LUND UNIVERSITY
School of Economics and Management

DEPARTMENT OF ECONOMICS

BACHELOR THESIS

SPRING 2010

Determinants of Sovereign Credit Default Swap spreads for PIIGS

- A macroeconomic approach

Supervisor:

Hossein Asgharian

Authors:

Christoffer Brandorf

Johan Holmberg

ABSTRACT

This study examines the effects of changes in macroeconomic variables on sovereign CDS spreads for the countries within the PIIGS block. We run regressions for the countries individually and with the inclusion of Germany as a benchmark. In addition to study the whole time period (2004Q1-2009Q3), we divided it into two sub-periods, the first being financially stable and the second being characterized by financial turmoil. A Ramsey RESET test shows that our first model is correctly specified during the second sub-period. We find the highest number of significant variables in this particular model. For the first sub-period we find our regressions to be insignificant.

Overall we find unemployment rates to be the most frequently significant determinant of the CDS spread. Our study shows that, in many cases, increasing government debt, independently as well as relative to Germany, contributes to wider CDS spreads. Furthermore we find varying results for GDP growth rate, while inflation is found to be the least significant variable in our study.

1 INTRODUCTION

The introductory chapter presents the background of this paper followed by a problem discussion which delineates the purpose of the paper. The chapter ends with a brief section conveying the paper's disposition.

1.1 BACKGROUND

The first structures of the Credit Default Swap (CDS) were created in the mid 90s. Since its inception, this particular credit derivative has revolutionized the market and grown at an extremely rapid pace. The CDS is a credit derivative that inherits and derives its value from changes in the underlying asset, or more specifically from the credit risk inherent in corporate or sovereign securities. The main characteristics of a credit derivative are that it allows the isolation of credit risk and enables replication, transfer and hedging of credit risk. According to Duffie (1999) at least three types of investors can be identified to be attracted to these activities: those seeking diversification while identifying credit derivatives as a new asset class, those seeking to manage credit risk and those seeking to arbitrage.

Initially the CDS was created and solely used by banks to manage their credit risk. By enabling selling or hedging credit risk, banks did not have to deny clients credit in order to meet regulatory demands of maintaining a capital adequacy above a certain threshold (Basel II, BIS, 2004). The market for credit derivatives in general and CDSs in particular grew year by year and interestingly enough the market had come to be more and more dominated by players betting and speculating in the financial health of companies rather than by banks seeking to maintain a healthy balance sheet.

Numbers from International Swaps and Derivatives Association (ISDA, 2007) holds that the total notional amount of outstanding CDS contracts rose from $2,2 trillion in December of 2002 to $62,2 trillion in December of 2007. The market size had more than doubled during each of these years but hit a setback in 2008 and decreased to $38,6 trillion as it suffered from worldwide financial instability (see figure 1).

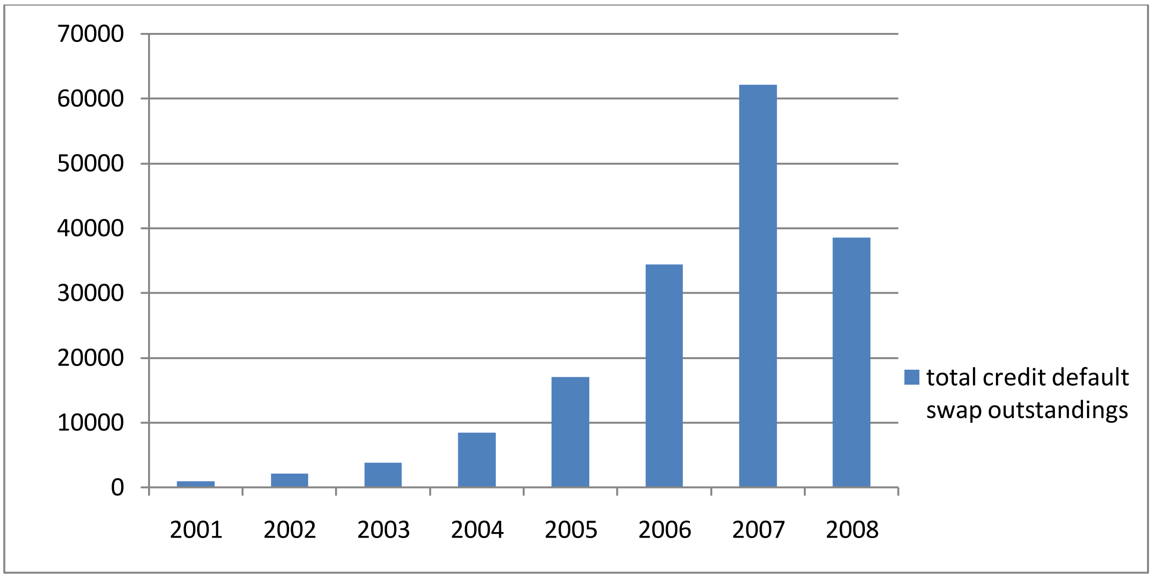

Figure 1: Market growth for CDSs. Notional amounts in billions of USD. Source: ISDA (2007)

The structure of the CDS along with the regulations of the financial market made it fully possible to buy protection without owning the underlying asset. By doing so one was betting against the entity being able to meet its obligations, i.e. one could make money as a direct result of a company's misfortune. The CDS protects the buyer against a pre-specified credit event. The credit event could constitute bankruptcy, failure to pay, obligation default, restructuring or a ratings downgrade below a given threshold. If this event occurs, the protection buyer is able to sell a given bond (the reference obligation) at par to the seller of the protection. In return for protecting one's investment, the buyer of the CDS is paying a spread (premium) which is denoted in basis points (bps) per annum.

Trading with corporate credit risk has been the primary contributor to CDS market. Not surprisingly, credit spreads and CDS spreads for sovereign securities rose during the recent and present financial crises, but the volumes were still nowhere near the volumes traded with corporate securities as reference entity. However volumes in the European sovereign CDS market are increasing.

According to an article in Financial Times (February 3rd 2010), the market saw record high volumes due to the present instability in Greece.

1.2 PROBLEM DISCUSSION

"It suddenly occurred to me that I wasn't reading much about Greece the last few days. Was the situation stabilizing? Not according to the bond market and the CDS market, which both seem to show things heading off a cliff. Why the sudden hush?"

The quote above is from Paul Krugman's blog on the New York Times website (April 3rd 2010). The situation in Greece appeared in newspapers almost every day for several weeks – and then, suddenly, it vanished. The perception that the conditions in Greece were brightening was refuted by the credit markets. Due to the lack of media coverage, the bond market and the CDS market acted as sole information bearers on Greece's crisis. The transfer of focus from uncertainty in corporate financial health to sovereign financial health is an interesting turn of events in the global financial crises. Articles and news discussing Lehman Brothers and General Motors have been replaced by those focusing on increasing unemployment in Spain and Greece's enormous deficit. Greece's enormous deficit bears huge implications for the global economy and the euro-zone in particular.

Portugal, Ireland, Italy, Greece and Spain (PIIGS) are all euro-zone members and are currently experiencing extensive financial trouble; this is reflected by high CDS spreads. From a simplified arbitrage perspective the CDS spread on a reference entity should equal the credit spread on the same entity (Duffie, 1999). E.g. the CDS spreads traded with Greece as reference entity would equal the interest rate Greece is able borrow at, minus a benchmark riskless government bond or note. Therefore a high CDS spread implies a high borrowing rate.

Macroeconomic factors are prominent indicators of economic climate and are widely used among most of the players in the financial market. Every week new statistics on these factors are communicated to the market. According to the credit rating bureau Fitch, the credit rating downgrade on Portugal on March 24th 2010 was mostly based on weak macroeconomic figures such as a budget deficit of 9,3 percent of GDP. The relationship between CDS spreads and macroeconomic variables has not been sufficiently studied. However, Tang and Yan (2009) examines the impact of macroeconomic conditions on corporate Credit Default Swaps and find that average CDS spreads decrease as GDP growth rate increases. Barrios, Iversen, Lewandowska and Setzer (2009) analyze the determinants of government bond yield spreads in the euro area and find a significant interaction of general risk aversion and macroeconomic fundamentals. They conclude that the impact of domestic factors increase during a financial crises.

In a video interview for yahoo finance (http://www.berninger.de/index.php?id=80), finance guru Marc Faber argues that sovereign debt could potentially evolve into a new financial crisis and cites the PIIGS-countries as particularly vulnerable to default. Sovereign debt is undoubtedly a hot topic in today's global economy, and the relationship between macroeconomic fundamentals and levels of CDS spreads is particularly interesting.

1.3 PURPOSE

The aim of this paper is to examine whether changes in macroeconomic variables such as GDP growth rate, inflation, gross debt and unemployment affect the level of sovereign Credit Default Swap spreads. The study is limited to the PIIGS-countries.

1.4 DISPOSITION

This paper consists of five components. The introduction covers background material on which the paper is based. The second section discusses general theories regarding Credit Default Swaps. The third section contains the study's expected outcome and an outline of our empirical procedure regarding methodology and the sets of data we utilized. The fourth section presents and analyzes the test results; this is followed by the conclusion.

2 THEORY

In this chapter we present the definitions of credit risk and the credit spread. In addition, we link these two concepts to the theory of Credit Default Swaps and the pricing of these. We also focus on contrasting the characteristics of sovereign CDSs and corporate CDSs.

2.1 CREDIT RISK

Credit risk, simply put, is the risk of not receiving your money back from a debtor when providing them with credit. Using this simple explanation, one can easily conclude that credit risk affects the whole society and most businesses, not just banks and financial institutions. However the term credit risk commonly refers to the risk of not getting repaid upon granting some counterpart credit.

Traditionally there are four major components of credit risk (see, e.g., Hull, 2008):

- Arrival risk – Uncertainty whether a default will occur or not.
- Timing risk – Uncertainty of precise timing of default.
- Recovery risk – Uncertainty about the severity of losses given default.
- Market risk – Risk of changes in the market price of the asset, even if no default occurs.

Of course the creditor is entitled to a premium for lending the money. This premium is determined based upon the exposure of credit risk, i.e. how large is the probability of the debtor not fulfilling its obligations and repaying the loan. If the debtor cannot repay the loan, a credit event - most often default - occurs.

2.2 CREDIT SPREADS

The Credit spread is typically viewed as the difference between the promised yield of a credit risky security and the yield on a benchmark government bond or note. Theoretically there are two core determinants of the credit spread: The probability of default and the expected recovery in the event of default. The probability of default is positively correlated to the credit spread, while the recovery rate of the security must be inversely correlated to the credit spread. This implies that the yield of a bond is the sum of the yield of a government benchmark security and the credit spread.

YIELD OF BOND X = YIELD OF BENCHMARK SECURITY + CREDIT SPREAD OF BOND X

An explicit link between the credit spread and the spread of a CDS contract is presented by Duffie (1999). Duffie determines that cash-flows of a CDS contract are the equivalent to buying a government benchmark bond (default-free floater), receiving interest R, and short-selling a corporate bond (defaultable), paying R + spread S, on the same entity as referred to in the CDS contract, i.e. constructing a synthetic CDS (see figure 2).

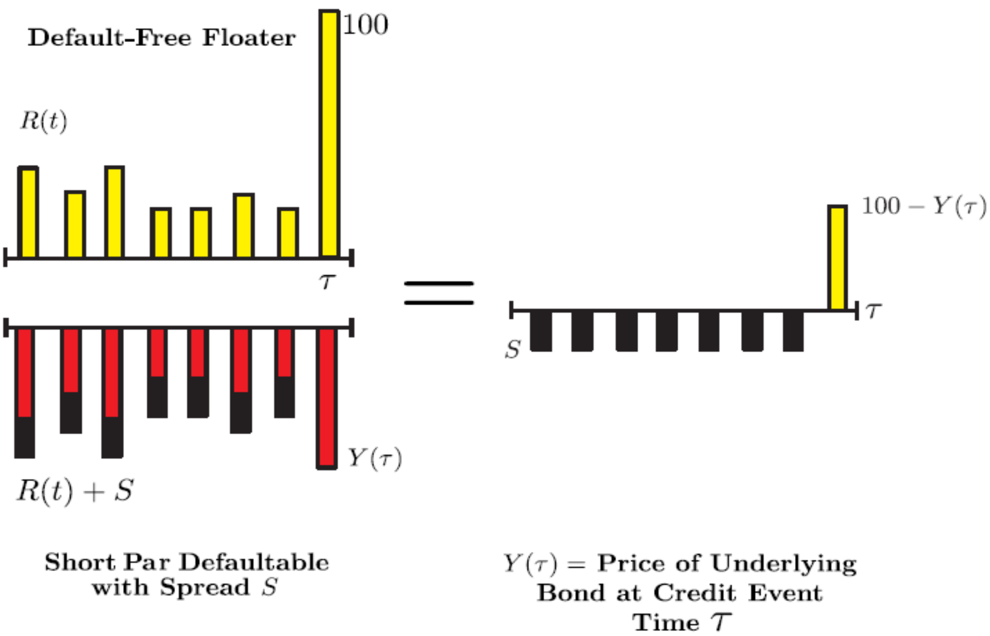

Figure 2: Structure of synthetic credit swap cash-flows. Source: Duffie (1999).

Further, O'Kane and McAdie (Lehman Brothers, 2001) wrote a paper on the default swap basis and defines it as:

DEFAULT SWAP BASIS = DEFAULT SWAP SPREAD – PAR FLOATER SPREAD

If the basis does not equal zero, a theoretically risk-free trade can take place. If the basis is negative, the following sets of trades are implied:

1. Buy a par floating rate asset which pays a coupon of LIBOR plus a spread F. Assume that you can fund the purchase by borrowing at LIBOR flat.
2. Buy default protection on the asset at equal maturity and for this pay a spread D.

By implementing this strategy, the investor earns LIBOR plus a risk free spread of F-D. If basis (D-F) would have been positive one could just, theoretically, inverse the trade by selling protection and receive D, short-selling the par floating rate asset paying LIBOR plus F and investing at LIBOR flat. In spite of this theoretical argument, the basis rarely equals zero. O'Kane and McAdie (Lehman Brothers, 2001) argues the basis to be non-zero due to certain basis drivers. One of many basis drivers is known to be counterparty risk, which represents the uncertainty of the protection seller's risk of not being able to compensate the protection buyer in the event of default.

2.3 CREDIT DEFAULT SWAPS

As briefly mentioned in the introduction, the CDS contract consists of two parties: the protection buyer and the protection seller. Under the terms of the CDS contract, the protection buyer has the right to sell a given bond, issued by the reference entity, to the protection seller at par upon the realization of default or another, in contract, pre-specified credit event (see, e.g., Hull, Predescu and White, 2004). For this insurance the protection buyer makes periodic payments - known as the CDS spread or premium - to the seller. If a default occurs a residual payment may be required from the buyer. This is due to the fact that the default may be realized between two periodic payments. The notional principal of the swap is the total principal covered by the CDS contract.

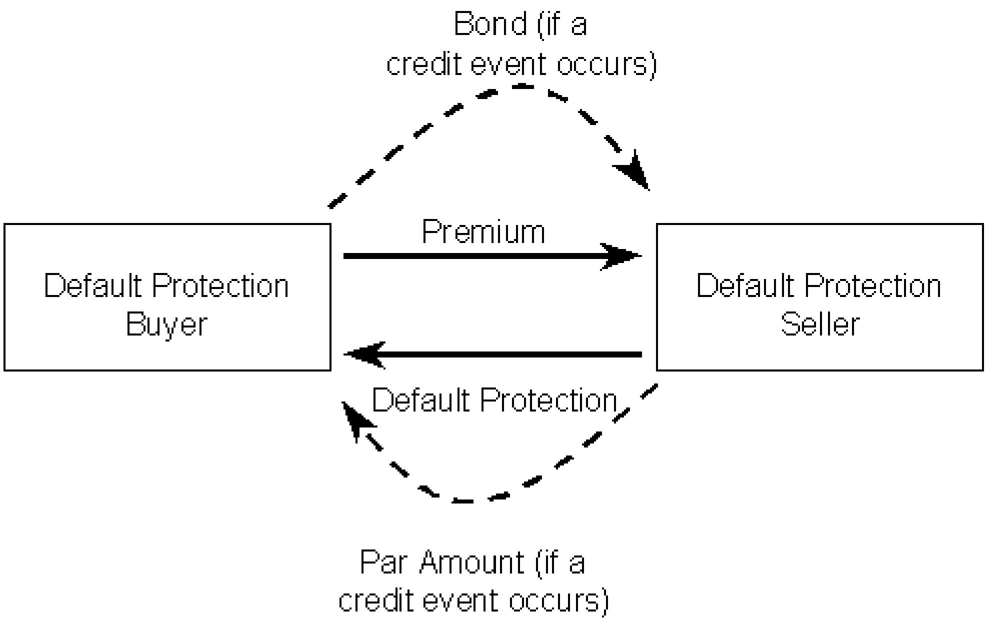

Figure 3: Structure for a plain vanilla Credit Default Swap.

If a default occurs, settlement can be made either physically or in cash. Figure 3 demonstrates physical settlement in the event of default. In a case of default, the buyer delivers the bond to the protection seller in return for the par value of the bond. If settlement takes place in cash, a mid-market price of the reference asset is computed on a pre-specified number of days after the credit event. This mid-market price is then subtracted from the notional and the remainder is given to the protection buyer. The default constitutes a credit event which is always carefully pre-specified in the CDS contract. A credit event could be bankruptcy, failure to pay or restructuring. Unlike a corporation, a sovereign can hardly cease to exist upon default. The credit event for a sovereign entity is, for this reason, most often restructuring or repudiation of external debts (Pan and Singleton, 2008).

Consider the following example:

- A CDS requires a premium of 80 basis points per annum to be paid on a semiannual basis.
- The notional principal of the contract is $500 million.
- Suppose default occurs after two years and three months
- Settlement is to be made in cash, and the recovery rate is set to 70 percent by the calculation agent.

Table 1: Example of CDS contract

Periodic payments	Time	Cash-flow	Reciever
	0,5	0,5 * 0,008 * 500000000 = 2000000	Seller
	1,0	0,5 * 0,008 * 500000000 = 2000000	Seller
	1,5	0,5 * 0,008 * 500000000 = 2000000	Seller
	2,0	0,5 * 0,008 * 500000000 = 2000000	Seller
Default payment	2,25	0,3 * 500000000 = 150000000	Buyer
Accrual payment	2,25	3/6 * 2000000 = 1000000	Seller

- The seller receives a premium of $2000000 every six months until the occurrence of default.
- At default the buyer receives (1-recovery rate) multiplied by the notional principal.
- At default the seller receives an accrued payment.

According to O'Kane and Turnbull (Lehman Brothers, 2004) the requirement of accrued payment is standard for CDSs on corporate securities while it is not standard on CDSs on sovereign securities.

2.4 PRICING CREDIT DEFAULT SWAPS

To retrieve the price or the spread of a CDS contract one must first consider how to value CDSs. The value of a CDS contract should at inception equal zero, meaning there is no cost for entering a CDS contract for any part.

This stems from the present value of the premium leg and the present value of the default leg respectively.

VALUE = PV (PREMIUM LEG) – PV (DEFAULT LEG)

$$PV\ (PREMIUM\ LEG) = \sum_{\mathrm{i}=1}^{\mathrm{f \cdot T}} \cdot e^{-r_i \cdot t_i} \cdot s \cdot N \cdot Q(\tau \geq t_i)$$

$$PV\ (DEFAULT\ LEG) = (1 - R) \cdot N \cdot \sum_{\mathrm{i}=1}^{\mathrm{f \cdot T}} \cdot e^{-r_i \cdot t_i} \cdot (Q(\tau \geq t_{i-1}) - (Q(\tau \geq t_i))$$

T is the maturity of the CDS contract in years, f is the number of premium payments in a year, s is the CDS spread, N is the notional, r_i is the risk-free interest rate, Q is the risk-neutral default probability, and R is the recovery in the event of a default. Using the equations above, one can solve for the spread. However, one must calculate Q $(\tau \geq t_i)$ in order to receive the default probabilities using either a structural or a reduced-form model.

2.4.1 STRUCTURAL MODEL

The structural model is very useful for estimating default probabilities when balance sheet data is the most reliable source. According to O'Kane and Turnbull (Lehman Brothers, 2003) most of today's structural models are variants of the framework Merton invented back in 1974. The Merton framework is built on the Black and Scholes option pricing theory. Merton finds equity to be analogous to a call option on the firm's assets and debt to be a risk-free bond and a short put option.

To estimate the default probabilities, Merton uses asset value and asset volatility. The spread can then be examined as a function of leverage, asset risk and debt maturity (Merton, 1974). The main results of this framework regarding the behavior of the spreads were:

- Spreads increase in leverage and asset risk.
- Spreads increase in maturity for low leveraged firms with a possible hump shape.
- Spreads decrease in maturity for highly leveraged firms.

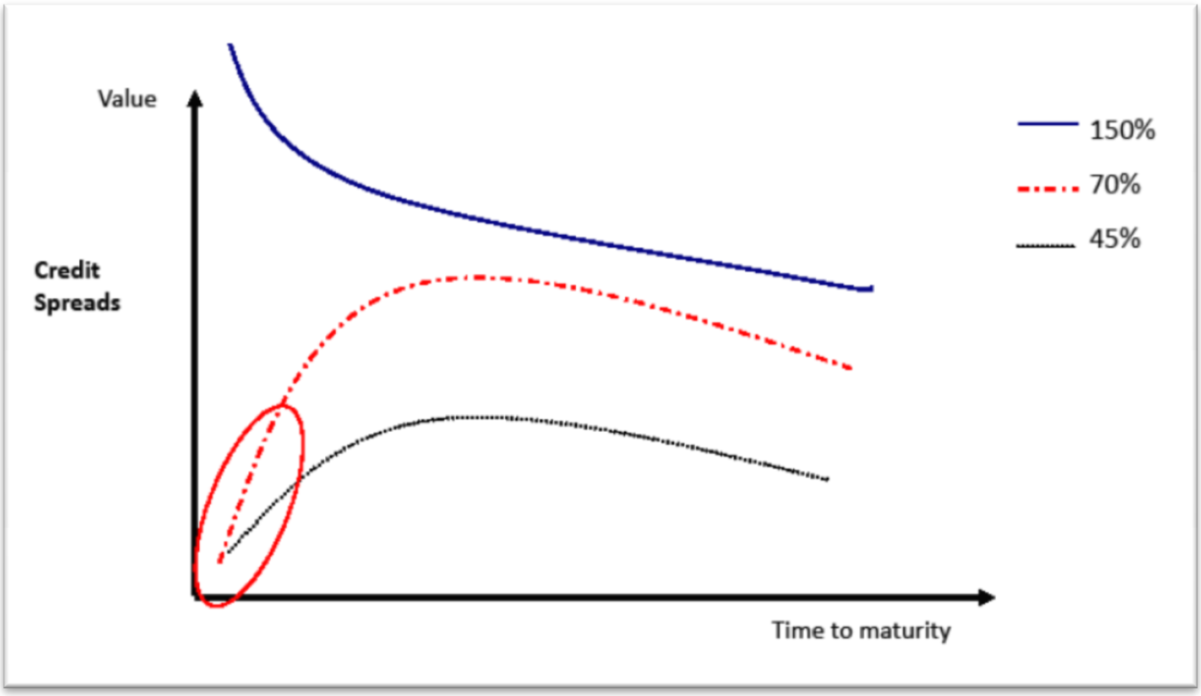

Figure 4: Credit spreads for different leverage levels. Source: McGill University (2009)

The intuition behind this is that for low leveraged firms, default will occur if the firm value drops substantially, which, in expected terms, will take time. For high leveraged firms, default can only be avoided if you give the firm time to grow.

Moody's/KMV (Crosbie and Bohn, 2003) employ a similar approach, modeling default risk by following three essential steps:

- Estimating asset value and asset volatility by using data regarding market value and volatility of equity and the book value of liabilities.
- Calculating the distance-to-default by using the estimations in previous step.

- Calculating the default probability which is determined from the distance-to-default and the default rate for given levels of distance-to-default.

However, there are some criticisms of modeling default risk in this way. O'Kane and Turnbull (Lehman Brothers, 2003) claim structural models are limited in at least three important ways. They suggest structural models are hard to calibrate due to the fact that firms' data are often only published four times a year. In addition, structural models lack the flexibility to exactly fit a given term structure of spreads in most cases. This makes it problematic to extend structural models to price credit derivatives. Instead of using structural models to model default risk, reduced-form modeling can be implemented.

2.4.2 REDUCED-FORM MODEL

According to O'Kane and Turnbull (Lehman Brothers, 2003), the most common approach when reduced-form modeling is based by the work of Jarrow and Turnbull (1995). The major contrast between structural models and reduced-form models is that the latter does not consider the explicit link between capital structure and default probabilities. Instead, default probabilities or default risk is modeled as an exogenous random variable (see, e.g., Duffie and Singleton, 1999). By using market prices on liquid traded securities, the distribution of default probabilities is recovered, which can then be used when valuing credit derivatives such as the CDS. The reduced-form model is fairly technical, which is why we have attempted to keep the theory and explanations behind it simple and use text rather than formulas to describe it. We recommend that any interested readers seeking further understanding of this model study papers by e.g. Darrel Duffie and Dominic O'Kane (see reference list).

3 METHODOLOGY AND EMPIRICAL PROCEDURE

We believe that the sovereign CDS-spread, our dependent variable, is affected by macroeconomic variables alongside the variables already derived in existing models. According to O'Kane and Sen (Lehman Brothers, 2004), the CDS-spread is the best measure of credit risk and the CDS contract is, in layman's terms, almost a pure credit play. Because of this, we considered which sovereign macroeconomic variables exerted the largest effect on the default risk and credit risk. We chose to test the effects of four macroeconomic variables: GDP growth rate, inflation, unemployment and gross debt. We assume that these four variables affect default risk and credit risk of a sovereign more than others. A brief description of these variables is presented in section 3.1.2.

We expect the GDP growth rate and inflation to be inversely related to the CDS spread, since a lower growth rate induces a reduced ability to handle sovereign debt. In this state, inflation is expected to decrease and these effects will most likely cause the CDS spreads to widen. The gross debt and the unemployment rate are expected to be positively related to the CDS spread, since surging debt levels obviously increase the probability of default, and high unemployment rates causes increased government expenditure. Furthermore, we expect to find stronger significance during the second sub-period as compared to the first sub-period. This is due to previous research, which proves that higher volatility enables a more significant effect of macroeconomic fundamentals on bond yields.

We did not include exchange rates among the chosen variables. Due to the fact that the countries included in our study are all part of the euro-zone and have the same currency, we believe that this variable would have been redundant if used in our regression models. The other variables are rather straight forward and are commonly used to estimate the financial state of a nation. One might extend our study and include the complete GDP identity, if significant, instead of the more condensed growth rate indicator. This, however, falls outside the scope of this paper.

3.1 DATA

As a consequence of data limitations involved with macroeconomic variables, the highest frequency of analysis we are able to perform occurs on a monthly basis. We initially transformed all the data collected to a basis point change from the previous observation, enhancing the economic feasibility of our analysis. According to a paper written for the European central bank (Attinasi, Checherita and Nickel, 2009), one can track signs of the worldwide financial crisis back to the end of July 2007. This suggests that our data consists of two vastly different economic conditions: a stable period from 2004 to mid 2007 and an unstable period lasting from mid 2007 until the end of 2009. As a result of this, we estimated our models individually for these discerned periods as well as the complete series. This should distinguish whether our values are a result of financial distress, or statistically significant during both stable times and times of financial distress.

3.1.1 COUNTRY SELECTION

No one could have eluded the recent demise of Greece, and experts are discussing contagion effects around the whole block referred to as PIIGS. Therefore, we found it reasonable to include the whole PIIGS block when examining the surging CDS-spreads. In our models - see section 3.2 - we test each country separately, as well as testing for the PIIGS block as a whole by taking the block average for each variable, for each time t.

In a paper written for the European Commission, Barrios, Iversen, Lewandowska and Setzer (2009) refers to the German sovereign bond market as the "safest haven, both in terms of credit quality choice ("default-free") and liquidity". They claim that during times of high risk aversion the "flight-to-safety" and "flight-to-liquidity" is more pronounced for German government bonds than for other sovereign bonds. Because of this, we included the German statistics as a benchmark in the model - see section 3.2.2 - with the intention of explaining the excess premium paid for PIIGS sovereign CDSs with regard to our chosen variables.

3.1.2 VARIABLE SELECTION

Macroeconomic variables were collected through Eurostat, and are monthly or quarterly reported values that we, if quarterly, manually interpolated. The CDS-spreads were collected from CMA vision through DataStream. The data consists of 67 observations per variable and country during the period of March 2004 (Q1) to the end of September 2009 (Q3).

3.1.2.1 Sovereign CDS Spread

According to Dave Klein (Index Universe, April 17th, 2009), Credit Derivatives Research's manager of indices, CMA vision is regarded as the leading independent source of credit derivatives market information. He reports that there is more liquidity in the five-year CDS contract. Based on the fact that the five-year contract is the most traded on the market at the moment, we chose to use it in our analysis. The spreads used are the "mid-quote" for each country included, meaning they are the average of bid and ask price. For Spain, however, we could not track the five-year CDS spreads as far back as the start of 2004, so we substituted it for the six-year contract which was comparative to the five-year contracts mid-quotes for our time period.

3.1.2.2 GDP Growth Rate

GDP values were collected through Eurostat and express conditions on a quarterly basis. Tang and Yan (2009) find GDP growth rate to be inversely related to the level of CDS spreads. Since our intention is to run the models on a monthly basis, we interpolated the change in GDP within each quarter to receive the monthly change in basis points. The time series of GDP growth rate contained a linear trend which we extracted by detrending the series.

3.1.2.3 Sovereign Gross Debt

The sovereign gross debt levels are also reported quarterly, and are defined as the total gross debt at a nominal value outstanding at the end of each quarter between and within the sectors of the general government (Metadata, Eurostat). To obtain monthly values, assumptions about a constant growth within each quarter had to be made and the values could then be interpolated. Standard in the credit swap market is for settlement to be made in USD, which is why we have chosen to transform the gross debt for each country from euro to USD (Financial Times, April 30th, 2010). Here too we discovered a linear trend which we extracted in the same manner as the GDP growth rate.

3.1.2.4 Inflation

Eurostat reports inflation in two different ways, consumer price indices (CPIs) or the harmonized indices of consumer prices (HICP). The consumer price index is defined as a measure of the changes over time in the prices of consumer goods and services acquired, used or paid for by households. The harmonized index is released each month by Eurostat and covers the price indices themselves as well as annual average price indices and rates of change. Since the harmonized indices are released on a monthly basis and seem to include more variables to create a more accurate result, we chose the HICP for our study. Since 2006, (base year 2005=100) Eurostat reports the national HICPs with one or two decimal places depending on the country's dissemination policy. We adjusted for a linear trend in this series as well.

3.1.2.5 Unemployment

Unemployed people are defined as persons between 15 to 74 years of age who were not employed during the reference week, have actively sought work during the past four weeks and are ready to begin working immediately or within two weeks. It is reported by Eurostat monthly as a percentage of the total work force.

3.2 MODELS

3.2.1 MULTIPLE REGRESSION MODEL

We started the analysis by creating a multiple regression model that we used throughout,

$$Spread_{it} = \alpha_0 + \beta_1 \Delta GDP_{it} + \beta_2 \Delta Debt_{it} + \beta_3 \Delta Inflation_{it} + \beta_4 \Delta Unemployment_{it} + \varepsilon_{it}$$

where $Spread_{it}$ is the CDS-premium in basis points charged per annum at time t for country i, ΔGDP_{it} is the basis point change in GDP at time t for country i (GDP-growth rate), $\Delta Debt_{it}$ is the basis point change in country i's gross debt at time t, $\Delta Inflation_{it}$ is the basis point change in country i's inflation at time t, $\Delta Unemployment_{it}$ is the basis point change in unemployment rates at time t for country i. The result of this regression will help us understand to what extent the macroeconomic variables explain the CDS-spread at time t for country i.

3.2.2 MULTIPLE REGRESSION MODEL WITH GERMANY AS BENCHMARK

The model itself is relatively simple, though one has to be careful when interpreting the results. We subtracted all German values from the values of each observed country in our study and ran individual multiple regressions:

$$(Spread_{it} - Spread_t^{Ger}) = \alpha_0 + \beta_1(\Delta GDP_{it} - \Delta GDP_t^{Ger}) + \beta_2(\Delta Debt_{it} - \Delta Debt_t^{Ger}) +$$
$$\beta_3(\Delta Inflation_{it} - \Delta Inflation_t^{Ger}) + \beta_4(\Delta Unemployment_{it} - \Delta Unemployment_t^{Ger}) + \varepsilon_t$$

By renaming and restructuring the formula we receive the more appealing:

$$Spread_{it}^{diff} = \alpha_0 + \beta_1 \Delta GDP_{it}^{diff} + \beta_2 \Delta Debt_{it}^{diff} + \beta_3 \Delta Inflation_{it}^{diff} + \beta_4 \Delta Unemployment_{it}^{diff} + \varepsilon_t$$

Where:

$Spread_{it}^{diff} = (Spread_{it} - Spread_t^{Ger})$

$\Delta GDP_{it}^{diff} = (\Delta GDP_{it} - \Delta GDP_t^{Ger})$

$\Delta Debt_{it}^{diff} = (\Delta Debt_{it} - \Delta Debt_t^{Ger})$

$\Delta Inflation_{it}^{diff} = (\Delta Inflation_{it} - \Delta Inflation_t^{Ger})$

$\Delta Unemployment_{it}^{diff} = (\Delta Unemployment_{it} - \Delta Unemployment_t^{Ger})$

The result of this regression will aid us in explaining the excess premium paid for PIIGS CDSs relative to German CDSs. As Germany is considered "the safest haven", we assume that the macroeconomic variables we have chosen to explain the CDS spread in Germany are also at an economically sound level, a "risk-free" level. By subtracting the values of the German variables under this assumption we would get a "risk-premium" in our independent variables for the PIIGS block, enabling us to explain the effects this has on the excess premium paid.

In a mathematical equation both legs should be equal. Our assumption is that if the left leg, the CDS, government bond etc, is considered "safe", then the variables determining the specific instrument can be considered "safe" as well, i.e. our macroeconomic variables.

3.3 DIAGNOSTIC TESTING

To ensure that we do not have a problem with multicollinearity we tested the independent variables by constructing a set of correlation matrices (see Appendix E). We found no problem with collinear independent variables. To test for specification errors we conducted a Ramsey RESET test with both one and two fitted terms (see Appendix F). The test gives us information whether or not our model is correctly specified. To support our decision to divide the data into sub-periods we chose to conduct a Chow breakpoint test which indicates if there is a structural break in the data.

A condition for the OLS estimator to have the lowest variance among all linear estimators is that there exist no heteroskedasticity or autocorrelation among the residuals. Therefore we conducted a White's test to discover any potential heteroskedasticity and the Breusch-Godfrey test to reveal any signs of autocorrelation. Based on the results from these tests we adjusted the procedure accordingly. If we found heteroskedasticity we used White's heteroskedasticity consistent covariances when estimating our regressions with OLS. If heteroskedasticity and autocorrelation were present we used the Newey-West's heteroskedasticity consistent covariances in order to retrieve robust standard errors.

4 RESULTS AND ANALYSIS

In this section of the paper we present the results and analysis of our regressions. The results are presented in six tables, which contain both the regression output of the countries in the PIIGS block separately and as a group. In the table of results regarding our first regression model (table 2-4) our benchmark country Germany is included separately. Regression outputs for the whole observed period as well as for our two sub-periods are presented. In tables 5-7, results from the second regression model are presented, where Germany is included as a benchmark in each regression. This is also presented as a whole series and two sub-periods.

We found no problem with multicollinearity in our independent variables (see Appendix E). The result from our Ramsey RESET test shows inconclusive result regarding the specification of the models. However, the second sub-period in our first model seems to be correctly specified. In most regressions, autocorrelation and heteroskedasticity were found among the residuals. We used Newey-West's or White's heteroskedasticity consistent covariances in order to retrieve robust standard errors to adjust for incorrect inference. The Chow breakpoint test supported our theory of dividing the time series into two sub-periods.

Table 2: Results from OLS multiple regression model

2004M04-2009M09	α	β1	β2	β3	β4	R2	Adj. R2	F-stat	Prob
Portugal	19,2588	-0,099809	0,003830	-0,170812	0,071566	0,2640	0,2157	5,4701	0,0008
Ireland	28,6269	-0,414332*	0,009886	-0,470781***	0,089238*	0,4874	0,4537	14,4978	0,0000
Italy	32,9890	-0,008600	0,014747	-0,087264	0,028644	0,0685	0,0074	1,1214	0,3548
Greece	43,3885	-1,056096	0,041328*	-0,029896	0,125525***	0,4150	0,3766	10,8163	0,0000
Spain	15,7931	-0,283980	0,019152*	-0,040989	0,096930***	0,6680	0,6462	30,6853	0,0000
No of sign variables		1	2	1	3				4
Average						0,3806	0,3399		
PIIGS	20,3857	-0,149334	0,029955***	-0,090520	0,231798***	0,7230	0,7049	39,8122	0,0000
Germany	11,8363	-0,048096	0,003926	-0,037975	0,045349	0,1509	0,0952	2,7092	0,0382

* Significance level 5 percent

** Significance level 1 percent

*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

From the first model we find significance in six of our seven regressions. Italy is the only country where the independent variables can not explain the CDS spread on a statistically significant level. The regression for the PIIGS block indicate that our independent variables explain 70,5 percent of the observed CDS spread, which is higher than each country on its own and implies a better fit. The adjusted R^2 for Germany is significantly lower than for the PIIGS block and for the average adjusted R^2 of the single-country regressions. However, the regression for Germany is statistically significant, meaning the variables have an effect on the CDS spread. Unemployment is significant on a three-star level for PIIGS CDS spread. It indicates that if the unemployment in PIIGS increases with one percent the spread will widen with 23,2 basis points, the largest effect in the regressions where unemployment is significant. The GDP growth rate is inversely related to the CDS spread while the rate of unemployment is positively related to the CDS spread.

The change in inflation rate is inversely related to the CDS spread and is statistically significant for Ireland, yet not significant for the PIIGS block. Changes in gross debt could only be proved statistically significant for Spain and Greece, but are statistically significant on a three-star level for the PIIGS block.

Table 3: Results from OLS multiple regression model, first sub-period

2004M04-2007M07	α	β1	β2	β3	β4	R2	Adj. R2	F-stat	Prob
Portugal	5,8568	0,007746	-0,000163	0,003309	-0,004093	0,1514	0,0544	1,5611	0,2063
Ireland	7,9584	-0,043131	-0,003037	0,038838	-0,010374	0,0877	-0,0166	0,8412	0,5085
Italy	9,3177	0,001811	-0,000342	-0,006421	-0,000070	0,0341	-0,0763	0,3092	0,8699
Greece	10,3206	-0,007164	-0,001495	-0,001507	-0,000046	0,0178	-0,0944	0,1586	0,9578
Spain	4,5065	0,036033	-0,000963	0,001754	-0,001630	0,0511	-0,0574	0,4712	0,7565
No of sign variables		0	0	0	0				0
Average						0,0684	-0,0380		
PIIGS	7,8698	0,004180	-0,001696	0,004061	0,005195	0,0582	-0,0494	0,5411	0,7065
Germany	2,4940	-0,004293	0,000119	0,00721	0,002999	0,2307	0,1428	2,6239	0,0512

* Significance level 5 percent

** Significance level 1 percent

*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

The output from the regression of our first sub-period show no statistically significant effects on the CDS spread caused by our macroeconomic variables. This might imply that during a solely stable financial climate, which this sub-period qualifies as, the chosen macroeconomic variables have no statistically significant effect on the CDS spread. It can also be an effect of the CDS spreads demonstrating a less volatile behavior than during a financial crisis (see Appendix A). The output values for Germany do not differ greatly from the regression containing the whole time period, which might strengthen the argument that it is less sensitive to worldwide financial instability. The opposite applies for the PIIGS block.

Table 4: Results from OLS multiple regression model, second sub-period

2007M07-2009M09	α	β1	β2	β3	β4	R2	Adj. R2	F-stat	Prob
Portugal	42,1248	-0,223978**	-0,001930	-0,148631	0,098267**	0,6216	0,5527	9,0332	0,0002
Ireland	29,1541	-0,460622	0,004761	-0,674289**	0,114456	0,4442	0,3432	4,3960	0,0092
Italy	66,2269	-0,020643	0,011005	-0,131825	0,007876	0,0434	-0,1305	0,2497	0,9068
Greece	77,2823	-1,428017***	0,039739*	-0,076653	0,111314*	0,5459	0,4634	6,6123	0,0012
Spain	4,4998	-0,403944*	0,024117	-0,025866	0,126610**	0,4807	0,3863	5,0913	0,0047
No of sign variables		3	1	1	3				4
Average						0,4272	0,3230		
PIIGS	14,4748	-0,250260	0,038847**	-0,065582	0,272985***	0,7107	0,6582	13,5146	0,0000
Germany	27,3087	-0,157408*	0,005637	-0,082189	0,121870***	0,6420	0,5769	9,8634	0,0001

* Significance level 5 percent
** Significance level 1 percent
*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

The second sub-period demonstrates a more significant dependence than the first sub-period. Similar to table 2, six out of seven regressions are statistically significant. The CDS spread for Italy show no signs of dependence on macroeconomic variables.

These results imply that our hypothesis concerning the effects of macroeconomic variables on the CDS spread has more bearing in times of financial distress than in times of financial stability. Similar findings were made by Barrios, Iversen, Lewandowska and Setzer (2009) in their paper written for the European commission. They conclude that the impact of domestic factors increase significantly during a financial crisis. E.g. The OLS-estimate for β_1 indicate that a percentage increase in Greece's GDP growth rate would tighten the CDS spread by 142,8 basis points, in times of financial distress, but the estimate is insignificant in times of financial stability.

Table 5: Results from OLS multiple regression model with Germany as benchmark

2004M04-2009M09	α	β1	β2	β3	β4	R2	Adj. R^2	F-stat	Prob
Portugal	11,8979	-0,082000	0,022890	-0,024798	0,021519	0,1126	0,0544	1,9345	0,1161
Ireland	24,7808	-0,406495*	0,012321	-0,185266	0,045593	0,3339	0,2902	7,6449	0,0000
Italy	22,5817	0,036776	0,089206	-0,005252	0,009391	0,0468	-0,0157	0,7482	0,5630
Greece	30,3022	-0,174811	0,176977*	-0,004209	0,061633*	0,3216	0,2771	7,2298	0,0001
Spain	9,9224	0,024468	0,121891***	0,000068	0,026247***	0,7756	0,7609	52,7083	0,0000
No of sign variables		1	2	0	2				3
Average						0,3181	0,2734		
PIIGS	15,4046	-0,025195	0,235322**	-0,029328	0,077981***	0,4933	0,4604	14,8627	0,0000

* Significance level 5 percent
** Significance level 1 percent
*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

Table 5 shows some interesting results. Statistically significant, 46,0 percent of the excess premium paid for CDSs in the PIIGS block relative to Germany, can be explained by the differences in our macroeconomic variables. Similar to the first regression (table 2), we can find statistical significance for the effect of the gross debt and unemployment rate on the CDS spread for the PIIGS block. Italy proves yet again that our model does not explain their CDS spread.

The estimate for β_2 says that if the PIIGS block increase their government gross debt with one percent relative to Germany's level of government gross debt, the CDS spread will widen by 23,5 basis points relative to Germany's CDS spread, on average for the entire PIIGS block. Spain's exhibition of three-star significance in the variable unemployment rate is likely due to the fact that their level of unemployment has increased steadily during the observed time period and is the highest within the PIIGS block (see Appendix B, figure 1). The estimate for β_4 however, is approximately three times lower for Spain then for Greece, which might be an effect of the CDS spread being tighter for Spain than for Greece.

Table 6: Results from OLS multiple regression model with Germany as benchmark, first sub-period

2004M04-2007M07	α	β1	β2	β3	β4	R2	Adj. R2	F-stat	Prob
Portugal	3,1851	0,010585	0,001826	0,004269	-0,000265	0,1172	0,0163	1,1612	0,3446
Ireland	6,1154	-0,070317	-0,004098	0,033290	-0,008242	0,1314	0,0321	1,3237	0,2804
Italy	6,9359	0,003545	0,003764	-0,005593	-0,000823	0,0390	-0,0708	0,3555	0,8384
Greece	7,9394	0,005206	-0,003275	-0,001291	0,001792	0,0140	-0,0986	0,1246	0,9726
Spain	2,5602	-0,003265	0,001618	0,004798	-0,000733	0,0107	-0,1023	0,0948	0,9835
No of sign variables		0	0	0	0				0
Average						0,0625	-0,0447		
PIIGS	5,2507	-0,005820	-0,013430	0,005372	0,002284	0,0830	-0,0218	0,7921	0,5383

* Significance level 5 percent

** Significance level 1 percent

*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

Table 6 has got no significant regressions. The levels of the CDS spreads during this time period were relatively similar. This was likely due to the fact that the volatility was low for the PIIGS block as well as for Germany (see Appendix A). The volatility in government debt was also low during the first sub-period (see Appendix C).

Table 7: Results from OLS multiple regression model with Germany as benchmark, second sub-period

2007M07-2009M09	α	β1	β2	β3	β4	R2	Adj. R2	F-stat	Prob
Portugal	23,8451	-0,193227*	0,001042	0,022507	0,042649	0,2977	0,1700	2,3313	0,0876
Ireland	37,0869	-0,475267	0,000021	-0,316888	0,052304	0,1703	0,0194	1,1287	0,3686
Italy	49,0047	0,144074	0,210120	0,010769	-0,015313	0,1833	0,0348	1,2343	0,3252
Greece	49,1733	-0,209046	0,187899*	-0,015526	0,094697*	0.323118	0,2000	2,6255	0,0622
Spain	26,7762	0,128641**	0,121264***	-0,008361	0,002051	0,8354	0,8055	27,9164	0,0000
No of sign variables		2	2	0	1				1
Average						0,2973	0,2459		
PIIGS	31,4441	0,602246*	0,529963***	0,004800	0,058166	0,6055	0,5338	8,4428	0,0003

* Significance level 5 percent

** Significance level 1 percent

*** Significance level 0,1 percent

Notes: α is an intercept, β1 is the GDP growth rate (bps), β2 is the change in gross debt (bps), β3 is the change in inflation (bps), β4 is the change in unemployment rate (bps).

The second sub-period nets us a lower amount of significant regressions and variables than the regression of the whole time period. The regression for the PIIGS block is still statistically significant with an explanatory power that is higher than for the whole time period. Interestingly enough, the regression with the differences in CDS spread for Spain relative to Germany, has an explanatory power of 80,5 percent, which is the highest adjusted R^2 in our study. However the variables inflation and unemployment are insignificant. Spain has, throughout the study, maintained a high explanatory power, indicating that the data has a good fit for our model.

5 CONCLUSION

The output from both regression models during the first sub-period has proven to posses less explanatory power and statistical significance. We have concluded that our models are better suited for times of financial turbulence and a more volatile credit market. Results from the second sub-period, where credit markets were volatile, granted us a higher explanatory power and more significant economical conclusions could be drawn. However, we find that regressions in terms of significance in our study are approximately equal for the whole time period and the second sub-period. The observed time period consists of parts of stable and volatile financial states, enabling a more complete economic interpretation of the credit market.

We conclude our chosen macroeconomic variables to be inconsistent, in terms of significance, when testing the countries individually. However, sovereign gross debt is concluded to be consistently significant during the second sub-period and the whole time period for the PIIGS block. We find inflation to be the least significant variable in our study. We find some evidence indicating that CDS spreads decrease in GDP growth rate, although not as strong as Tang and Yan (2009) have shown. Based on our test results we conclude unemployment rate to be the variable that is most frequently significant.

6 REFERENCES

Attinasi, M-G., Checherita, C., and Nickel, C. 2009. "What Explains the Surge in Euro Area Sovereign Spreads During the Financial Crisis of 2007-09?". European Central Bank, Working Paper Series, no. 1131 (December 2009).

Barrios, S., Iversen, P., Lewandowska, M., and Setzer, R. 2009. "Determinants of Intra-Euro Area Government Bond Spreads During the Financial Crisis". Directorate-General for Economic and Financial Affairs, European Commission, Economic Papers 388 (November 2009).

BIS. 2004. "Basel II: International Convergence of Capital Measurement and Capital Standards: a Revised Framework" (June 2004).
http://www.bis.org/publ/bcbs107.pdf?noframes=1

Bohn, J., and Crosbie, P. 2003. "Modeling Default Risk". Moody's/KMV (December 2003)

Duffie, D. 1999. "Credit swap valuation". *Financial Analysts Journal*, (January/February 1999): 73-86.

Duffie, D., and Singleton, J. 1999. "Modeling Term Structures of Defaultable Bonds". *The Review of Financial Studies*, vol. 12, no. 4 (1999): 687-720.

Faber, M. January 13th, 2010. "PIIGS are going to be Slaughtered".
http://www.berninger.de/index.php?id=80

Hull, J. 2008. "Options, Futures and other Derivatives ,7th edition, Prentice Hall, New Jersey.

Hull, J., Predescu, M., and White, A. “The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements”. *Journal of Banking & Finance*, 28 (2004): 2789-2811.

Index Universe. April 17th, 2009. ”Measuring Sovereign Credit Risk”. http://www.indexuniverse.eu/europe/opinion-and-analysis/5703-measuring-sovereign-credit-risk.html?start=1&Itemid=126

Kotsianas, N. April 30th, 2010. “Euro currency mismatch plays out in CDS as investors prep for quanto leap”. *Financial Times*. http://www.ft.com/cms/s/2/725d679e-545e-11df-b75d-00144feab49a,dwp_uuid=e8477cc4-c820-11db-b0dc-000b5df10621.html

Krugman, P. April 3rd , 2010. ”Why Has Greece Dropped From The Headlines?”. The Conscience of a Liberal, *The New York Times*. http://krugman.blogs.nytimes.com/2010/04/03/why-has-greece-dropped-from-the-headlines/

Merton, R. 1974. “On the Pricing of Corporate Debt: The Risk Structure of Interest Rates”, *Journal of finance*, vol. 29, no. 2 (May 1974): 449-470.

Oakley, D. February 10th, 2010. “Record Volumes for Sovereign CDS”. *Financial Times*. http://www.ft.com/cms/s/0/fcf13b66-10f1-11df-9a9e-00144feab49a.html

O’Kane, D., and McAdie, R. 2001. “Explaining the Basis: Cash versus Default Swaps”. Structured Credit Research, Lehman Brothers (May 2001).

O’Kane, D., and Sen, S. 2004. “Credit Spreads Explained”. QCR Quarterly, vol. 2004-Q1/Q2, Lehman Brothers (March 2004).

O’Kane, D., and Turnbull, S. 2003. “Valuation of Credit Default Swaps”. QCR Quarterly, vol. 2003-Q1/Q2, Lehman Brothers (April 2003).

Pan, J., and Singleton, K.J. 2008. "Default and Recovery Implicit in the Term Structure of Sovereign CDS Spreads". *The Journal of Finance*, vol. 63, no. 5 (October 2008): 2345-2384.

Tang, D.Y., and Yan, H. 2009. "Market Conditions, Default Risk and Credit Spreads". *Journal of Banking & Finance*, 34 (2010): 743-753.

Fitch Ratings http://www.fitchratings.com/index_fitchratings.cfm

International Swap and Derivatives Association http://www.isda.org/index.html

APPENDIX A: Credit default swap spreads

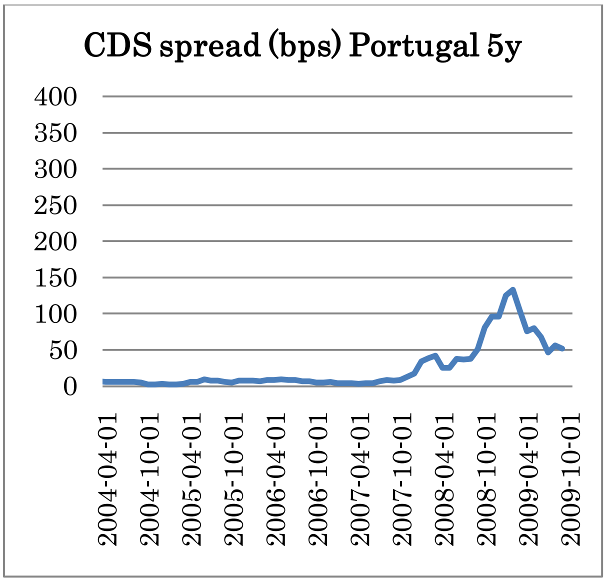

Figure 1

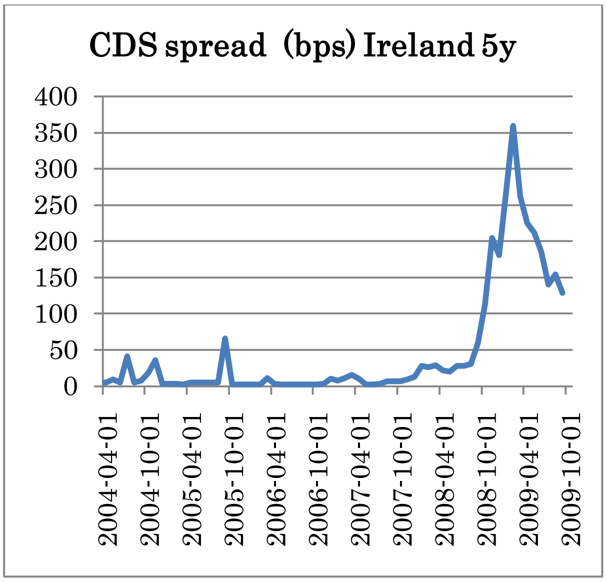

Figure 2

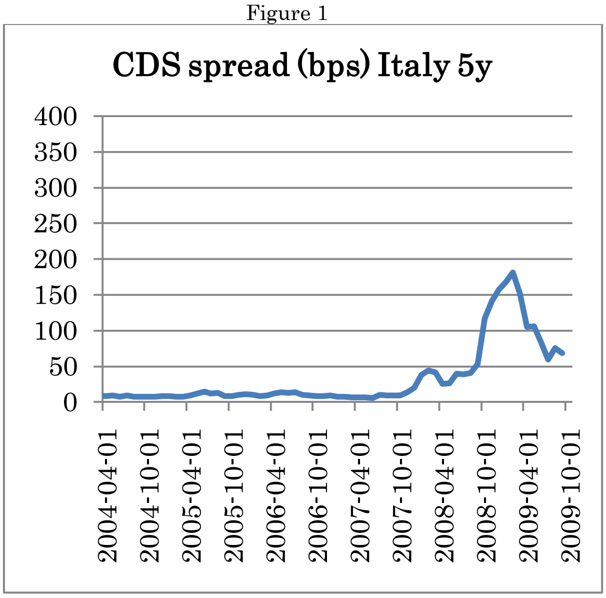

Figure 3

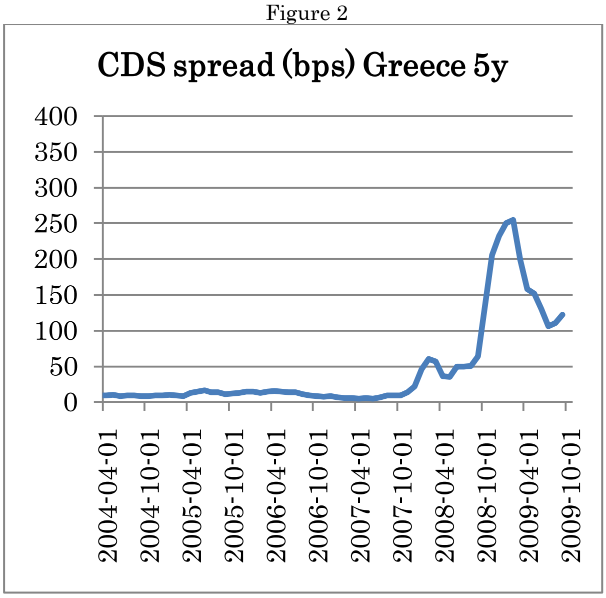

Figure 4

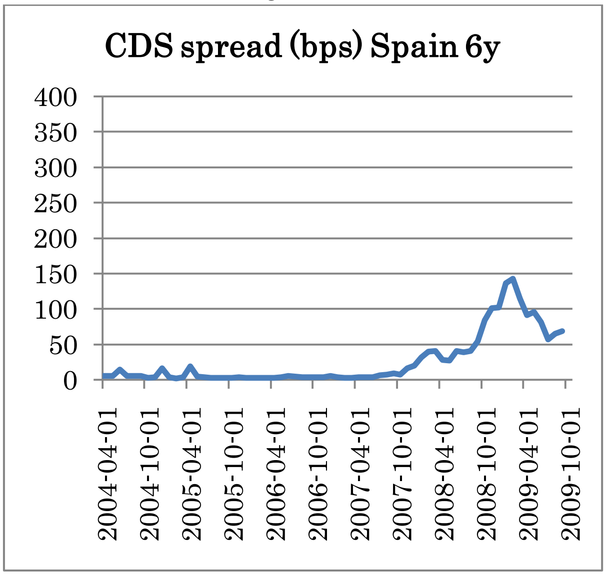

Figure 5

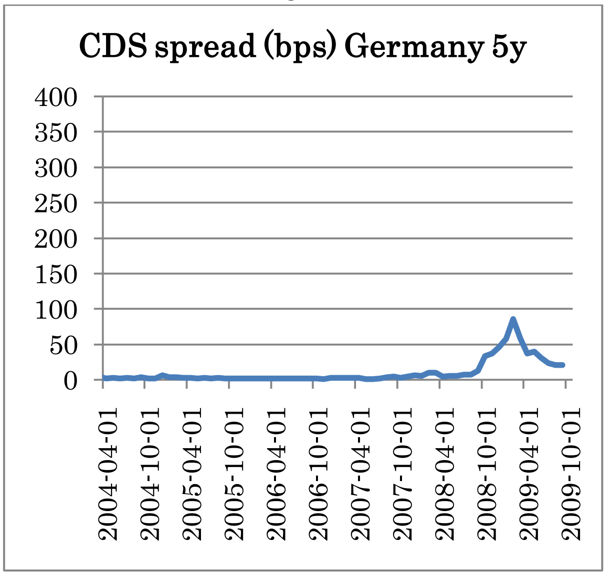

Figure 6

APPENDIX B: Unemployment rates

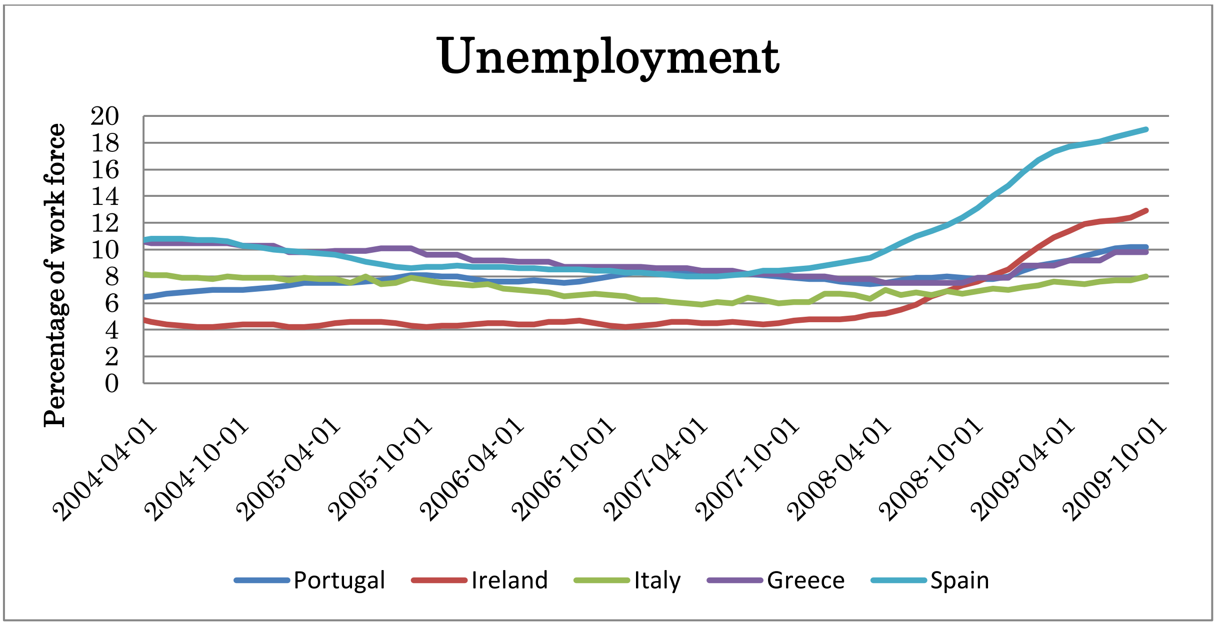

Figure 1

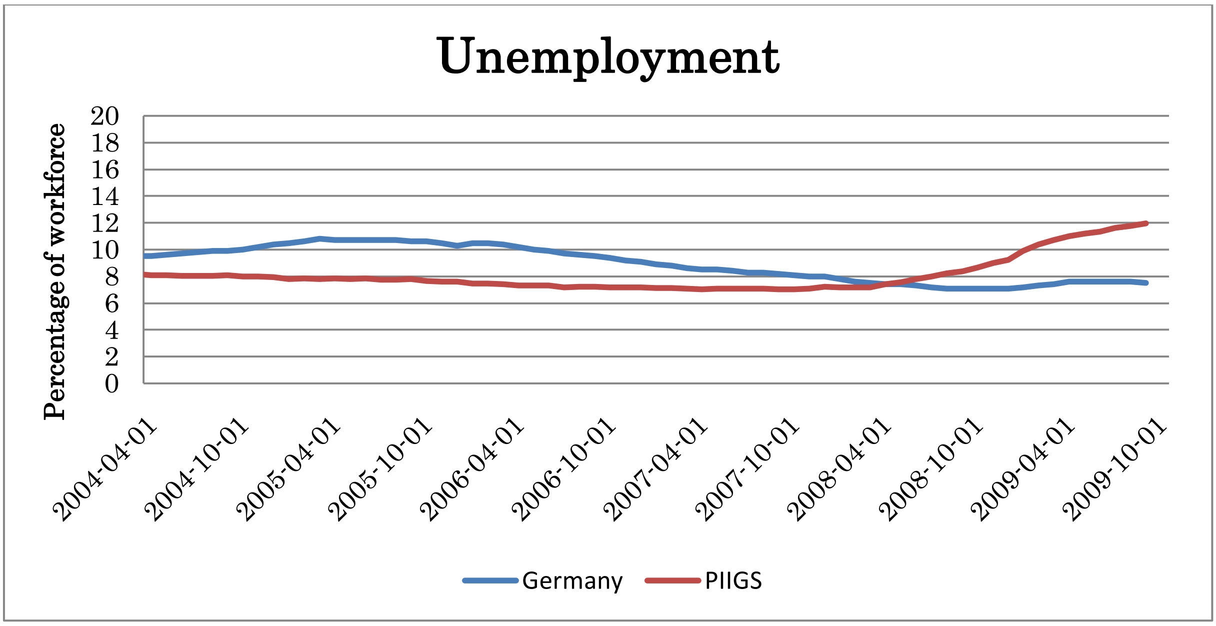

Figure 2

APPENDIX C: Basis point change in gross debt

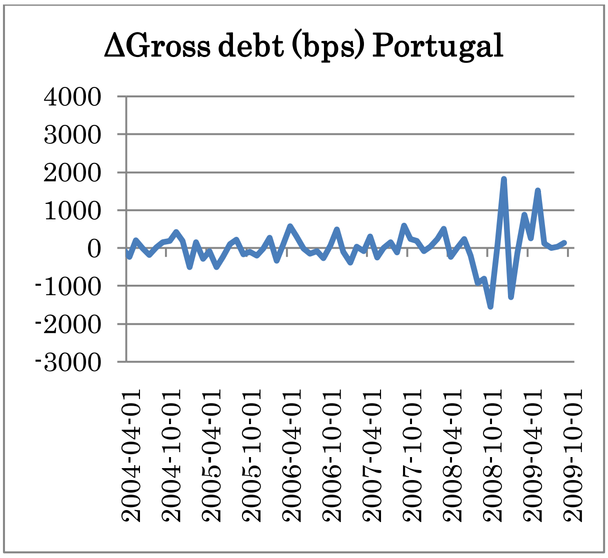

Figure 1

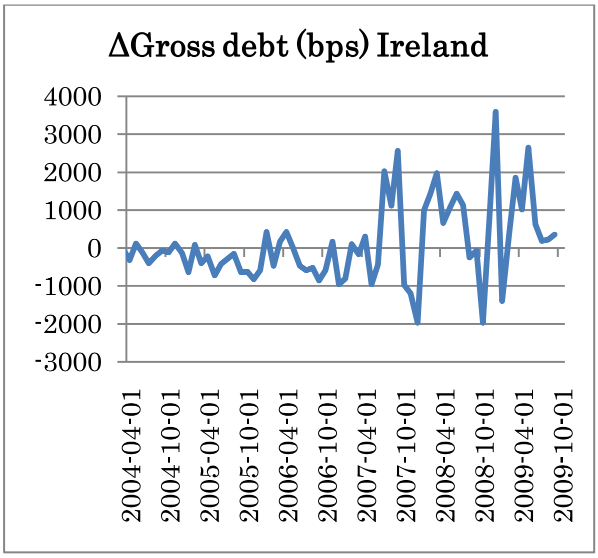

Figure 2

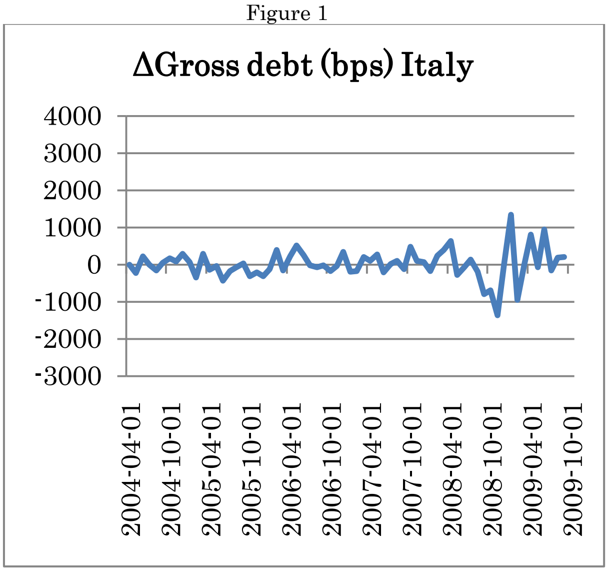

Figure 3

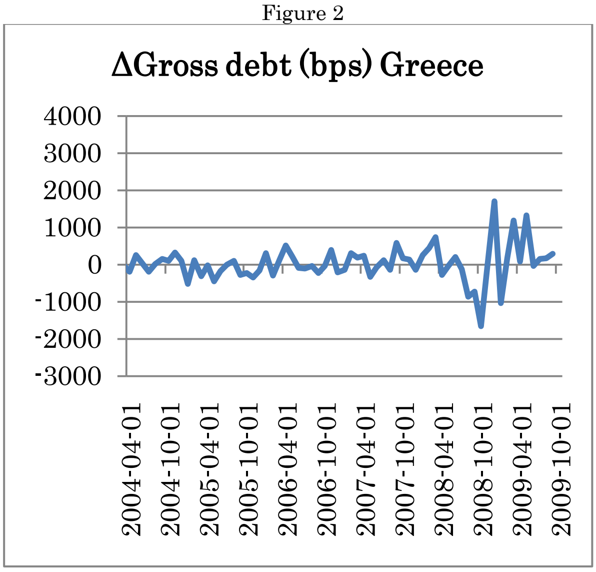

Figure 4

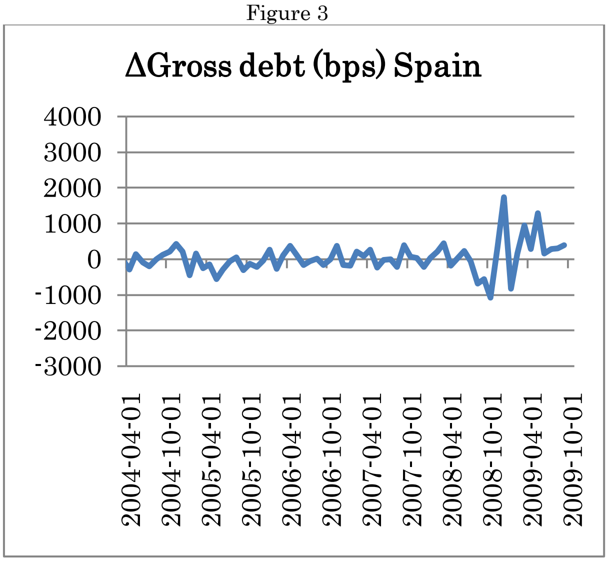

Figure 5

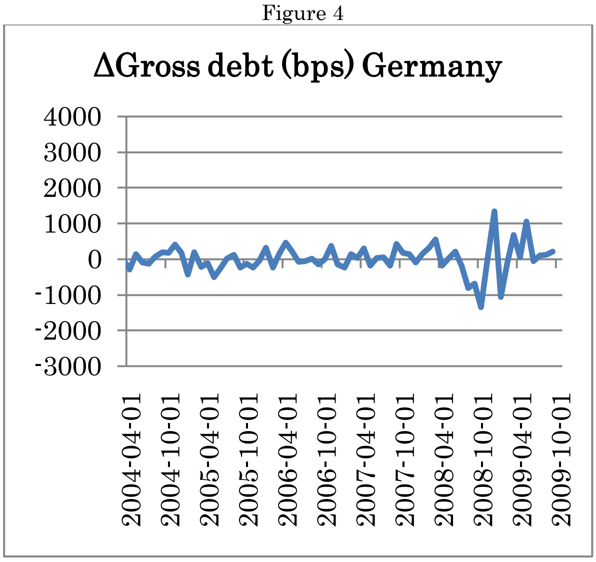

Figure 6

APPENDIX D: Basis point change in GDP growth rate (interpolated monthly)

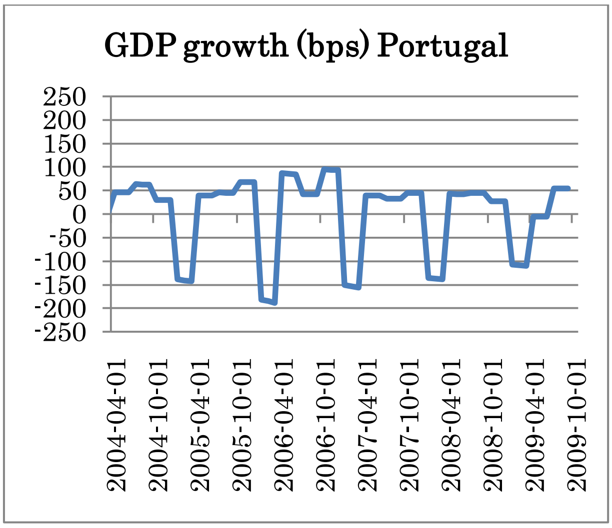

Figure 1

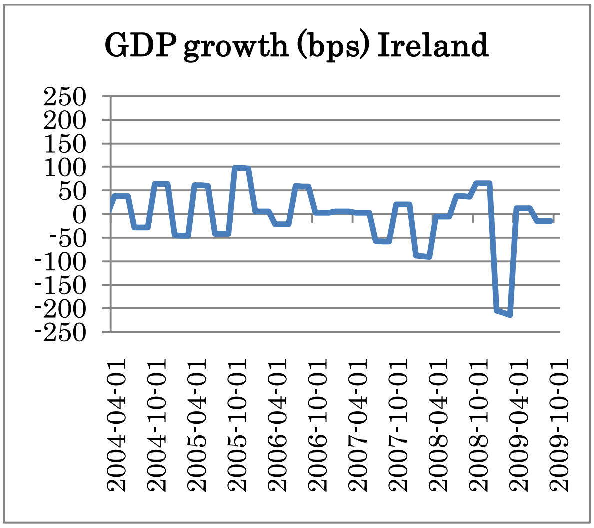

Figure 2

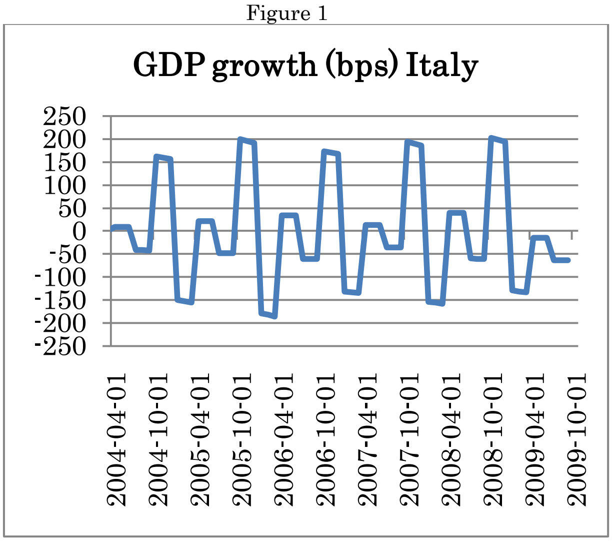

Figure 3

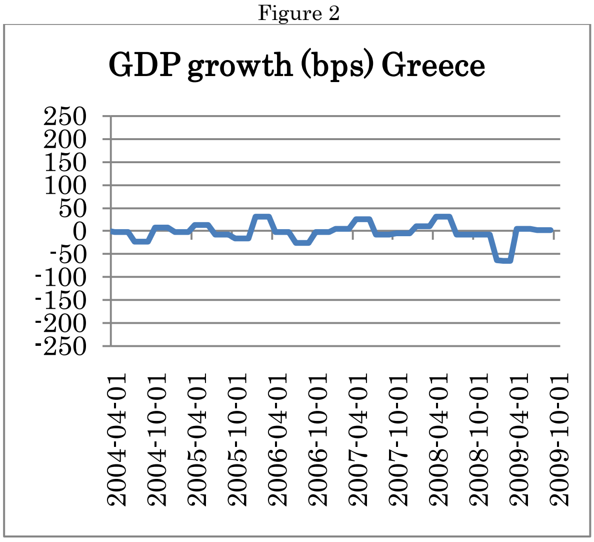

Figure 4

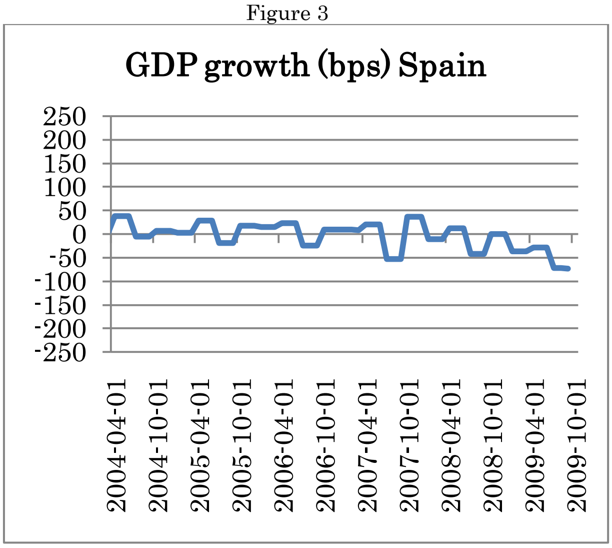

Figure 5

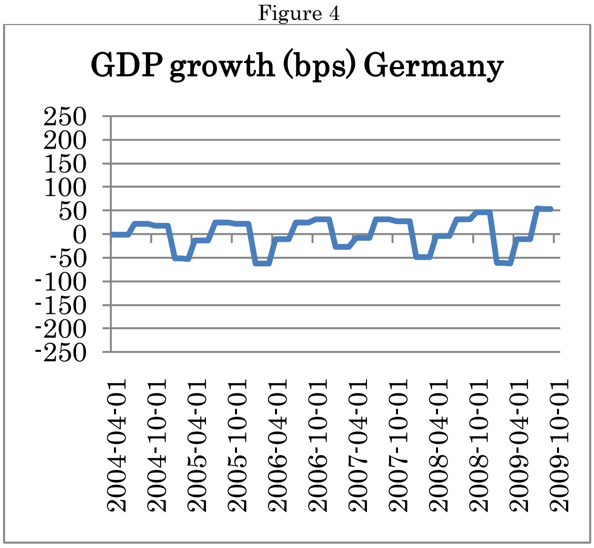

Figure 6

APPENDIX E: Correlation matrices

Portugal	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,172	1,000			
Gross debt	0,050	0,049	1,000		
Inflation	-0,267	-0,058	0,175	1,000	
Unemployment	0,365	0,172	0,136	-0,041	1,000

Ireland	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,443	1,000			
Gross debt	0,300	-0,253	1,000		
Inflation	-0,318	-0,028	0,007	1,000	
Unemployment	0,525	-0,226	0,231	-0,080	1,000

Italy	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,034	1,000			
Gross debt	0,070	-0,079	1,000		
Inflation	-0,114	0,111	0,212	1,000	
Unemployment	0,203	0,058	-0,168	-0,062	1,000

Greece	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,443	1,000			
Gross debt	0,176	0,043	1,000		
Inflation	-0,084	0,070	0,119	1,000	
Unemployment	0,475	-0,285	-0,238	-0,091	1,000

Spain	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,476	1,000			
Gross debt	0,266	-0,135	1,000		
Inflation	-0,252	0,449	0,052	1,000	
Unemployment	0,737	-0,285	0,031	-0,133	1,000

Germany	CDS spread	GDP Growth rate	Gross debt	Inflation	Unemployment
CDS spread	1,000				
GDP Growth rate	-0,157	1,000			
Gross debt	0,056	-0,028	1,000		
Inflation	-0,113	0,021	0,194	1,000	
Unemployment	0,356	-0,160	-0,067	-0,103	1,000

APPENDIX F: Ramsey's RESET test

Table 1: Results from Ramsey's RESET test

	Whole	First sub-period	Second sub-period	Whole diff	First sub-period diff	Second sub-period diff
Portugal (1)	0,0009	0,5791	0,8045	0,1018	0,4449	0,8679
Portugal (2)	0,0042	0,3991	0,6189	0,2613	0,5751	0,8276
Ireland (1)	0,0022	0,0010	0,8646	0,0206	0,0159	0,0060
Ireland (2)	0,0078	0,0000	0,8618	0,0150	0,0040	0,0208
Italy (1)	0,6582	0,7317	0,6940	0,0026	0,2250	0,0007
Italy (2)	0,0170	0,3704	0,2326	0,0107	0,4828	0,0015
Greece (1)	0,0017	0,1013	0,3839	0,0001	0,6403	0,2327
Greece (2)	0,0016	0,0387	0,2942	0,0004	0,5673	0,3969
Spain (1)	0,0002	0,0574	0,3685	0,3648	0,8669	0,0210
Spain (2)	0,0006	0,1591	0,5243	0,0000	0,9373	0,0742
No of sign variables						
Ram (1)	4	1	0	3	1	3
Ram (2)	5	2	0	4	1	2
PIIGS (1)	0,0005	0,0397	0,9919	0,0000	0,0331	0,2793
PIIGS (2)	0,0000	0,0011	0,5775	0,0000	0,0036	0,2441
Germany (1)	0,7992	0,0005	0,6476			
Germany (2)	0,4709	0,0000	0,0064			

Notes: (n) is the result from Ramsey's RESET test with n fitted variables. "Diff" indicates that we are using the second model type with Germany as benchmark.