally, the outburst of financial crisis intensified the differences between the economies of the PIIGS countries and Germany. When we examined these countries with the S.U.RE method we saw that not all of them had to pay for the same premiums (corporate risk premium, credit risk premium and domestic risk premium).

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