Explaining Sovereign Risk Premia:

The Case Of Euro-Zone Countries 2005-2011

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ABSTRACT

In this thesis I analyse the effect of fiscal policy on two measures of sovereign risk premium, the bond spread and the CDS premia, and on the difference of the two, the so-called default swap basis, as this latter is not always zero, contradicting the no-arbitrage condition. From the several panel regression methods, I use the so-called Factor Augmented Panel (FAP), developed by Giannone and Lenza (2008), which introduces global factors with heterogenous effects on different countries. My results show that these heterogenous global factors are indeed significant explanators of the different risk premia and the default swap basis, even if I include country and time fixed-effects as well. As for the fiscal policy, the inflation rate, the primary deficit and the debt-to-GDP ratio all have significant positive effect on risk premia, meaning that as they increase, the risk premia increase, too. In case of the default swap basis, the following result is worth emphasizing: ceteris paribus as the CDS premium increases, the spread and the CDS premia get more and more in line on average; while on the other hand, the increase of pessimism on the financial markets ceteris paribus widens their difference.

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INTRODUCTION

As we are experiencing the European debt crisis nowadays, the determinants of sovereign spread got into the spotlight of public discussions. Not many years ago the volume of sovereign spread and the possibility of default seemed to be the problems of only the emerging countries, so most of the articles concentrates on them (Panizza et al, 2009). This has definitely changed.

For the question 'what determines sovereign spread?', there are many answers in the literature, at which the authors arrived using various methods. One group of candidates are the fiscal policy variables and global factors (see for example Reinhart and Sack (2000), Chinn and Frankel (2007), Dell'Erba and Sola (2011) or von Hagen et al. (2011)). Another direction of research aims to assess the effect of credit ratings (see for example Cantor and Packer (1996)).

The aim of my thesis is twofold: first, to measure the effect of fiscal policy on sovereign spreads focusing on developed countries – this is why my dataset contains nine euro-zone countries for the time period 2006-2011; second, to investigate the difference between sovereign spread and another measure of risk premia, the Credit Defaul Swap (CDS) premia. The motivation from the latter comes from the fact that the difference of these two measures should be zero due to the no-arbitrage condition, however, it is an established empirical observation that during the recent crisis, there were large unexercised arbitrage opportunities on the financial markets (Foley-Fisher, 2010). So I not only run regressions for the spread, but for the CDS premia, and for the difference of the two, the so-called default swap basis.

As for the methodological issues, the nature of the dataset – multiple countries, multiple time periods – calls for panel econometric procedures. In the literature several approach is used, I chose the so-called Factor Augmented Panel (FAP), developed by Giannone and Lenza (2008), following the article of Dell'Erba and Sola (2011). The main advantage of the FAP is that it not only allows for country and time fixed-effects, but introduces global factors with heterogenous effects on different countries.

My results show that these heterogenous global factors are significant explanators of the different risk premia and the default swap basis, even if I include country and time fixed-effects as well. As for the fiscal policy, the inflation rate, the primary deficit and the debt-to-GDP ratio all have significant positive effect on risk premia, meaning that as they increase, the risk premia increase, too. In case of the default swap basis, the following result is worth emphasizing: ceteris paribus as the country is deemed more risky, in other words, as the CDS premium increases, the spread and the CDS premia get more and more in line on average; while on the other hand, the increase of pessimism on the financial markets ceteris paribus widens their difference. I ran regressions on the differenced series too, because I cannot reject the non-stationarity of them. In these regressions, almost all variables lost their significance, probably due to the loss of information, caused by the differencing. As we cannot surely state that some of the variables are indeed non-stationary, I tend to believe the level regression results.

The thesis proceeds as follows: in Chapter 1, I give a brief overview of the relevant literature, in Chapter 2, I introduce my dataset and the applied methodology and in Chapter 3, I present the results and discuss them. That is followed by the Conclusion.

CHAPTER 1 – LITERATURE REVIEW

The economic theory of sovereign debt and default is very widespread; it spans from explaining the existence of sovereign debt at all in the absence of legal enforcement, through the theory of debt structure and restucturing to the empirical analysis of its costs (Panizza et al, 2009). One popular question of this empirical literature is: what is the effect of fiscal policy on the cost of sovereign debt?

Cantor and Packer (1996) extend this question in the way that their main focus is the effect of credit ratings on spreads and whether these ratings carry any information above the publicly available macro data. First, they investigate the drivers of credit ratings on multiple countries: they find that per capita income, GDP growth, inflation rate, the external debt-to-export ratio, and the dummy variables of economic development (industrialized or not) and default history (default on foreign currency debt 1970 or not) all significantly explain the ratings. Second results is that credit ratings are significant explanators of sovereign spreads; the same is true for the external debt-to-export ration, and the economic development and default indicators in a different regression. However, after putting all these variables into one regression, only the credit ratings remain significant. The conclusion is that credit ratings have some superior information compared to publicly available macro variables.

From the numerous other articles focusing on the effect of fiscal policy I chose Dell'Erba and Sola (2011) for guidance in methodological issues. They compile a real-time database of 17 OECD countries with macroeconomic and fiscal variables, where real-time means that the variables come from the OECD *Economic Outlook*, so they can be taken as expectations. This way the authors can account for the forward-looking nature of economic agents and avoid simultaneity between interest rates and fundamental variables. Their main contribution is to use the so-called Factor Augmented Panel method, originally introduced by Giannone and Lenza (2008), in order to include global factors in their analysis and allowing them to have heterogenous effects on countries; later on I will give a detailed description of their methodology. Their main results are that both public debt and primary deficit are significant explanatory variables of sovereign spreads and that global risk aversion has a significant, but heterogenous impact on them, which is incorporated in the global factors.

Reinhart and Sack (2000) and Chinn and Frankel (2007) also use the OECD *Economic Outlook* data in investigating the sovereign spread. The first pair of authors analyse the effect of budget deficit on spreads and find a significant negative effect on a sample of 19 OECD countries. However, their methodology differs from Dell'Erba and Sola's because they do not include the level of public debt and global factors as explanatory variables. In the second article the authors main regressor is public debt and their sample includes Germany, France, Italy and Spain. Their finding is that public debt is a significant regressor only if they include the US interest rate, explicitly allowing financial integration to be an important factor. One can also interpret this as using the US interest rate as a global factor, but not allowing it to have heterogenous effects.

Von Hagen et al. (2011) use a sample of 15 EU countries in analysing the relationship of sovereign spreads and public debt, in which they measure the public debt as difference from the benchmark country and also include time fixed-effects. They find a significant positive effect for public debt.

The other part of the literature analyses the credit default swap premia. Since it is much smaller given that the credit default swap itself is a much more recent financial product than simple bonds, I cite only one article from this area. Longstaff et al. (2011) investigate how important the global factors are in determining the CDS premia in case of emerging economies.

Their methodology is quite different from Dell'Erba's and Sola' (2011) in the way that they compute principal components only from CDS premia and they use currency price and stock exchange index as local factors and US variables as global ones; however, they find that CDS premia are more linked to global factors than to local variables.

One further article that gives motivation to this paper is wrote by Foley-Fisher (2010), which studies the relationship between sovereing bond spreads and credit default swap premia. Its starting point is the empirical observation that during this financial crisis, the no-arbitrage condition was not always satisfied, meaning that the spread and the premium was not always the same, resulting in large unexercised arbitrage oppurtunities. Since that is mainly a theoretical paper, I decided to investigate this issue further, meaning not explaining only the bond spreads with fiscal policy and fundamental macro variables, but the CDS premia and their difference as well.

CHAPTER 2 – DATA AND METHODOLOGY

2.1 Data

The database I collected for this analysis contains quaterly variables for 9 euro-zone countries[1] (European Commission, 2012) and spans from 2005 till 2011, given that there is generally no data about CDS premia before that in Datastream. I had to exclude Cyprus, Estonia, Finland, Greece, Luxemburg, Malta, Slovakia and Slovenia because of full or partial lack of data, considering that the time series are already quite short.

I was mainly interested in the effect of fundamental macro variables on sovereign risk premia and I decided to measure it with two different variables: CDS premia and yield spreads (defined as yield on the 5 year bonds minus the yield of the 5 year German bond). As the difference of the two, also known as default swap basis, is not always zero, I investigated its behaviour as well. These series are available on a monthly frequency, so in order to avoid simultaneity I used the values from the first month of quarter and regressed on variables from previous quarter.

The macro variables I collected following Dell'Erba and Sola (2011) are short-term interest rate, inflation, real GDP growth, primary deficit, debt-to-GDP ratio and the Chicago Board Options Exchange Market Volatility Index, also known as VIX[2]. Summary statistics are listed in Table 1:

[1] Countries included: Austria, Belgium, France, Germany, Ireland, Italy, Portugal, Spain, The Netherlands.
[2] Data sources are listed in Table A1, in the Appendix.

Table 1 Descriptive statistics

	Mean	Standard Deviation	Minimum	Maximum
CDS premia	0.91	1.78	0.01	12.24
Yield spread	0.72	2.03	-1.49	15.41
Default swap basis	0.16	0.54	-3.50	1.52
Inflation	-0.05	1.13	-4.02	2.35
Real GDP growth	0.21	1.08	-4.01	5.46
Primary deficit	-1.24	6.22	-36.58	11.18
Debt/GDP	71.90	22.83	25.00	121.00
Short-term interest rate	2.59	1.51	0.66	4.98
VIX	22.44	10.12	11.39	44.14

2.2 Methodology

There are four approaches in the literature of estimating the effect of fundamental variables on sovereign yields, listed by Dell'Erba and Sola (2011). In the first one, the data generating process is thought to contain only a time-invariant country fixed-effect besides the observed variables, as for example at Reinhart and Sack (2000):

$$r_{it} = \alpha_i + \beta x_{it} + \varepsilon_{it}$$

In the second a time fixed-effect is added, assuming that there is an unobserved homogenous common shock to all country in every period:

$$r_{it} = \alpha_i + \tau_t + \beta x_{it} + \xi_{it}$$

or including an observable variable as proxy for common factors as for example in Chinn and Frankel (2007). In the third, the variables are transformed to be the deviation from the cross-sectional average, which serves as a benchmark or from an explicit benchmark and these regressors are accompanied with an unobserved country fixed-effect as for example in von Hagen et al. (2011):

$$r_{it} = \alpha_i + \beta(x_{it} - \overline{x_t}) + \xi_{it}$$

The problem with the first method is that it assumes independence from global phenomena, which is unrealistic in case of open economies. The second and the third methods both allow for the effect of global shock, but they suppose that it is homogenous across countries. Since the true data generating process is thought to be different, this means that the estimated coefficients from these regressions are all inconsistent.

Dell'Erba and Sola (2011) use instead a method called Factor Augmented Panel (FAP), proposed by Giannone and Lenza (2008) and this is the method I will also apply along with the simple country and time fixed-effects panel methods. Giannone and Lenza (2008) investigated the relationship of investment and saving, which are highly correlated in the data contradicting The Intertemporal Theory of the Current Account, called the Feldstein-Horioka puzzle. They solved it by allowing for general equilibrium effects – namely global shocks. They argued that previous attempts to incorporate global shocks had failed, because they had assumed homogenous effects on different countries. They introduced a new method, the Factor Augmented Panel, to account for idiosyncratic shocks affecting savings and investment. Basically, what they did is decompose the savings and investment into a few global factor and an idiosyncratic component, where the factor loadings are country-specific:

$$S_{j,t} = \lambda_{1,j}^{S} f_{1,t} + \ldots + \lambda_{r,j}^{S} f_{r,t} + S_{j,t}^{id}$$

$$I_{j,t} = \lambda_{1,j}^{I} f_{1,t} + \ldots + \lambda_{r,j}^{I} f_{r,t} + I_{j,t}^{id}$$

They argued that according to The Intertemporal Theory of the Current Account, the savings' and investment's relationship can be written as:

$$I_{j,t}^{id} = \alpha_j + \beta S_{j,t}^{id} + \varepsilon_{j,t}$$

Using the decomposition above, they substituted out the unobservable idiosyncratic parts to get an almost estimateable equation:

$$I_{j,t} = \alpha_j + \beta S_{j,t} + \delta_{1,j} f_{1,t} + \ldots + \delta_{r,j} f_{r,t} + \varepsilon_{j,t}$$

The global factors are still unobservable, so the last step was to consistently estimate the global factors by principal component analysis.

Similarly, what Dell'Erba and Sola do is decompose the variables of their interest into an idiosyncratic component and the sum of global factors in the following way:

$$\begin{cases} r_{it} = \sum_{k=1}^{q} \lambda_{ki}^{r} f_{kt} + r_{it}^{ID} \\ x_{it} = \sum_{k=1}^{q} \lambda_{ki}^{X} f_{kt} + x_{it}^{ID} \end{cases}$$

They argue that the only consistent way to estimate the effect of macro variables on yield is based on the idiosyncratic parts of the variables:

$$r_{it}^{ID} = \alpha_i + \tau_t + \beta x_{it}^{ID} + u_{it}$$

These idiosyncratic components are unobservable; however they can be substituted in using the previous decomposition to get:

$$r_{it} = \alpha_i + \tau_t + \sum_{k=1}^{q} \delta_{ki} f_{kt} + \beta x_{it} + u_{it}$$

They use the no-arbitrage condition to write up the relationship between the yield and the benchmark interest rate and assume zero recovery rate for simplicity:

$$(1 + r_{it})p_{it} = \left(1 + r_{jt}^{B}\right) + \theta_{it}(1 - p_{it})$$

,

where $(1 - p_{it})$ is the probability of default and θ_{it} is a measure of investors' risk aversion. After further assuming that the probability of default is a linear function of macro variables and risk aversion is proportional to some global common factor, with a country-specific ratio, they rewrite the previous equation expressing the yield spread as:

$$\left(r_{it} - r_{jt}^{B}\right) = \alpha_i + \beta x_{it}^{ID} + \Psi_i f_t^{RP} + \alpha_i \, r_{jt}^{B} + \mu_{it}$$

They substitute out the idiosyncratic parts as before and get the almost ready-to-estimate relationship:

$$\left(r_{it} - r_{jt}^{B}\right) = \alpha_i + \beta x_{it} + \sum_{k=1}^{q} \Delta_{ki} f_{kt} + \Psi_i f_t^{RP} + \alpha_i r_{jt}^{B} + \mu_{it}$$

The last step of this FAP procedure is to estimate the global factors by creating $N(k+1)$ principal components from the observable variables and include the first q of them in the regression. Dell'Erba and Sola (2011) argue that under the assumption that these global factors are pervasive and the idiosyncratic parts not, one can regard the principal components as consistent estimates of these factors. The marginal and cumulative proportions explained by the principal components I computed can be seen in Table 2. As we can see, after including the second component, 95 percent of the variation is explained, so I decided to add only the first two to the regression as global factors.

Table 2 Marginal and cumulative proportions of principal components

	Component 1	Component 2	Component 3
Marginal proportion	0.6326	0.3221	0.0191
Cumulative proportion	0.6326	0.9547	0.9737

CHAPTER 3 – RESULTS

3.1 Unit root tests

Because of the time series characteristics of the dataset, I had to investigate the stationarity of the variables before conducting the regression analysis. This is important since running a regression on non-stationary time series gives inconsistent coefficients and the tests will not work (Wooldridge, 2003). I performed two types of panel unit root tests following Dell'Erba and Sola (2011), which both account for the cross-section dependence of a variable between the countries – another way of saying that they are affected by the same shocks. The first is the so-called CADF test[3], proposed by Pesaran (2007), where the simple Dickey-Fuller test is augmented by two elements: the cross-section averages of lagged level variables and the first-differenced series. The second test is proposed by Moon and Perron (2004)[4] and estimates the common factors driving the series before testing the stationarity. Both tests' null hypothesis is that all the series are non-stationary. As we can see below in Table 3, I could not reject that at any conventional significance level in the case of the CDS premia, the debt-to-GDP ratio and the yield spread. This means at least that we have to handle the level regression results with caution; however, as the power of the tests with this short time series is quite low (see for example Pesaran, 2007), I decided to compute the level regressions anyway.

[3] I used the downloadable Stata command *pescadf* for this test. The author is Piotr Lewandowski, Warsaw School of Economics, Institute for Structural Research, Poland, Piotr.Lewandowski@sgh.waw.pl

[4] I received the Matlab codes for the Moon-Perron test from Salvatore Dell'Erba. The zipped codes are downloadable from http://www.univ-orleans.fr/deg/masters/ESA/CH/Panel_UR_Tests.zip. The author is Cristopher Hurlin.

Table 3 Results of CADF and Moon-Perron unit root tests

	CADF	p-value	MP	p-value
CDS premia	3.921	1.00	1.239	0.89
Inflation	-2.524	0.25	-10.179	0.00
Real GDP growth	-4.711	0.00	-7.713	0.00
Primary deficit	-5.798	0.00	-11.038	0.00
Debt/GDP	-2.120	0.73	-1.041	0.15
Yield spread	-1.410	1.00	-1.279	0.10

3.2 Level regressions

In the first set of regressions I explained the CDS premia with the short-term interest rate, inflation, real GDP growth, the primary deficit, the debt-to GDP ratio and the VIX index. In the first column of Table 4 we can see the results of the equation containing only country fixed-effects, with clustered standard errors in parenthesis. The short-term interest rate and the real GDP-growth are not significant at 5 percent; only the inflation, primary deficit, debt-to-GDP ratio and the VIX index are. A one percentage point increase in the inflation rate means a 20 basis point increase in the CDS premia on average, in case of the primary deficit this value is 8 basis point, in case of debt-to-GDP ratio 14 basis point, in case of the VIX index 2 basis point. After including time fixed-effects as well, the coefficient and significance of inflation both increase, while the other variables' coefficients decrease. The short-term interest rate and the VIX index drop out because the time dummies fully capture their effect. The adjusted R-squared also increases, meaning that adding common shocks significantly mitigates the unexplained part of the CDS premia's variance. However, in this second regression I only allowed for homogenous effect of common shocks. I relaxed this constraint in the third regression, where I also included the first two principal components in interaction with country dummies to control for heterogenous shocks. One methodological issue is worth emphasizing here: in the first two regression, I eliminated the fixed effects using built-in panel regression function in Stata, but in the third one following Dell'Erba and Sola (2011), I eliminated the country and time fixed-effects using the standard within-transformation of observable variables, computed by hand.[5] The principal components are also estimations of unobserved variables, so I had to reduce the degree of freedom in computing the standard errors and the adjusted R-squared accordingly.[6] I followed this procedure for all regression groups. As for the regression results, the coefficients do not change much compared to column 2, but the heterogenous effects of the principal components are jointly highly significant[7]. The adjusted R-squared decreases, but this is only the result of taking out the cross-section and yearly averages from the variables.

[5] Dell'Erba and Sola (2011) cite Bai (2009) for further reference.
[6] In adjusting the degrees of freedom, I followed Wooldridge (2002) and (2003).
[7] See Table A2 in the Appendix.

Table 4 CDS premia regressions

Explanatory variables	(1) CDS premia	(2) CDS premia	(3) CDS premia
Short-term interest rate	0.1324*		
	(0.062)		
Inflation	0.2023**	0.3571***	0.3769***
	(0.081)	(0.099)	(0.103)
Real GDP growth	-0.0369	-0.0719	-0.0307
	(0.076)	(0.121)	(0.078)
Primary deficit	0.0826**	0.0609**	0.0659***
	(0.032)	(0.023)	(0.019)
Debt/GDP	0.1425***	0.1183***	0.1216***
	(0.031)	(0.024)	(0.017)
VIX	0.0269**		
	(0.010)		
Observations	211	211	211
Adjusted R-squared	0.7019	0.7853	0.4650
Number of id	9	9	9
Country FE	yes	yes	yes
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), country and time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1

As for the yield spread (see Table 5), I used the same methodology, but the results are a bit different. In the first regression, the short-term interest rate becomes highly significant, while the VIX index proves to be insignificant. A one percentage point increase in the short-term interest rate means a 31 basis point increase in the yield spread on average, in case of the inflation rate this value is 27 basis point, in case of primary deficit 11 basis point and in case of debt-to-GDP ratio 18 basis point. In the second and third regressions (after including time fixed-effect and global factors) the coefficient of the inflation rate increases significantly, while the effect of primary deficit and debt-to-GDP ratio do not change much. In the FAP regression, the principal components are again highly significant jointly. What we can infer from this is that according to this results, the VIX index is much more relevant to the OTC-traded CDS-premia than for the bonds.

Table 5 Yield spread regressions

	(1)	(2)	(3)
Explanatory variables	Yield spread	Yield spread	Yield spread
Short-term interest rate	0.3053***		
	(0.068)		
Inflation	0.2659**	0.4629***	0.4953***
	(0.096)	(0.122)	(0.149)
Real GDP growth	-0.0258	-0.0325	0.004
	(0.115)	(0.171)	(0.098)
Primary deficit	0.1103**	0.0942**	0.0988***
	(0.044)	(0.032)	(0.026)
Debt/GDP	0.1798***	0.1671***	0.1688***
	(0.036)	(0.030)	(0.022)
VIX	0.0188		
	(0.013)		
Observations	218	218	218
Adjusted R-squared	0.6637	0.7167	0.44
Number of id	9	9	9
Country FE	yes	yes	yes
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), country and time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1

The third set of regressions deals with the difference of the yield spread and the CDS premia, the default swap basis. As we could see in the summary Table 1 above, its mean is 0.16 and it has a nonzero standard deviation, so I analysed it with the same methods as the risk premia. I expanded the set of explanatory variables with the level of CDS premia in order to see whether it has an impact on the basis. In the first column of Table 6 we can see, that the short-term interest rate, the inflation rate, the VIX index and the level of CDS are the variables which are significant at maximum 5 percent. A one percentage increase in the inflation means a 12 basis point drop in the basis on average, in case of the inflation rate this value is 4 basis point, while in case of the VIX index it is a 1 basis point increase and in case of the level of CDS a 20 basis point decrease. These results are quite interesting, since they tell us that ceteris paribus as the country is deemed more risky, in other words, as the CDS premium increases, the spread and the CDS premia get more and more in line on average; while on the other hand, the increase of pessimism on the financial markets ceteris paribus widens their difference. The effect of the level of CDS gets bigger in the second and third regression, and the principal components are again highly significant.

Table 6 Default swap basis regressions

	(1)	(2)	(3)
Explanatory variables	Default swap basis	Default swap basis	Default swap basis
Short-term interest rate	-0.1233***		
	(0.024)		
Inflation	-0.0432**	0.0054	-0.0239
	(0.015)	(0.032)	(0.049)
Real GDP growth	-0.0215	-0.0424*	-0.0433
	(0.025)	(0.020)	(0.052)
Primary deficit	-0.0139	-0.0096	-0.0129
	(0.013)	(0.010)	(0.009)
Debt/GDP	-0.0109	-0.0097	-0.0118
	(0.012)	(0.010)	(0.009)
VIX	0.0126**		
	(0.005)		
CDS	-0.1967**	-0.2574***	-0.2474***
	(0.070)	(0.058)	(0.046)
Observations	211	211	211
Adjusted R-squared	0.5204	0.7069	0.4868
Number of id	9	9	9
Country FE	yes	yes	yes
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), country and time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1

3.3 Differenced regressions

Since I was not able to reject the non-stationarity for a couple of variables, I also computed the above regressions for the differenced series. I include only one of them in the main text (see Table 7), as the results became quite insignificant for the CDS and the default swap basis (see Appendix Table A3 and A4). The regressions are different from the level ones in the way that the differencing already eliminates the unobserved country fixed-effects (Wooldridge, 2003), so I did not include them. Thus the first column is estimated without any fixed effects, the second has time fixed-effects, and the third time fixed-effects and global factors. The coefficients did not change much, but the adjusted R-squared decreased significantly, indicating that much information was lost due to the differencing. Another fact to highlight is that the global factors are no longer significant jointly.

Table 7 Differenced yield spread regressions

	(1)	(2)	(3)
Explanatory variables	Δ(Yield spread)	Δ(Yield spread)	Δ(Yield spread)
Δ(Short-term interest rate)	0.3911***		
	(0.14)		
Δ(Inflation)	0.1235***	0.1412*	0.1478
	(0.05)	(0.08)	(0.105)
Δ(Real GDP growth)	-0.0002	0.0208	0.0354
	(0.04)	(0.03)	(0.039)
Δ(Primary deficit)	0.0297***	0.0234**	0.0212*
	(0.01)	(0.01)	(0.011)
Δ(Debt/GDP)	0.1205**	0.0875**	0.0599
	(0.05)	(0.04)	(0.054)
Δ(VIX)	0.0126**		
	(0.01)		
Observations	209	209	209
Adjusted R-squared	0.1683	0.3549	-0.0293
Number of id	9	9	9
Country FE	no	no	no
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), the time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1

CONCLUSION

The aim of my thesis was twofold: first, to measure the effect of fiscal policy on sovereign spreads focusing on developed countries – this is why my dataset contained nine euro-zone countries for the time period 2006-2011; second, to investigate the difference between sovereign spread and another measure of risk premia, the Credit Defaul Swap (CDS) premia. The motivation from the latter came from the fact that the difference of these two measures should be zero due to the no-arbitrage condition, however, it is an established empirical observation that during the recent crisis, there were large unexercised arbitrage opportunities on the financial markets (Foley-Fisher, 2010). So I not only ran regressions for the spread, but for the CDS premia, and for the difference of the two, the so-called default swap basis.

As for the methodological issues, the nature of the dataset – multiple countries, multiple time periods – called for panel econometric procedures. In the literature several approach is used, I chose the so-called Factor Augmented Panel (FAP), developed by Giannone and Lenza (2008), following the article of Dell'Erba and Sola (2011). The main advantage of the FAP is that it not only allows for country and time fixed-effects, but introduces global factors with heterogenous effects on different countries.

My results showed that these heterogenous global factors are significant explanators of the different risk premia and the default swap basis, even if I included country and time fixed-effects as well. As for the fiscal policy, the inflation rate, the primary deficit and the debt-to-GDP ratio all had significant positive effect on risk premia, meaning that as they increase, the risk premia increase, too. In case of the default swap basis, the following result was worth emphasizing: ceteris paribus as the country is deemed more risky, in other words, as the CDS premium increases, the spread and the CDS premia get more and more in line on average; while on the other hand, the increase of pessimism on the financial markets ceteris paribus widens their difference.

One final remark about the stationarity of my variables: before conducting the regression analysis, I performed two types of unit root tests, since running a regression on non-stationary time series gives inconsistent coefficients and the tests will not work (Wooldridge, 2003). Following Dell'Erba and Sola (2011), these tests were the so-called CADF test, proposed by Pesaran (2007), where the simple Dickey-Fuller test is augmented by two elements: the cross-section averages of lagged level variables and the first-differenced series; the second test was proposed by Moon and Perron (2004) and it estimates the common factors driving the series before testing the stationarity. These procedures both account for the cross-section dependence of a variable between the countries – another way of saying that they are affected by the same shocks. Both tests' null hypothesis is that all the series are non-stationary. I couldn't reject that at any conventional significance level in the case of the CDS premia, the debt-to-GDP ratio and the yield spread. This meant at least that we had to handle the level regression results with caution; however, as the power of the tests with this short time series is quite low (see for example Pesaran, 2007), we cannot surely state that some of the variables are indeed non-stationary. So I tend to believe the level regression results.

Anyway I ran regressions on the differenced series too, but almost all variables lost their significance, probably due to the loss of information, caused by the differencing.

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APPENDIX

Table A1 Data sources

Variable	Source
CDS premia	Datastream
Bond Spread	Datastream
Short-term interest rate	OECD
Inflation	OECD
Real GDP growth	OECD
Primary deficit	European Central Bank
Debt/GDP	Eurostat
VIX	Chicago Board Options Exchange, Bloomberg

Table A2 F-statistics of principal components-dummy interactions joint significance

Dependent variable	pc1 and pc2 interactions jointly	pc1 interactions	pc2 interactions
CDS premia	3.10***	1.02	3.21***
Yield spread	1.74*	1.48	2.70***
Default swap basis	2.34***	2.05**	2.13**
Δ(CDS premia)	1.48	1.07	1.36
Δ(Yield spread)	1.10	0.89	1.12
Δ(Default swap basis)	1.57	0.33	0.95

Notes- F-statistics are adjusted to account for real degrees of freedom.*** p<0.01, ** p<0.05, * p<0.1

Table A3 Differenced CDS premia regressions

Explanatory variables	(1) Δ(CDS premia)	(2) Δ(CDS premia)	(3) Δ(CDS premia)
Δ(Short-term interest rate)	0.4083***		
	(0.13)		
Δ(Inflation)	0.0961**	0.0997	0.105
	(0.05)	(0.07)	(0.086)
Δ(Real GDP growth)	-0.0622*	-0.0304	-0.0141
	(0.03)	(0.02)	(0.024)
Δ(Primary deficit)	0.0186**	0.0105*	0.0086
	(0.01)	(0.01)	(0.008)
Δ(Debt/GDP)	0.1020**	0.0700**	0.0506
	(0.04)	(0.03)	(0.042)
Δ(VIX)	0.0140***		
	(0.00)		
Observations	202	202	202
Adjusted R-squared	0.2008	0.5045	-0.0232
Number of id	9	9	9
Country FE	no	no	no
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), the time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1

Table A4 Differenced Default swap basis regressions

Explanatory variables	(1) Δ(Default swap basis)	(2) Δ(Default swap basis)	(3) Δ(Default swap basis)
Δ(Short-term interest rate)	0.0063		
	(0.05)		
Δ(Inflation)	-0.0361**	-0.056	-0.0676
	(0.02)	(0.04)	(0.051)
Δ(Real GDP growth)	-0.0631*	-0.0546*	-0.0596*
	(0.03)	(0.03)	(0.034)
Δ(Primary deficit)	-0.0118	-0.0108	-0.0116
	(0.01)	(0.01)	(0.011)
Δ(Debt/GDP)	-0.0191	-0.0098	-0.0064
	(0.02)	(0.02)	(0.014)
Δ(VIX)	0.0017		
	(0.00)		
Observations	202	202	202
Adjusted R-squared	0.0613	0.3591	-0.1510
Number of id	9	9	9
Country FE	no	no	no
Time FE	no	yes	yes
Factors	no	no	yes

Notes- Clustered standard errors in parentheses. In column (3), the time-fixed effects are eliminated via standard within-transformation by hand. Global factors are interacted with country-dummies. Standard errors are adjusted accordingly.
*** p<0.01, ** p<0.05, * p<0.1