How did the financial crisis turn into a sovereign debt crisis?
From bank credit risks to sovereign credit risks.

Bachelor Thesis Finance

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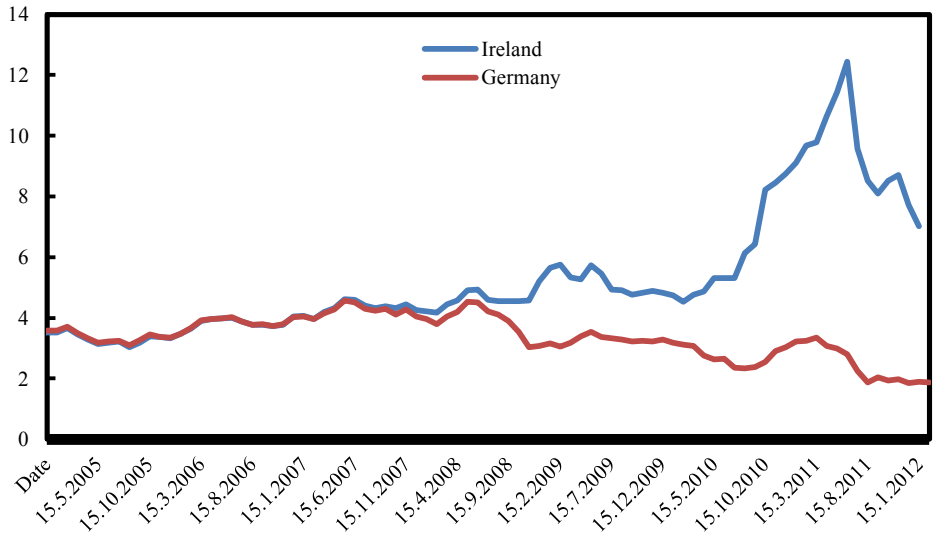
Chapter 1:
Introduction

Prior to the onset of the financial crisis in mid 2007 the sovereign credit risk indicators of all EU members were co-moving in a narrow manner. At that time there were no signs of stress in the Eurozone bond market. It has been argued that the observed stability of the sovereign spreads has been a result of the successful introduction of the euro currency and the effective integration of the financial markets in the Eurozone. However, the stage of tranquility ended soon and 2008 marked an interesting turning point in the movement of the European sovereign credit risk indicators (Mody, 2009).

The first indication of the financial crisis was the rapid devaluation of the US subprime mortgage market in 2007 which resulted in a transmission of financial stress to Europe. However, the financial sectors were not the only segments which were affected by the crisis. Even though there was no sign of sovereign crisis across the developed countries by that time, the bailout of Bear Stearns and the collapse of Lehman Brothers later in 2008 are argued to be the trigger for such for the Eurozone. The latter events sparked the first abrupt raise of the Eurozone countries' bond yields (see Acharya et al, 2011).

Following the onset of the financial crisis an increase in the sovereign credit risk of some countries in the Eurozone has been observed. This indicates that investors considered some financial markets as more risky and thus they discriminated between the public sectors of these countries. Hence, higher risk premiums have been required for the sovereign bonds issued by countries with insecure financial sectors like Greece, Ireland and Portugal. This trend could be traced by a historical inspection of Ireland's government bond yields. As presented on Figure 1, in the initial state before the crisis the Irish 10-year maturity bond yields were even lower than the German, but since its onset a rapid fluctuation of the yield spreads has been observed. In this context, the discussed fluctuation is exponentially curved reaching its peak during the financial crisis in February 2009 compared to the respective German bond yield. This is extensively investigated by Acharya et al. (2011) and the related literature following the stress exhibited by the financial sector of Ireland.

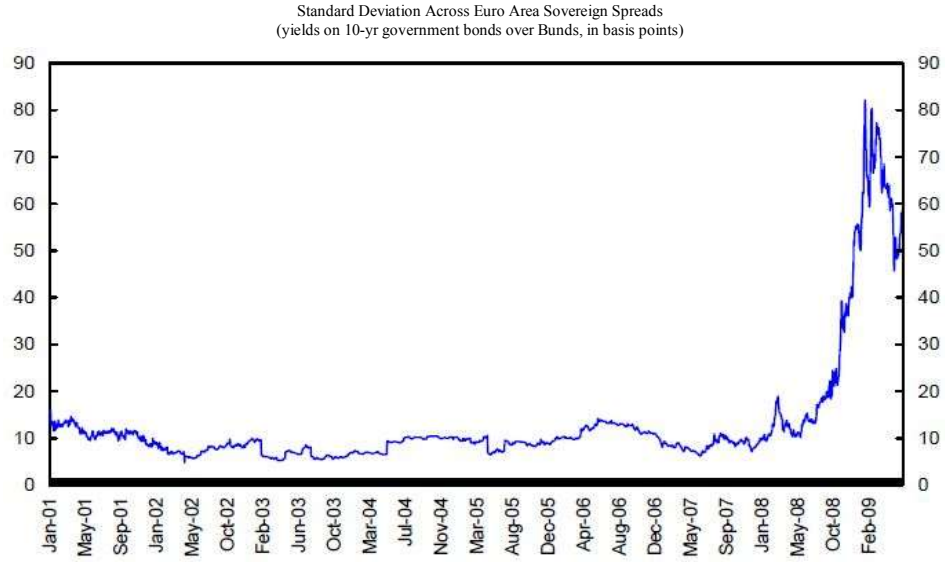
Figure 2. 10-year maturity bond yields development



Source: Datastream

Furthermore, in a wider general perspective the same movements could be observed also for the euro bonds in the whole Eurozone. The yields on the 10-year government bonds over the "risk-free" German 'Bund', used as a benchmark, denote an exponential increase in their riskiness and thus higher expenses for the government issuers, as it can be observed from Figure 2. Since the sovereign spreads are used as a measurement of countries' risk of default, the substantial increase in the Eurozone bond spreads gives a clear indication of the demanded higher risk premia. Nevertheless, despite the high realized levels of the sovereign spreads at that time, the actual perceived risk of default remains relatively low.

Figure 2. Euro Soverign Spreads Dispersion



Source: Datastream; Sgherri and Zoli (2009)

In addition, as Mody (2009) has found, after the onset of the crisis exposure to financial sector weaknesses has become an important determinant of the sovereign spreads. The financial sector in Europe has developed immensely and hence became central for the economic growth, financial stability and support of the corporate and government sectors in Europe. The European banking sector is an evidence for that with assets valuation totaling 350 per cent of the European-wide GDP in 2006 (see Molyneux, Wilson, 2007). However, the number of banks across the EU-area has shrunk by half during the last decade and hence achieved a "critical mass", concentration and intensification of competition which results in greater financial fragility and proneness to globally transmitted stress. Hence, the contagion of the financial sector is being inevitably transmitted not only internationally, but also regionally affecting the Eurozone sovereign bonds.

During the time of the crisis the exhibited increase in the sovereign credit risk has been mainly perceived as related to the international financial stress. In other words, the main opinion was that the bank credit crisis is mostly influenced by external factors because it is a worldwide and globally transmitted phenomenon. Policy makers found relieve in this perception as well. However, even after the mitigation of the financial sector externalities the sovereign spreads did not exhibit an equivalent decrease; but to the contrary, the differentials widened across countries in Europe (see Mody, 2009). Therefore, it could be concluded that the globally transmitted financial stress does not solely contribute to the understanding of the sovereign spreads movement. In turn this implies that the factors and prerequisites, which directly influence the dispersion of the sovereign spreads, must be further investigated, in order to better explain the relationship between the financial and sovereign debt crises. The event of the financial crisis and the period thereafter will serve as a basis, which would let us examine the country specific domestic factors, which contribute to the increase of the sovereign credit risk.

Additionally, as discussed above the sovereign credit crisis, which chronologically followed the financial crisis, has important implications concerning public policy and sovereign government stability. However, further discussion is required in order to explain the interconnection of these phenomena. In this context, the thesis will delve into investigating the factors relevant to the developed disruption in the sovereign spreads across the EU countries and thus allowing us to paint a better picture of the magnitude of this event.

We investigate the connection between the financial sector developments and the sovereign credit risks, by postulating a positive relationship between the size of the banking sector and the dispersion of spreads. This assumption is consistent with the one made by Gerlach et al. (2010) that in times of economic recession a big financial sector is a source of government financial risk. The results of this paper demonstrate this relationship and show that a sizable banking sector contributes to the increase in sovereign spreads.

Additionally, we aim to reveal whether certain macroeconomic factors exert influence on the increase in the sovereign spreads following the onset of the crisis. Our empirical results support the stated hypothesis showing that country-specific factors do matter. Indeed, countries with higher debt-to-GDP ratio exhibit greater sovereign spread widening in the period after the crisis. Hence, we find that countries with lower competitiveness are seen as riskier by investors and this explains the increase in the bond yields.

The remainder of the paper is structured as follows. In the next section the relevant literature on sovereign bond spreads will be reviewed, with focus on the most significant findings in the field. Section 3 will outline the empirical approach implemented in this paper, by presenting the model and the used data set. Next, the main estimation results of the analysis will be presented while in Chapter 4 a summary will be provided which will mark the main conclusions of the paper.

Chapter 2:
Literature Review

There is consensus in the literature that the occurrence of the financial crisis and the increased dispersion of sovereign spreads. This indicates an evident relationship between the two phenomena. The investigation of this relationship will constitute the starting point for our discussion. There are three main questions which this paper attempts to answer. First, we are interested in finding out the factors which influence the increase of the sovereign spreads. Based on a review of the current literature in this field, we attempt to summarize the most important variables that carry explanatory power. Second, is there a positive correlation between the ratio of the financial sector equity to the total domestic market capitalization, and the widening of the sovereign spreads? Third, do the country specific macroeconomic factors influence the dispersion of sovereign spreads in the period after the financial crisis? We are interested to know whether countries with worse competitiveness indicators are predisposed to a greater increase in credit spreads.

2.1 Motivation

As mentioned in the previous chapter, the Eurozone sovereign bond market was tranquil despite disturbances in the financial markets. Thus, the perceived country default risk has remained relatively low. However, starting in 2008 there has been a significant increase in the sovereign credit risk across Europe. This trend could be observed through the measure of riskiness of the financial and the sovereign sectors, by making use of the European banks and sovereign CDSs (see Acharya et al, 2011). Dividing the CDS levels of the 2 sectors into 3 periods of time produces interesting results: the bank CDS upsurge from 93.2 bps (13.5 bps for sovereigns at the time) to a peak of 288.6 bps in October 2008, in contrast to the sovereign CDS's which show an insignificant change – reaching a level of 39.3 bps. Nevertheless, in 2010 the sovereign CDS spreads exhibit a significant increase reaching 108.5 bps, whilst the bank CDS's decrease to 188.7 bps and thus remaining high. Based on these findings a correlation between the financial and government credit risks has been argued,

which represents the central point of this paper. Additionally, Acharya et al. (2011) suggests that one may speak of transfer of risk towards the public sector, due to the substantial outstanding liabilities of the financial sector which urges for eventual bailout. In this paper we look into this issue by investigating the dispersion of the sovereign bond yields in the three consecutive periods. These will be used as reference points when the crisis dummy variables are constructed.

2.2 Key factors

Several factors are deemed influential over the relationship between the financial sector credit risk and sovereign credit risk and therefore foster the risk transfer between the two. In this section we will concisely discuss some of the important determinants of sovereign spreads by reviewing the related literature. We will mainly concentrate our attention on the role of common risk, financial risk and macroeconomic factors.

According to Manganelli and Wolswijk (2007) interest rates are one of the significant factors which have proven their impact not only on the corporate, but also on the government bond spreads. They proxy the aggregate risk through the short term interest rate and argue that high interest rates result in a widening of sovereign spreads, in the case that investors have absolute return objectives. Furthermore, it is suggested that sovereign bond spreads are mainly dominated by the short-term interest rates set by the Eurosystem, which in turn are highly related to the liquidity of the bond markets and global risk aversion. In this context, the liquidity risk is implied to be an important consideration when yield differentials of the bond markets are being investigated.

However, Codogno et al. (2003) prove that an international risk factor, represented by the US swap spread, is one of the significant determinants of EU bond spreads. Hence, the latter findings suggest that liquidity is not of primary importance. Although previous studies downplay its role and claim that liquidity is dependent on investors' risk aversion, some more recent researches show the contrary. Gomez-Puig (2006) finds that greater liquidity of sovereign bonds result in lower sovereign spreads. In this context, Manganelli and Wolswijk (2009) argue that liquidity premiums are highly positively correlated to the sovereign bond yields and even more - they are able to explain half of the movement of the government

spreads. However, liquidity remains highly controversial factor. The debate about its relevance is further reinforced by other findings, which prove that liquidity is highly dependent on the risk level measured in current period (see Gerlach et al., 2010). Following from that, liquidity should have a smaller effect on sovereign spreads when high common risk levels are measured. In this fashion liquidity will have a negative overall effect on government bond differentials. This relationship is explained by the reduced set of alternative investment opportunities, which make investors less inclined to depart from bonds (see Gerlach et al., 2010). As a result, despite the generally high valuation of liquidity, investors would price it less in a period of high riskiness.

However, being highly correlated with the liquidity of the bond markets, the global risk aversion is seen by the literature as the main common factor driving the sovereign bond spreads. After the burst of the financial crisis, the actual investors' preferences for the low risk German bonds can be observed, which depict the flight-to-quality in the Eurozone (see Caceres et al., 2010). While the "Bunds" benefited, the bonds of other EU members saw a rise of their yields. The latter constitutes the evidence of global risk aversion governing the "animal spirits" and thus having an adverse effect over the low-quality issuers.

Recent publications examine financial sector bailouts and guarantees as events, which affected the sovereign risk premium differentials (see Sgherri and Zoli, 2009). Economists claim that government attempts to shore up the national financial systems result in a worsening of the prospects for domestic competitiveness. In particular, the increase in the expected default frequency (EDF) in the financial sector is said to be the event that sparks the concern about the fiscal implications of the government support. As a consequence, this ultimately leads to an upsurge of the sovereign CDS's (see Sgherri and Zoli, 2009).

The above mentioned relationship is much relevant for understanding the risk transfer from the financial to the public sector. In that context the investigation of the correlation between the financial sector bailouts (in terms of asset purchase programs, debt guarantees and equity injections) and the sovereign credit risk increase has produced significant outcomes (see Acharya et al., 2011). This has been achieved through the empirical examination of bank and sovereign credit default swaps movement instead of bond yields. Acharya et al. (2011) discusses 3 main periods. The first period is the pre-bailout announcement period (starting in January 2007) during which it has been observed a surge of the bank CDS index (in bps)

while the sovereign CDS spreads exhibit an insignificant change. However, in the second period, which captures the time span between the first bailout announcement and the first realized bailout, there is a significant decline of bank CDSs and an increase in sovereign CDSs. These findings provide a first evidence for the spillover of bank credit risk to sovereign credit risk. In this paper we investigate variables with time-varying effect and thus by looking into these relationships we gain an important insight about the significant chronological events related to the financial crisis. Thus, we base the choice of the time periods upon these findings in the construction of our model.

However, researchers have argued for a more intricate relationship between the financial and public sector concerning the risk transfer. There is evidence for a post-bailout co-movement of the bank and sovereign credit risk due to a positive correlation in this period (see Acharya et al., 2011). This also indicates a direct two-way feedback between bank and sovereign CDSs. In this context, the notion of the co-movement of bank and sovereign credit risk in the post-bailout period could be reinforced by two additional concepts. The "carry trade" principle argues that banks would engage in buying their own sovereign debt because of the "double or quits" bet – if the government defaults the financial sector would inevitably follow (see e.g., Bolton and Jeanne (2011); Gennaioli, Martin, and Rossi (2010)). Moreover, banks are given the opportunity to finance this venture by borrowing from the ECB at a preferential interest rate (3%) and thus earning a higher yield in the process.

Another incentive for obtaining sovereign bonds by the financial sector is that they could be used as a "liquidity cushion" of safe assets, which has been demanded by regulators. The outcome was an expansion of the sovereign bond purchases by banks in the bail-out period. This further supports Acharya's et al. (2011) findings that in the Eurozone 69.4 per cent of the sovereign bonds issued are held by banks being headquartered in the same country and thus reinforces the notion of co-movement of the bank and credit CDS.

Countries' growths estimates are also a significant macroeconomic element which should not be omitted when issues related to the recent financial crisis are examined (see Mody, 2011). Because of the negatively revised growth projections during the crisis deepening in 2008 and the overall perceived loss of investor confidence in EU governments, it has been suggested that countries which possess weaker competitiveness are much more likely to experience a

greater sovereign stress as a result of financial sector weakness. In particular, this is interpreted as higher sovereign spreads for countries with lower growth projections.

The main focus of this paper will be the in-depth investigation of the link between the financial credit crisis and the increase in the sovereign credit risk. Additionally, it will be questioned whether the rise of sovereign credit risk is just a mere transfer of the bank sector risk due to the liability incurred while rescuing the financial system, or it also depends on other country-specific factors such as the growth of the economy and debt-to-GDP. In particular, the extent of the correlation of domestic macroeconomic factors with the proneness for sovereign sector contagion will be investigated. Hence, we will examine whether financial sector vulnerability, low growth, high debt-to-GDP prospects tend to go together with higher sovereign spreads The extent of the impact of countries' competitiveness on the sovereign credit risk in the circumstance of a financial sector weakness will be measured.

Chapter 3:
Empirical analysis

3.1. Data and methodology

In this paper the relationship between the financial shocks and sovereign spreads will be investigated by considering a two-period model, which will connect the government and the financial sector. As discussed previously in the text, we are mainly interested in the banking sector developments. Therefore we will lay the main focus on it, as a representative of the whole financial one. The determinant factors of monthly changes in the sovereign bond spreads of 10 EU member states will be inspected through an econometric analysis. A time period of 10 years will be covered, starting from 2003 until 2012. Next to that, the estimates of the variables in the analysis will be presented on monthly basis. The investigated sample will consist of the following countries: Austria, Belgium, Netherlands, Finland, France, Greece, Ireland, Italy, Portugal, and Spain. The omission of Germany in the composed sample is intentional, since the yield of the "Bund" has been used to compute the spreads of each country. Additionally, new member states (such as Cyprus, Slovakia, Slovenia) are also excluded from the study due to the short time span and insufficient data.

As introduced by Mody (2009), this paper will incorporate a somewhat similar model, which will make an attempt to acquire a distinctive perspective of how the recently observed increase in sovereign credit risk emerges. However, we have constructed several basic linear regression models that were based on the potential quantitative predictors discussed in the literature review. This was done in order to formulate the main model, which will be central for this paper. As a consequence of this process several variables have been omitted.

Model:

$$S_{it} = \alpha_i + \beta_1 S_{it-1} + \beta_2 F_{it} + \beta_3 \Delta GDP_{it} + \beta_4 (Debt/GDP)_{it} + \beta_5 USBond\_ln + \beta_6 CDummy_i + \beta_7 CrisisInter_i + \boldsymbol{U}_{it}$$

First, the sovereign spreads (Sit) will constitute the dependent variable. Our main interest will be laid upon investigating the determinants of its movements. In this context, instead of focusing on credit default swaps, we will concentrate our attention on the sovereign spreads. For that reason, we will investigate the 10-year maturity bond yields of each respective country (i) at the given time (t), over the German 10-year government "Bund" (r_{dt}) and thus $S_{it} = r_{it} - r_{dt}$. As mentioned earlier in the text, the German bond constitutes the current notion of risk-free rate in the markets and therefore it is being widely regarded also in the related literature. Hence, the observed spread will be representative for the risk premium paid reflecting the sovereign bond default expectations. In addition, the international risk factor will be proxied by the logarithmic values of the US bond yields ($USBond\_ln$), while the $\boldsymbol{U}_{it}$ will represent the residual in the model.

Another factor which gives important insights about the dispersion of sovereign spreads is the "financial sector prospects". This measure, denoted by '*F*', is corresponding to the ratio of the country's financial sector equity, divided by the overall country market valuation index. Thus, F indicates the financial sectors' expected size, relative to the total domestic market valuation. In particular, a same directional relationship between 'F' and the movement of the sovereign spreads is anticipated with the only exception of Finland, which will be discussed later in the text. This being explained, in times of high aggregate risk an increase in F would signify that the financial sector will bear more financial risk, which is due to the increase in the size-to-total market. This will lead to higher level of risk that will be also recognized in the rest of the economy. Consequently, the markets will alter their expectations of the country's financial sector in a negative way, leading to an increase of the sovereign spreads.

As mentioned earlier, this paper seeks to explain the determinants which influence the degree of risk transfer from the financial sector to country's public sector, resulting in an increase of

sovereign credit risk. Therefore, we introduce two measures of public finances to the model, which aim at capturing sovereign default risk. First, the debt-to-GDP (*Debt/GDP*) is taken into account since it signals the capacity of the debtors, represented by the national states, to repay loans with respect to their liabilities. Additionally, monthly GDP forecasts are estimated, in order to match the forward looking perspective of the bond yields. The GDP values provided by the states are on a quarterly basis; Eurostat has been used as a source for both the GDP and debt data collection. Secondly, as being explored in the literature (see Mody 2009) *growth* (*ΔGDPit*) also holds a viable explanatory power when the financial-sovereign credit risk relationship is being investigated. The variable is constructed on the basis of the gathered GDP data and it comprises the next predictor in our model. Seeking for correlation, it is anticipated that the discussed notion is not simply an outcome from the crisis, but that a slow national growth account will result in a greater stress transmission between the financial and the public sector.

As an addition to the model, a lagged dependent variable ($Sit\text{-}1$) will be added to the regression. We expect that the successive observations of the time series will exhibit a strong correlation. Thus, by adding the first-order autoregressive coefficient we attempt to capture the persistence of the spreads. Another significant step in the empirical analysis is the exploration of different time periods. Since distinctive tendencies in the sovereign spreads movement are observed in the development of the financial crisis, dummy variables for the specific phases will be included, in order the model to allow for these period-specific trends. The implications for these variables are several. Most importantly, the presence of time dummies will allow for the impact of unobserved country factors on the sovereign spreads. Additionally, in order to investigate the changes in the most significant variables over time we will construct interaction variables with the dummies.

The following time period dummies will be included in our model:

D_1 = between April, 2003 and March, 2007 - *base value*.

D_2 = 1 between March, 2007 and June, 2009 and zero otherwise.

D_3 = 1 between week of June, 2009 and beyond and zero otherwise.

However, one of the problems, which inevitably arise as a part of our data collection, is that the time series considered are not present in the same frequencies. While the data on the financial variables is continuously available, the macroeconomic information becomes problematic because it exists mostly in quarterly frequency. We approach this issue by making a monthly approximation of the GDP and government debt on the basis of the quarterly macroeconomic data (see Appendix). We avoid using daily estimations of the spreads and therefore mitigate the short-term noise, without sacrificing the capture of financial markets' turbulence (see Gerlach et al., 2010). From a statistical perspective, the remaining mismatch is close to a measurement problem due to the financial data's higher frequency compared to the data which originated on quarterly basis. As proposed by Gerlach et al. (2010), these measurement errors will be ignored, since they are believed to be negligible. We assume that one of the reasons why more frequent data is not available is that these macroeconomic measures do not change as swiftly in short periods of time.

The main regression technique used for analyzing the collected data is panel data analysis. The argument behind this choice is that through panel data analysis we can observe the performance of individual countries over time. Additionally, it allows us to control for country specific variables that change over time but not across countries. Next to that, fixed effects will be used in our model because we aim at exploring the relationship between the predictor and the outcome variables within the panels. In other words, country specific characteristics will be taken into account and the regression will be controlled for country level factors which can bias or somehow influence the predictor.

3.2 Main findings

3.2.1 Domestic financial sector does matter

Table 1 exhibits the result of the exploratory process, which is attempted during the preliminary analysis of the variables and the designing of the model. The main importance of that process is to study the explanatory power of the predictors and fit them in a useful model, which will serve the purpose of this paper. This is, at first glance, to examine the stated assumption that the size of the domestic financial sector can predict the upsurge of sovereign spreads during the financial crisis. By including the lagged dependent variable and creating a first-order autoregressive model, we are also inspecting for further correlation in the successive periods.

As already has been stated, in this paper we investigate the positive relationship between the increase of the financial sector size and the widening of the sovereign spreads. Intuitively, investors perceive that due to the growth in size of the banking sector the government's ability to fund the financial sector in time of crisis is decreasing. The question being posed whether the government's difficulty to support the domestic financial sector translates into an increase in the sovereign yield, our main interest falls in the investigation of the F variable. The link between the short-term financial vulnerability (F) and the sovereign spreads is shown as an outcome of our regression. By observing the coefficients on Table 1, one sees that the financial sector prospects, indeed, represent one of the bases, on which the sovereign yields are gauged. However, the two-way relationship between the financial and the sovereign risk factors suggested by Acharya's et al. (2011) will not constitute a discussion point in this analysis. It will, however, represent a future research possibility.

Focusing on the results exhibited in Table 1, we see the positive feedback on our second hypothesis. As provided in column (1), the F variable has a positive coefficient of 1.45. It represents the positive effect of an increase in the financial sector size, relative to the whole domestic market valuation, on the sovereign bond spreads. This relationship is, indeed, statistically significant for all the investigated panels. Thus, the decrease in country's

competitiveness, expressed through the increase of its financial sector riskiness, is shown to positively translate into the reassessment of sovereign bonds. However, we are also interested in whether this effect is country-specific and so depending on the domestic finances. For that reason, Finland and Austria are taken under consideration in our analysis. While Finland has one of the smallest financial sector equity to total market capitalization ratios (0.083[1]), Austria is an example of the opposite tendency, accommodating a large financial sector (0.451[2]). Therefore, by omitting Finland from the regression the relationship between the financial sector and S appreciates, and an increase in the F coefficient is observed (Column (2), Table 1). This is attributed to the fact that the link between Finland's financial sector growth and the widening of the sovereign spreads is weaker due to the smaller relative size of the financial sector and its better competitive fit, compared to the rest sampled countries. The contrary trend is observed when Austria is excluded from the regression sample, which further reinforces the previous findings. As seen in Column (3), the decrease in the F coefficient shows a lesser explanatory power of the predictor, when a country with large financial sector is excluded from the model. While F remains statistically significant in all of the regressions, r-squared decreases by the omission of Austria.

Next to that, we investigate how the crisis influences the above discussed relationship by introducing the interaction terms ***Crisis*F_2*** and ***Crisis*F_3,*** which are, respectively, the interactions of F with crisis dummy 2 and with crisis dummy 3. Contrary to ***Crisis*F_2***, ***Crisis*F_3*** is significant for the model, which is observed in Column (3) and (4) of Table 2. F does not deteriorate in statistical significance as well. As assumed, in the period of crisis the interaction term gains a positive coefficient that explains the stress coming from the financial to the public sector. However, a more interesting observation is the one of the ***Crisis*F_3*** coefficient, which exhibits a negative value. This indicates that after the crisis F loses explanatory power in terms of examining the dispersion of sovereign spreads. In addition, it shows that in tranquil times the markets perceive a country's big financial sector as an indication for security and thus less risk premium is required. Moreover, a further reference can be made to the following section of this paper, which shows the opposite trend exhibited by the macroeconomic factors.

[1] Average for the observed period (2003-2012)
[2] Average for the observed period (2003-2012)

Finally, the US bond has been used as a common risk factor in the regression, representing international measure of financial instability. As it could be seen from Table 1 and Table 2, the predictor exhibits a steady relation to the European sovereign spreads. The positive coefficient of the US bond provides us with an indication of its positive correlation with the dispersion of sovereign spreads. In other words, it shows that country's funding condition deteriorates even more when a combination of aggregate risk and financial sector prospect risk is present.

3.2.2 The significance of macroeconomic factors

The other main hypothesis attempted to be examined in this paper is whether country specific macroeconomic factors have an influence on the sovereign spreads. We investigate public debt and GDP growth as sources for national vulnerability. However, although the growth proves to be an insignificant predictor for the model, the outcomes of this section support the hypothesis that loss in competitiveness would climax in the presence of domestic weaknesses. In details, the assumption made is that the lower growth expectations and a higher debt-to-GDP ratio will turn into more risk, transferred to the countries' external competitiveness. This presumption should, furthermore, grow in power as a consequence of the global financial crisis. That is the time when the country prospects are discounted even more.

As discussed earlier, the data collection represented a substantial statistical problem which led to specific issues during the empirical analysis stage. The main challenge when investigating the change of sovereign spreads was that the bond yield data was available on monthly basis, while the debt-to-GDP ratio has lower frequency observations. I addition to that, the change of debt and GDP is less dynamic over the periods given the drastic movements in spreads. As a consequence, for the sake of greater accuracy, we have estimated the quarterly macroeconomic data on monthly basis by mean of *spline interpolation* (see Appendix).

Table 3 concentrates on the periods during and after the financial crisis. Our main aim is looking into and identifying a correlation between debt-to-GDP on a national level and the dramatic increase in sovereign spreads. For this regression we construct interaction terms (***Crisis*Dept-to-GDP_2*** and ***Crisis*Dept-to-GDP_3***) between the time varying dummy variables,

which depict the phases of the crisis, and the level of debt-to-GDP ratio. We have omitted the country dummies for this analysis.

The results acquired from the regression give a positive indication of the expected trend. The panel analysis shows a progressive positive dependence of the change in sovereign spreads on the debt-to-GDP ratio. The interaction terms between the latter and the crisis dummies become strongly statistically significant in the period after the crisis i.e. ***Crisis*Dept-to-GDP_3*** has a p-value equal to 0.00 (see Table 3). Looking further into the coefficients of the interaction terms, we see a positive relationship between the public debt and the sovereign credit risk premium in the post-crisis period. It can be concluded that the interaction terms show that countries with more indebted public sector will suffer from a greater loss of competitiveness, illustrated by the increased sovereign spread dispersion. Noticeably, this effect does not hold as strongly for countries with less vulnerable domestic environment. In order this to be illustrated we will take Finland into consideration, which is the least indebted country in the constructed sample. Only by excluding it from the regression we notice a reasonable positive increase in the coefficient of the interaction term between the third crisis dummy and the debt-to-GDP ratio (see Table 3, Column 2). However, this is not the case when a country with significantly higher debt-to-GDP ratio, such as Belgium, is omitted from the estimation (see Table3, Column 3). Then the opposite trend is noticed and the ***Crisis*Dept-to-GDP 3*** coefficient decreases as a consequence.

In a nutshell, the attempted analysis produces results, which shed light on an important tendency: countries with higher debt and hence lower growth probability exhibit lower competitiveness. Therefore, despite the global dimensions of the financial crisis, it is shown that country specific vulnerabilities do matter. That being said, it can be observed that countries like Greece and Belgium, which have high debt-to-GDP ratios in combination with risky financial sector, have been treated differently by investors. This loss of competitiveness has been translated into the sovereign spreads of these countries and their drastic upsurge explains the increase of perceived risk. As shown earlier, when a country has difficulties servicing its debt this inevitably implies the increase in the bailout costs and the increase in perceived default risk. In other words, the forecasted probability of a country to service an increasing debt has been one of the drivers of the sovereign bond spreads after the crisis. However, in the case of countries with still higher competitiveness, such as Finland, the

change in spreads is smaller relative to the debt increase, which indicates that macroeconomic factors have lesser effect.

Chapter 4:
Conclusion

Attempting to shed light upon the events of the financial crisis and the repercussions which could be observed as a consequence of it, this paper discusses the developments of the international risk perception in that period. Although the Eurobonds were considered a "safe haven" by investors, shortly after the onset of the subprime crisis in 2007 this notion has been shattered. Markets recognized the probability of sovereign default and thus started differentiating the EU member states' credit risk profiles. In this paper we use monthly data for the sovereign spreads variation, financial sector stress measures and country specific factors, which influence domestic instability, in order to investigate the increase in sovereign credit risk in the light of the crisis.

Exploring the significance of domestic financial fragility, we show that the financial sector size, expressed as an index of the country's financial sector equity over the total country market capitalization, is a significant driver of sovereign credit risk. As the outcome of our analyses indicates, in periods of high common risks there is a positive relationship between the financial sector size and the spread of the bond yields. Moreover, the results show that countries with larger financial sectors like Austria are expected to exhibit a higher rise in the sovereign spreads in the period of crisis. However, the opposite relationship is witnessed in the post-crisis period. Then investors perceive countries with large financial sectors as less risky, which, in turn, drives down the sovereign spreads.

Next to the above, we examine the country specific macroeconomic factors, in order to gauge their influence on the sovereign credit risk. One of the most important conclusions of these findings is that, despite the global characteristics of the financial crisis, domestic vulnerabilities are, indeed, perceived as significant drivers of government default risk. Our outcomes indicate that the debt-to-GDP is one of the main determinants of the sovereign spreads differentials. Countries with higher debt levels exhibit worsened competitiveness, which translates into a widening of the sovereign spreads. Furthermore, the proof that countries with greater domestic vulnerabilities are more inclined to exhibit an increase in the bond yields, represents an important consideration to the policy makers.

"Oat cuisine"[3]

The developments in the recent years have shown that the financial crisis, despite its global nature, asks for specific governmental policy responses. The introduction of further extensions to the Capital Requirement legislation by the EU Commission and the EU Parliament has been one of the implemented measures, which came to mitigate future financial risk. It intends to reduce banks' credit and market risk by demanding them to maintain a higher level of equity and liquidity cushions. This should improve the financial sector stability and make it more resilient to systemic risks. However, emerging from the financial crisis in 2009, Europe has been immediately hit by the sovereign debt crisis. As a consequence, the borrowing costs of most member states continued to rise. By that time countries, such as Italy, Portugal, Spain and, most of all, Greece, proved that the notion of government bonds being a risk-free investment, is rather shortsighted.

The years of the financial crisis and thereafter have further shown that the rapid raise of the sovereign bond spreads and Eurozone countries' high indebtedness go hand in hand. In addition, the political instability turned out to be a growing issue, which even led to doubts about the integrity of the European Union. The inevitable government bailouts were not the only factor contributing to the strengthening the political turmoil. In the period of crisis the difficulties to service government debt led to the downgrade of the credit ratings of many member states, which consequently resulted in a further increase of their borrowing costs. The latter comes in support of our findings that the increase of the sovereign spreads reflects domestic instability. Second, the fixed-rate regime of the euro was not able to weather off the debt crisis for countries like Greece, which were not able to devalue in a time of need. Thus, by exerting their power, the markets have strengthened the political pressure even more. Eventually, the institution of the European Stability Mechanism (ESM) in 2011 came as one of the responses to the debt crisis. Being expected to be ratified in mid-2012 (ECB, 2011), only time will tell whether this is the right measure to be taken. One thing is certain though: the associated austerity measures are already further fueling the political instability across the EU (see 'The Economist', 2012).

[3] *"The Economist, Feb 11th 2012*

All these developments feed back into the cycle of widening of the sovereign spreads, which in turn become an "*oat cuisine*" for investors. Therefore, although few years ago the prospects of a Eurozone break up were highly unlikely, today's developments show that such outcome is not that elusive anymore. Nevertheless, the needed decrease in the sovereign spreads, the stimulation of economic growth and the maintenance of a healthy financial sector will pave the way towards the main objective – the preservation of the EU integrity.

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Appendix

Table1. Investigating Domestic Finance

This table reports the examination of relationship between financial sector size (F) and the DV sovereign spreads (S). Column (1) and (2) represent the whole sample (n=10), while (3) and (4) investigate the change in F for countries with different financial sector size.

VARIABLES	(1) All S	(2) All S	(3) Finland omitted S	(4) Austria omitted S
F	1.446***	1.380***	2.032***	1.477***
	(0.368)	(0.381)	(0.455)	(0.410)
debt_gdp	1.009***	0.957***	0.888***	0.989***
	(0.074)	(0.080)	(0.089)	(0.086)
Δ.GDP	0.44	0.39	0.40	0.75
	(1.105)	(1.104)	(1.216)	(1.213)
ln_usbond	1.122**	1.263***	2.100***	1.277**
	(0.476)	(0.482)	(0.544)	(0.536)
S_lag	0.690***	0.686***	0.671***	0.682***
	(0.017)	(0.017)	(0.018)	(0.018)
Crisisdummy2	0.151***	0.06	0.00	0.05
	(0.053)	(0.133)	(0.193)	(0.144)
Crisisdummy3	0.07	0.335*	0.863***	0.333*
	(0.078)	(0.174)	(0.255)	(0.200)
Crisis*F_3		-1.009*	-2.572***	(1.077)
		(0.538)	(0.730)	(0.694)
Crisis*F_2		0.31	0.49	0.38
		(0.385)	(0.524)	(0.438)
Constant	-8.592***	-9.111***	-13.33***	-9.281***
	(2.334)	(2.360)	(2.672)	(2.611)
Observations	1,044	1,044	939.00	940.00
R-squared	0.866	0.867	0.873	0.867
Number of country1	10	10	9	9
p-value for sum of F=0	0	0	0	0

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table2. Investigating Domestic Finance

This table reports the examination of relationship between financial sector size (F) and the DV sovereign spreads (S) in the different during and after the financial crisis. This is achieved by examining the interaction terms of F and the crisis dummies.

	(1)	(2)	(3)	(2)
VARIABLES	**S**	**S**	**S**	**S**
F	1.446***	1.300***	1.460***	1.380***
	(0.368)	(0.379)	(0.367)	(0.381)
debt_gdp	1.009***	1.014***	0.947***	0.957***
	(0.074)	(0.074)	(0.079)	(0.080)
Δ.GDP	0.44	0.45	0.38	0.39
	(1.105)	(1.105)	(1.103)	(1.104)
ln_usbond	1.122**	1.255***	1.202**	1.263***
	(0.476)	(0.483)	(0.476)	(0.482)
S_lag	0.690***	0.687***	0.687***	0.686***
	(0.017)	(0.017)	(0.017)	(0.017)
Crisisdummy2	0.151***	(0.028)	0.155***	0.06
	(0.053)	(0.125)	(0.053)	(0.133)
Crisisdummy3	0.07	0.04	0.393**	0.335*
	(0.078)	(0.080)	(0.158)	(0.174)
Crisis*F_3			-1.164**	-1.009*
			(0.501)	(0.538)
Crisis*F_2		0.57		0.31
		(0.359)		(0.385)
Constant	-8.592***	-9.194***	-8.818***	-9.111***
	(2.334)	(2.363)	(2.331)	(2.360)
Observations	1,044	1,044	1,044	1,044
R-squared	0.866	0.866	0.867	0.867
Number of country1	10	10	10	10
p-value for sum of F=0	0	0	0	0

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table3. Public Debt

This table reports the examination of relationship between country-specific macroeconomic factors (debt_gdp) and the DV sovereign spreads (S). The interaction terms capture their changes during and after the crisis. Column (2) and (3) investigate the change in debt-to-GDP for countries with different government indebtedness.

Variables	(1) All S	(2) Without Finland S	(3) Without Belgium S
F	1.974***	1.816***	2.749***
	(0.34)	(0.38)	(0.45)
debt_gdp	0.957***	0.957***	1.160***
	(0.07)	(0.08)	(0.10)
Δ.GDP	1.19	1.43	1.16
	(1.02)	(1.13)	(1.12)
Ln_usbond	2.338***	2.607***	2.427***
	(0.45)	(0.50)	(0.49)
S_lag	0.580***	0.575***	0.564***
	(0.02)	(0.02)	(0.02)
Crisisdummy2	0.342***	0.336**	0.483***
	(0.13)	(0.15)	(0.14)
Crisisdummy3	-1.817***	-2.122***	-1.787***
	(0.17)	(0.20)	(0.18)
Crisis*Dept-to-GDP_2	-0.0604	-0.0637	-0.122**
	(0.04)	(0.05)	(0.05)
Crisis*Dept-to-GDP_3	0.599***	0.662***	0.560***
	(0.05)	(0.06)	(0.05)
Constant	-14.46***	-15.86***	-15.48***
	(2.20)	(2.48)	(2.40)
Observations	1,044	939.00	939.00
R-squared	0.89	0.89	0.89
Number of country1	10	9	9
p-value for sum of F=0	0	0	0

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Monthly GDP and Government debt approximation using a quarterly basis (stata)

```
mata
X = st_data((1,36),"x")
Y = st_data((1,36),"y")
XX = st_data(.,"xx")
A = spline3(X,Y)
B = spline3eval(A,XX)
st_store(.,"yy",B)
end
```

outreg2 using Output