Essays on Fiscal Policy and the Pricing of Sovereign Debt

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by

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Declaration of Authenticity & Copyright

This thesis is the result of the author's original research. It has been composed by the author and not been previously submitted for examination which has led to the award of a degree.

Signed: ....

Date: ....

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Thesis Overview

This thesis consists of three essays which relate to the conduct of fiscal policy and the pricing of sovereign debt.

The first chapter examines the credibility of official budgetary projections produced by the fiscal authorities of EU member states, as required under the provisions of the Stability and Growth Pact. Drawing upon existing studies, evidence is presented which demonstrates that these official projections are characterised by optimism bias, i.e. announced budgetary adjustments persistently falls short of those observed in practice. This chapter contributes to the existing literature by identifying a systematic link between the magnitude of this optimism bias and the degree of fragmentation which characterises the government: whereby greater fragmentation of this type coincides with a tendency to submit more optimistic projections. Numerical fiscal rules are then considered as a mechanism for improving the credibility of these projections and it shown that budgetary strictures of this form have been effective in reducing the optimism bias which emerges when government fragmentation increases.

The second chapter investigates the relative importance of systematic risk and conventional fiscal indicators in characterising the default risks of EMU member states and as potential explanations of pricing disparities which exist between public debt securities issued by these countries. Using both a portfolio approach and Fama and Macbeth cross-sectional regressions it is demonstrated that measures of systematic default risk (approximated by an issuer's default beta) and fiscal indicators overlap in the manner of risks which they represent. It is also shown that the common variation which exists between these alternate measures is relevant in explaining difference in the excess returns on EMU public debt securities in sample periods which both include and exclude the recent sovereign debt crisis.

The third and final chapter uses a panel data model to examine yield spreads on ten-year public debt securities issued by EMU sovereign nations from 2005 to 2012. Existing studies have highlighted that there are (at times) substantial discrepancies between the spreads implied this class of model and the value of spreads observed in practice, particularly since the advent of the sovereign debt crisis in late 2009. Evidence of this nature has been used to substantiate arguments that financial markets have incorrectly priced the relative risks associated with these securities given that their prices cannot be related to an assumed fundamental basis. In this chapter I present an alternative account of evolutions in EMU yield spreads during the crisis which focuses upon the scale of macroeconomic imbalances characterising certain member states and their implications for public debt sustainability. It is shown that once these factors are taken into account up to 83% of the observed variation in yield spreads can be explained over this period. These results re-establish the importance of fundamentals in understanding market based perceptions of sovereign default risk during the crisis.

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List of Abbreviations

APT	Arbitrage Pricing Theory
CAPM	Capital Asset Pricing Model
CDS	Credit Default Swap
CMP	Comparative Manifesto Project
CPD	Comparative Political Dataset
DPI	Database of Political Institutions
EC	European Commission
ECB	European Central Bank
EDP	Excessive Deficit Procedure
EFSF	European Financial Stability Facility
EMU	European Monetary Union
EU	European Union
FE	Fixed Effects
GDP	Gross Domestic Product
GIIPS	Greece, Ireland, Italy, Portugal and Spain
I-CAPM	Intertemporal-Capital Asset Pricing Model
OMT	Outright Monetary Transactions
PCA	Principal Components Analysis
PC	Principal Component
PCSE	Panel Corrected Standard Errors
MTO	Medium-Term Objective
SDF	Stochastic Discount Factor
SGP	Stability and Growth Pact

List of Abbreviations (cont.)

SP	Stability Programme
YTM	Yield-To-Maturity
VIX	Volatility Index

Chapter 1

Playing by the Rules: Do Numerical Fiscal Rules Improve the Credibility of Official Budgetary Projections?

"[A]n economic and monetary union could only operate on the basis of mutually consistent and sound behaviour by governments and other economic agents in member countries. In particular, uncoordinated and divergent national budgetary policies would undermine monetary stability and generate imbalances in the real and financial sectors of the Community."

Delors Committee, (1989 p.19)

1.1. Introduction

The recent sovereign debt crisis has reaffirmed the perception that harmonised budgetary policies amongst the members of a monetary union are vital for the on-going stability of such arrangements; see Werner (1970) and the recommendations of the Delors Committee (1989). This principle is purposefully reflected throughout the legal and institutional frameworks which connect the members of the European Union (EU) and seek to influence their economic and fiscal affairs. However, in spite of its widely held and established nature, attempts to translate this principle into a set of specific rules and arrangements capable of successfully influencing the economic priorities of member states has, and remains, a controversial topic; see Eichengreen and Wyplosz (1998), Galí and Perotti (2003), Wyplosz (2006, 2010) and Whelan (2012).

Member states are obligated to conduct their fiscal affairs in a manner consistent with the normative economic guidelines stipulated by a Stability and Growth Pact (SGP). A failure to do so exposes them to the prospect of political reprimand and/or the imposition of economic sanctions under the corrective arm of the SGP. It has been argued that the European Commission (EC) places undue reliance on the projections produced by member states when assessing the consistency of their prospective budgetary circumstances with the formal limits prescribed by the SGP; these projections are produced and submitted annually by national fiscal authorities in the form of Stability Programmes (SPs).

Existing studies have demonstrated that the budgetary and macroeconomic projections produced by national fiscal authorities are optimistic relative to observed outturns and thereby emphasised their significance in the context of alternative, predominately political, motives which influence the behaviour of policy makers. On this basis it has been argued that these projections are characterised by an optimism bias, therefore lack credibility and ultimately serve to undermine the efforts of the EC in monitoring and instilling fiscal discipline amongst member states. Examples of such studies include Jonung and Larch (2006), Beetsma et al. (2009), Frankel (2011), Pina and Venes (2011) and Frankel and Schreger (2013).

This chapter considers two questions in the context of such evidence: (i) is the presence and magnitude of this optimism bias systematically linked to the degree of fragmentation amongst the political parties forming the government? And (ii) are numerical fiscal rules an effective means of curbing optimism bias, thereby serving to enhance the credibility of official budgetary projections and those who produce them? To confront these questions this chapter utilises a real-time panel dataset which consists of official budgetary and macroeconomic data for 14 EU member states over the period of 1998 to 2007. This dataset spans the full pre-financial crisis period for which successive SPs are available online but excludes data relating to the recent crisis period. This data is omitted given that the pervasive and sizeable deficits which arose during this time would likely dominate the results and given that they were primarily driven by quite different and largely unforeseen factors.

It is demonstrated that optimism bias, of the type identified by the existing literature, is characteristic of the budgetary and macroeconomic projections contained within this dataset, particularly for projection horizons beyond one year. The macroeconomic, political and institutional determinants of this optimism bias are then examined by estimating fiscal policy reaction functions. Several findings of the existing literature are reconfirmed as it is demonstrated that official budgetary projections are optimistic when: (i) a nation's initial budgetary position is relatively favourable, (ii) subsequent to the publication of the projections there are upward revisions in a nation's initial budgetary circumstances, (iii) the magnitude of projected budgetary adjustment is relatively large, (iv) growth in real-GDP turns out to be lower than projected, and (v) the government reporting budgetary outturns is different from that which produced the initial projections. No evidence is found to suggest that the budgetary projections of countries identified as having an "excessive" budgetary position are more susceptible to optimism bias; defined in accordance with the 3% of GDP deficit limit outlined by the SGP.

The political and institutional basis of this optimism bias is then extended to consider the degree of fragmentation which exists between the political parties in government and the strength of numerical fiscal rules which operate at a national level. It is found that an increase in the number of political parties able to veto the approval of the national budget and the ideological dispersion of these parties coincides with the submission of more optimistic budgetary projections. However, it is also shown that the optimism bias resulting from these political sources can be moderated by numerical fiscal rules of certain strength, with the evidence presented indicating that a conditional, or interactive, relationship is appropriate between measures of fragmentation and numerical fiscal rules.

These results demonstrate that the ability of numerical rules to improve the credibility of official budgetary projections is contingent upon the political contexts which they operate within. They therefore provide qualified support for their introduction at a national level in so far as they target the sources of political failure which are perceived to give rise to biases in fiscal policy-making.

The rest of this chapter is structured as follows. Section 1.2 provides details of the data and notation used in my empirical analysis and demonstrates that optimism bias is characteristic of official EU budgetary projections published by individual member states over alternate time horizons. Section 1.3 reviews empirical and conceptual studies which regard political and institutional factors as central to understanding the causes of deficit bias and highlight the role of fiscal institutions, e.g. numerical fiscal rules, in moderating bias of this nature. Section 1.4 discusses the empirical methodology utilised to examine the economic, political and institutional determinants of optimism bias. Section 1.5 presents and discusses my empirical results before Section 1.6 concludes and highlights potential avenues for future research.

1.2. Demonstrating Optimism Bias in the Official Budgetary Projections of EU Member States: 1998 to 2007

This section describes the data and notation utilised in analysing official budgetary projections and observed deviations from these projections. It is then demonstrated that optimism bias, of the type identified by the existing literature, is characteristic of budgetary and macroeconomic projections produced by EU member states in accordance with the provisions of the SGP, particularly when considering projected developments beyond one year. It is also shown that a high proportion of the variation in discrepancies between projected and observed budgetary developments coincide with projection errors in real-GDP growth rates.

1.2.1. Measuring Optimism Bias: Data and Notation

Member states of the EU are obligated to manage their budgetary and macroeconomic affairs in a manner consistent with the normative economic principles stipulated by the SGP. With this objective, the EC requires the budgetary authorities of all member states to submit for evaluation their prospective budgetary policies and the anticipated impact of such policies on summary indicators of fiscal performance. These submissions are produced annually in the form of Stability Programmes (SPs)[1]. Other studies which have utilised SPs to analyse potential forecasting biases amongst EU member states include Beetsma et al. (2009), Abbas et al. (2011) and Holm-Hadulla et al. (2012).

Contained within each SP, and of substantive interest to the analysis conducted in this chapter, are the multi-annual projections for a nation's overall fiscal balance

[1] The Stability Programmes are published annually on the European Commission's website: http://ec.europa.eu/economy_finance/economic_governance/sgp/convergence/index_en.htm

ratio, measured as a percentage of GDP, and the reported values of this variable for contemporaneous and preceding years. Extracting this data from successive SPs facilitates a systematic comparison of the discrepancies which arise between official budgetary projections, i.e. those produced by national fiscal authorities and submitted to the EC for formal evaluation, and budgetary outturns which are observed in practice[2].

As demonstrated by Beetsma et al. (2009), observed budgetary adjustment in a nation's overall fiscal balance ratio (*FB*, measured as a proportion of GDP) between any two successive periods can be re-defined as the sum of two components. The first, the *projected change* in this ratio between adjoining periods and second, the *projection error* associated with this change, i.e. the difference between observed changes and those initially projected. This is represented more formally in equation (1-1):

$$\left(FB_{t+i}^{t+i} - FB_{t+i-1}^{t+i}\right) \equiv \left(FB_{t+i}^{t} - FB_{t+i-1}^{t}\right) + FB\_Error_{t}^{t+i} \qquad i = 1,2\ 3 \qquad (1\text{-}1)$$

where super-scripts are used to signify the year of a figure's publication, also referred to as its *vintage*, and sub-scripts the year which the figure applies to. For example, denoting a generic variable as x, then x_{t+1}^{t} is used to represent the projected value of this variable in year $t+1$ as outlined within the SP published towards the end of year t[3]. Using this notation the left-hand side of equation (1-1) measures the observed change in a nation's fiscal balance ratio between years $t+i$

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[22]An alternative source of this data would have been the Excessive Deficit Procedure reportings of member states, which are produced on a semi-annual basis, see for example, Pina and Venes (2011).

[3]All variables are measured at a country level but in order to avoid an encumbrance of notation I do not to utilise a country index.

and $t+i-1$, as published within the SP towards the end of year $t+i$, the first term on the right-hand side signifies the projected change in the fiscal balance ratio between years $t+i$ and $t+i-1$ as outlined at the end of year t, and $FB\_Error_t^{t+i} \equiv \left(FB_{t+i}^{t+i} - FB_{t+i-1}^{t+i}\right) - \left(FB_{t+i}^{t} - FB_{t+i-1}^{t}\right)$ is the discrepancy between observed and projected change in the fiscal balance ratio, a *projection error*. Finally, i is used to denote the horizon of the projection which could be one, two or three years into the future.

In a similar manner, cumulated changes in the overall fiscal balance over two and three year projection horizons can be decomposed into a projected change and observed deviations from these projections, this is represented in equation (1-2):

$$\left(FB_{t+i}^{t+i} - FB_t^{t+i}\right) \equiv \left(FB_{t+i}^{t} - FB_t^{t}\right) + FB\_Cumul\_Error_t^{t+i} \qquad i = 2,3 \qquad (1\text{-}2)$$

where $FB\_Cumul\_Error_t^{t+i} \equiv \left(FB_{t+i}^{t+i} - FB_t^{t+i}\right) - \left(FB_{t+i}^{t} - FB_t^{t}\right)$ denotes a cumulative projection error for the overall fiscal balance over either a two or three year period and all other variables are defined as per equation (1-1). Abbas et al. (2011) similarly use cumulative, and therefore potentially offsetting, projection errors to analyse large, multi-annual fiscal adjustments amongst EU member states.

A dataset constructed on the basis of these definitions and using data contained within successive SPs can be regarded as “real-time” in the sense that it will reflect, at each date, the data in a form which would have been available to economic agents at that point in time. Conducting a systematic comparison of observed and projected budgetary adjustments allows for the identification of potential biases in these projections and facilitates an examination of the economic, political and institutional determinants of these projection errors in a regression context.

1.2.2. Summary Statistics on Optimism Bias in Official EU Budgetary Projections

Utilising data extracted from the SPs of 14 EU member states and the notation outlined in the previous section, Table 1-1 provides full sample averages and the standard deviations of projected changes, observed changes and projection errors in overall fiscal balance ratios and their two main components; general government revenues and expenditures; with all variables calculated as a ratio of GDP. The sample period considered extends from 1998 to 2007 and covers 14 EU countries[4], it therefore spans the full pre-financial crisis period for which successive SPs are available online (excluding Luxembourg) but excludes data relating to the recent crisis period. Data relating to the crisis has been excluded given that the pervasive and sizeable deficits which arose during this time would likely dominate the results and given that they were primarily driven by quite different and largely unforeseen factors.

The statistical significance of the projection errors is assessed via a t-test of the constant in a regression of the projections errors on a constant and a set of country fixed-effects[5]. The standard errors utilised in constructing this t-statistic were

[4]These countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

[5]The constant in this regression is the average of the estimated country fixed-effects, which in the absence of any further regressors are the country-specific means of the projection errors. Tests of significance based upon conventional t-statistics of the full sample average provided almost identical results and did not modify any subsequent conclusions.

calculated to be robust to arbitrary forms of heteroskedasticity. It was not possible to calculate cumulative projection errors for the components of the budget balance given a lack of sufficient detail in the reported SPs which typically only provide the necessary split of the budget balance for published projections, the year of each SP's publication and the year immediately preceding that of publication.

Table 1-1

Summary Table of One, Two and Three Year Projections & Outturns in the EU-14, 1998 to 2007

	Change in Overall Fiscal Balance, %GDP			Change in General Government Expenditures, %GDP			Change in General Government Revenues, %GDP			Real GDP Growth Rate, %		
	Proj. Change	Observed Change	Proj. Error	Proj. Change	Observed Change	Proj. Error	Proj. Change	Observed Change	Proj. Error	Projected	Observed	Proj. Error
One Year:												
Sample Mean	0.09	-0.03	-0.11*	-0.45	-0.15	0.28***	-0.34	-0.24	0.10	2.72	2.52	-0.20***
Standard Deviation	0.77	1.07	0.76	0.64	0.97	0.76	0.66	0.79	0.83	1.21	1.62	1.01
Observations		124			112			113			126	
Two Year:												
Sample Mean	0.25	-0.10	-0.35***	-0.56	-0.15	0.41***	-0.31	-0.28	0.03	2.84	2.47	-0.37***
Standard Deviation	0.47	1.08	0.99	0.50	0.94	1.00	0.48	0.80	0.87	1.00	1.59	1.29
Observations		109			100			102			112	
Three Year:												
Sample Mean	0.31	-0.20	-0.51***	-0.52	-0.03	0.49***	-0.23	-0.27	-0.04	2.87	2.25	-0.62***
Standard Deviation	0.34	1.07	1.01	0.45	0.87	0.91	0.31	0.81	0.80	0.94	1.39	1.16
Observations		97			89			89			98	
Two Year Cumulative:												
Sample Mean	0.29	0.02	-0.27**	-	-	-	-	-	-	2.78	2.53	-0.25***
Standard Deviation	0.78	1.36	1.13	-	-	-	-	-	-	1.08	1.62	1.08
Observations		103			-			-			109	
Three Year Cumulative:												
Sample Mean	0.62	-0.02	-0.64***	-	-	-	-	-	-	-	-	-
Standard Deviation	1.09	2.16	1.94	-	-	-	-	-	-	-	-	-
Observations		93			-			-			-	

Notes: **Significant at 10%, **Significant at 5%, ***Significant at 1%. Statistical significance is based upon the t-statistic of the constant in a regression of the projection errors on a constant and country-fixed effects, this t-statistic is calculated using standard errors robust to arbitrary forms of heteroskedasticity.*

The summary statistics of Table 1-1 revalidate several stylised facts identified by the existing literature as characteristic of the official budgetary projections amongst EU member states. They demonstrate that, when considered collectively, projected budgetary adjustments of member states are optimistic relative to eventual outturns. National fiscal authorities submitted budgetary projections to the EC anticipating positive changes in their overall budgetary circumstances, with such changes growing in magnitude at longer time horizons; +0.09%, +0.25% and +0.31% are the calculated sample averages for the projection horizons of one, two and three years respectively. In contrast, the observed changes in fiscal balances for these time periods were either close to zero or negative; -0.03%, -0.10% and -0.20% respectively; thereby giving rise to negative and systematic projection errors, particularly at horizons beyond one year. The table also demonstrates that these properties are apparent when projection errors are cumulated over a two and three year period, again highlighting that member states appeared disposed to deviating from their budgetary projections at longer term horizons.

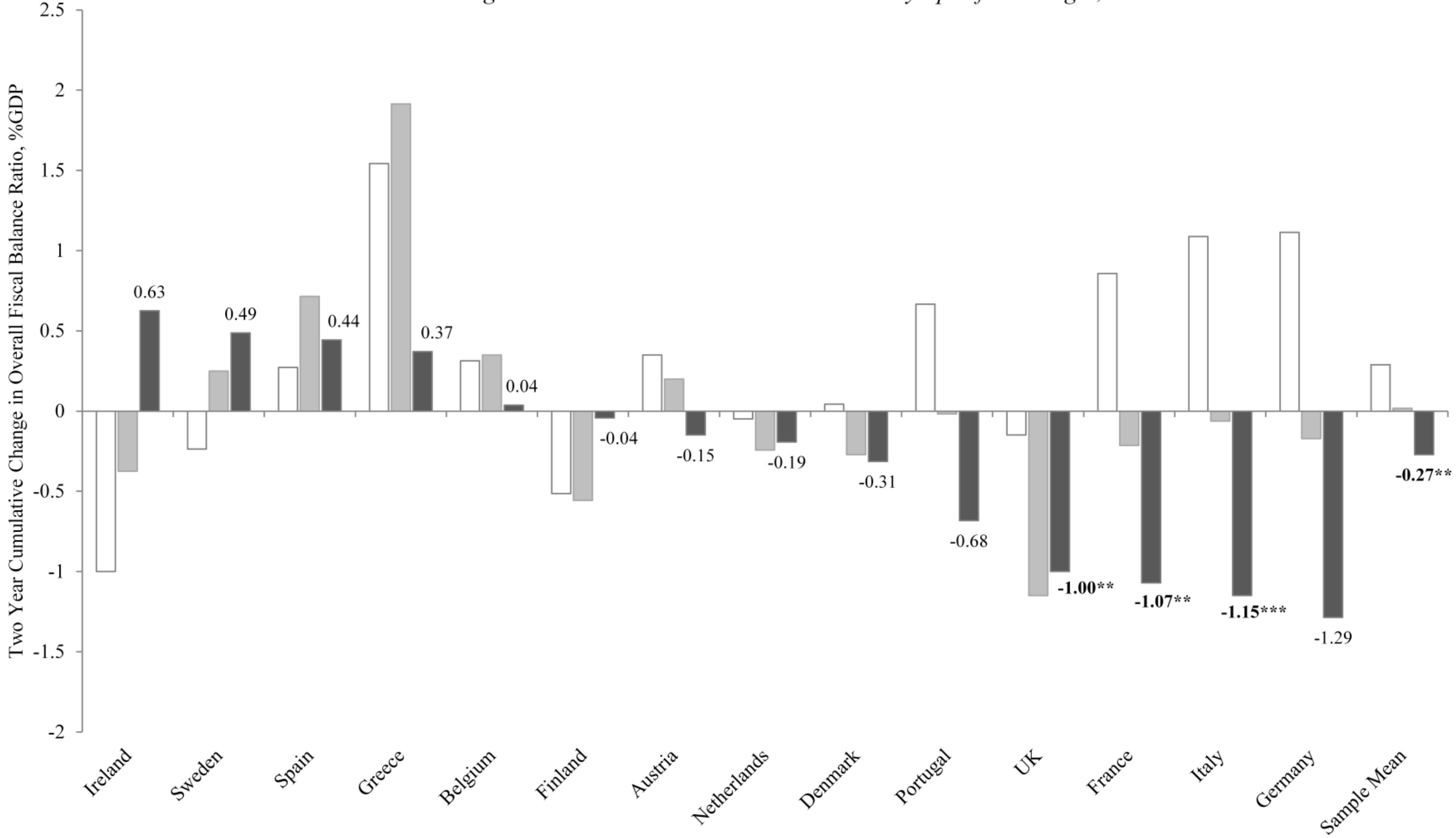
In terms of the primary constituents of the overall fiscal balance ratio, the submitted projections are found to have envisaged falls in both general government revenue and expenditure ratios, with larger declines being anticipated in the case of the latter; this perhaps indicates an intention to fund tax cuts through reductions in overall public outlays. The projection errors in the overall fiscal balance ratios are evidently driven by the expenditure side of the budget which exhibits projection errors that are sizeable and significant at the 1% level across all time horizons, i.e. observed falls in government expenditures did not match those projected. There is little evidence to suggest there was any collective tendency to bias projections on the revenue side of the budget for which the projection errors cannot be considered statistically different from zero over any time horizon.

Table 1-1 also provides summary statistics on projected rates of real-GDP growth and the discrepancy between these projections and observed real-GDP growth rates. These statistics highlight that, over the sample period, member states based their budgetary projections upon real-GDP growth rates which were again, on average, optimistic relative to eventual outturns. Projection errors are found to be increasingly negative as the time horizons considered are lengthened, -0.20%, -0.37% and -0.62% for one, two and three year projections, respectively, and these projections errors are all statistically significant at the 1% level.

Next it is considered whether optimism bias is a feature of the projections produced by specific member states and whether there was any tendency for EU nations to collectively deviate from their budgetary projections during particular time periods. Summary statistics for both country-specific and period-specific averages of the budgetary data are presented in Figure 1-1 and Figure 1-2, respectively. In both cases two-year cumulative projection errors are considered as these will be the focus of the analysis conducted in subsequent sections, although similar results are obtained when projection errors are calculated by cumulating the data over three years.

Figure 1-1

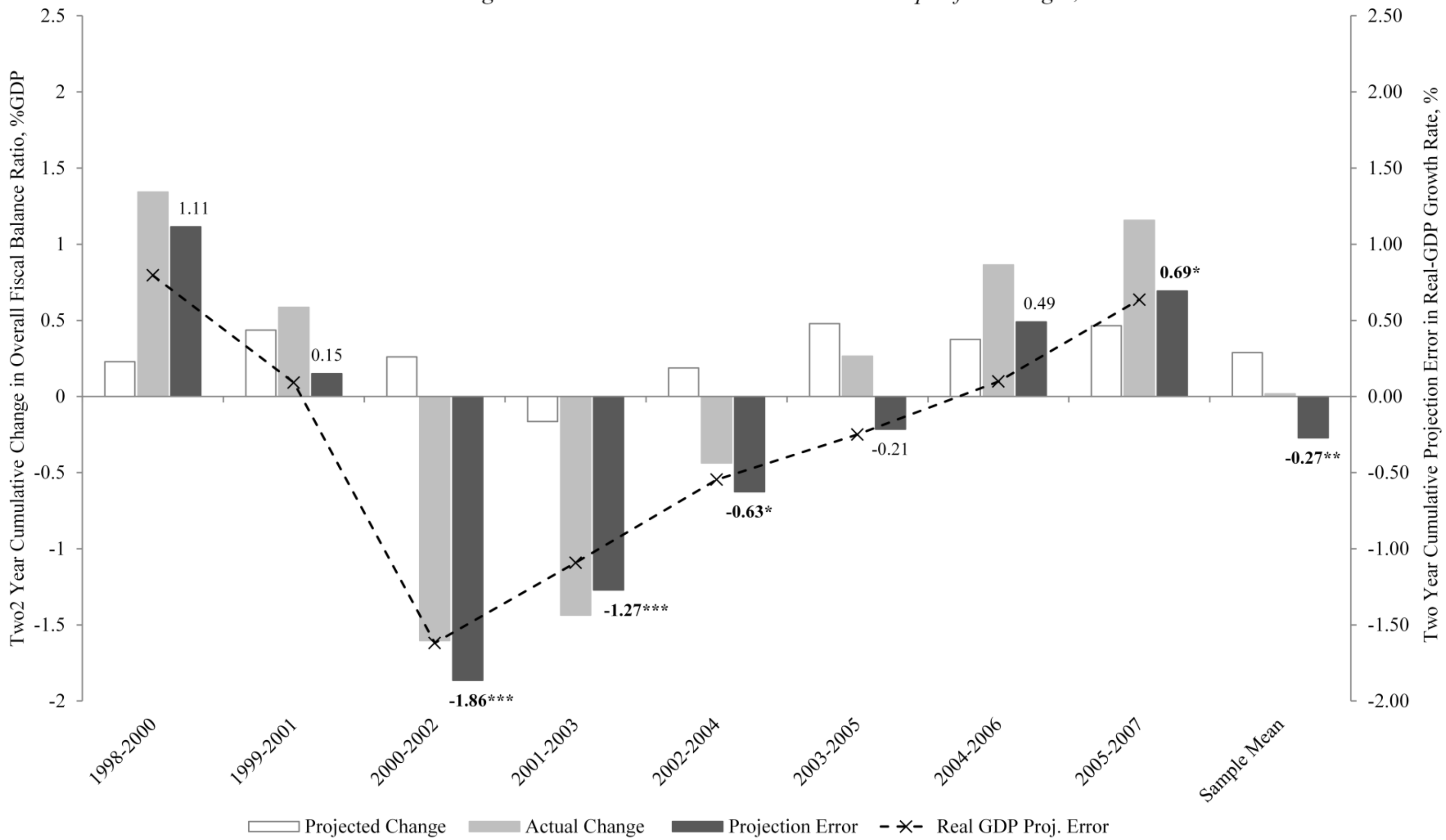
Two Year Cumulative Change in Overall Fiscal Balance Ratio: Country-Specific Averages, 1998 to 2007



Source: Stability Programmes of EU Member States, 1999 to 2007 and Author's Calculations.

Figure 1-2

Two Year Cumulative Change in Overall Fiscal Balance Ratio: Period-Specific Averages, 1998 to 2007



Source: Stability and Convergence Programmes of EU Member States, 1998 to 2007 and Author's Calculations.

Considering first the data at a country level presented in Figure 1-1. Projection errors for nine of the fourteen countries in the sample are, on average, negative, but only in the case of three countries (Italy, France and the UK) are these errors found to be statistically different from zero. This test of significance is based upon a t-test for the estimated country fixed-effects in a regression of the projection errors on a constant and a set of country fixed-effects. Hence the evidence suggests that certain countries were susceptible to submitting optimistic budgetary forecasts relative to others over the sample period.

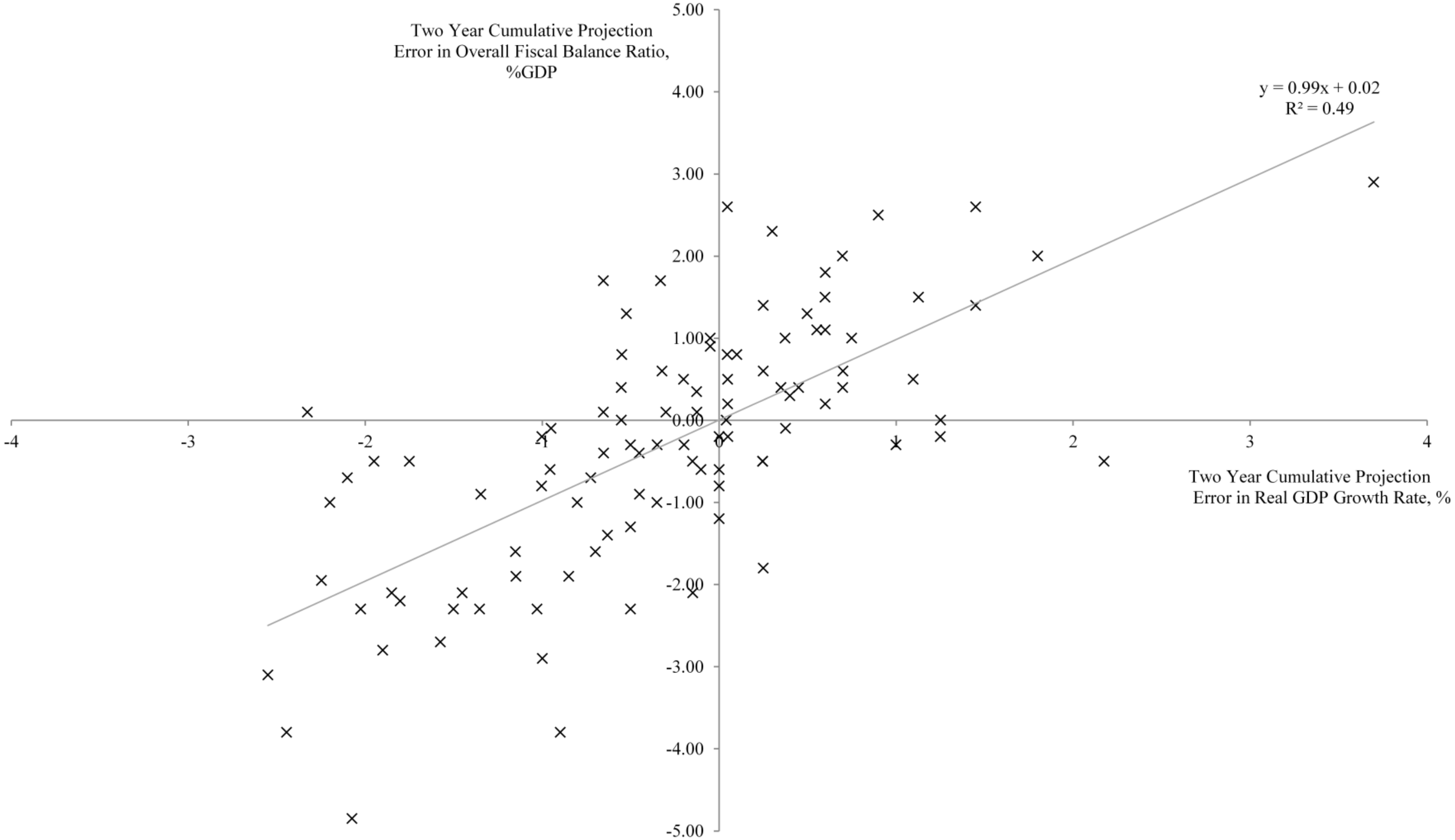
Next, period-specific averages of the projection errors are considered and displayed in Figure 1-2. Projection errors in real-GDP growth are presented alongside these averages which are calculated as the difference between the projected cumulative growth rate in real-GDP over two years and the actual growth in real-GDP for the same period, with both figures calculated on a per annum % basis. This evidence suggests that countries were collectively prone to overstating budgetary developments over the period of 2000 to 2004 for which large and statistically significant (negative) projection errors are apparent. These developments coincide with unanticipated shortfalls in economic growth rates, as confirmed by the period-specific projection errors in real-GDP growth rates which overlay the budgetary data. This evidence highlights the sensitivity of the overall fiscal balance ratio to fluctuations in economic output.

Finally, Figure 1-3 inquires further into the relationship between real-GDP growth and budgetary projections by plotting projection errors in real-GDP growth rates alongside those in overall fiscal balance ratios. The scatter plot confirms a positive and statistically significant relationship between these two variables. A simple bivariate regression reveals a coefficient estimate of 0.99 which is statistically significant at the 1% level, using a t-statistic robust to arbitrary forms of heteroskedasticity, and an R^2 which indicates that nearly half of the overall variation in projection errors for the overall fiscal balance ratio can be captured by this variable. The estimated marginal effects suggests that a -0.25% projection error in the real-GDP growth rate cumulated over two years[6] coincides with a -0.245% projection error in the overall fiscal balance ratio, measured as a ratio of GDP. Hence on the basis of Figure 1-2 and Figure 1-3 it is apparent that the economic cycle should be controlled for when considering projection errors in a regression context, this could be performed by including projection errors in real-GDP growth rates in these regressions and/or via the inclusion of time fixed-effects.

[6]-0.25% is sample average of projection errors in the real-GDP growth cumulated over a two year period, see Table 1-1. This relationship was also investigated using variables calculated as deviations from country-specific means, the results were very similar.

Figure 1-3

Two Year Cumulative Projection Errors in the Overall Fiscal Balance Ratio and Real-GDP Growth Rates, 1998 to 2007



Source: Stability and Convergence Programmes of EU Member States, 1998 to 2007 and Author's Calculations.

1.3. Related Literature

This section reviews related literature, both empirical and theoretic, which analyse fiscal policy from a political-economic perspective. These studies offer some insight into the causes of optimism bias as well as suggesting potential means of moderating its impact, e.g. through reform to national fiscal institutions.

1.3.1. National Budgeting, Government Fragmentation & Fiscal Discipline

It is frequently proposed that the pervasive budget deficits which characterise advanced economies result from divergences in the costs and benefits policy-makers perceived to be associated with public sector activities and the economic costs and benefits of their provision. Weingast et al. (1981), von Hagen and Harden (1995), Velasco (2000), Persson et al. (2007), Hallerberg et al. (2009) and Krogstrup and Wyplosz (2010) reflect a broad body of literature[7] which has focused, in a conceptual setting, upon the role of distributional conflict between groups in society as a principal cause of fiscal indiscipline.

Central to these studies is the idea that the benefits resulting from public spending are typically concentrated towards specific interest groups in society yet are funded from a pool of tax revenues towards which a broader segment of society contribute. This facet of government budgeting implies that those who gain from programmes of public expenditure rarely face the full costs of their provision and incongruence arises between the marginal benefit these groups (or those who represent them) perceive to be associated with these programmes and the marginal

[7] Eslava (2011) provides a comprehensive review of studies which analyse the political basis of deficit bias.

cost of their provision. When individuals can stake claims to a valuable resource for which they only pay a fraction of the costs there is an established tendency to excessively consume that resource. In the context of public sector budgets this is perceived to result in magnitudes of public spending, overall deficits and government debts which are higher than that consistent with certain normative economic benchmarks; commonly referred to as the common-pool problem of government budgeting.

The implications of these studies are that an increase in the degree of distributional conflict amongst the groups represented in the design and implementation of national fiscal policies should be negatively correlated with fiscal discipline. Equally, electoral systems which generate more fragmented (or democratically representative) governments characterised by greater distributional conflict, perhaps in the form of multi-party coalitions, should be associated with greater fiscal indiscipline, e.g. through systems of proportional representation. A large body of literature has developed seeking to examine the validity of such arguments in an empirical context.

Roubini and Sachs (1989) and Roubini et al. (1989) provided early evidence that governments formed of multi-party coalitions have struggled to contain the fiscal impact of adverse macroeconomic shocks. They argued that such governments are characterised by their inability to garner the degree of political consensus necessary to enact deficit reductions, electing to characterise these governments as politically "weak" and hence more susceptible to deficit bias. Whilst the findings of these studies were challenged on econometric grounds by Edin and Ohlsson (1991) and de Haan and Sturm (1997), further contributions to this empirical literature, including that of Kontopoulos and Perotti (1999), Volkerink and de Haan (2001), Perotti and Kontopoulos (2002), Fabrizio and Mody (2006) and Bawn and Rosenbluth (2006), re-confirmed that the degree of fragmentation characterising the government is systematically related to fiscal outcomes which are observed in practice and hence not conducive to the implementation of prudent fiscal policies. Whilst this group of empirical studies focused upon the impact of government fragmentation on fiscal *outcomes* a related literature has also developed which applies these concepts in the context of the budgetary *projections* produced by national fiscal agencies, particularly amongst members of the EU.

In this vein, Jonung and Larch (2006) argued that larger EU member states biased their projections of potential real-GDP growth in order to delay undertaking budgetary reforms which could be viewed as politically costly or risky. Whilst the authors suggest that such bias is politically motivated they do not examine whether there is any systematic link between political factors and the magnitude of forecasting bias. Beetsma et al. (2009) also examine the budgetary and macroeconomic projections in the EU but in a broader sample of 14 member states using data extracted from national SPs. They demonstrate that these projections are characterised by an optimism bias in a similar manner to that presented in this chapter. They support this statistical evidence with conceptual arguments that substantiate this bias as policy-makers attempting to balance a desire to appear fiscally disciplined (in an ex-ante sense) whilst simultaneously managing conflict over the allocations of public resources during the negotiation and approval stages of the budget. Whilst they recognise the potential influence of political conflict (or fragmentation) in giving rise to optimism bias they do not include any direct measure of this in their empirical analysis, although they do find a role for changes in government and shifts in government ideology as sources of optimism bias which have a political basis.

Pina and Venes (2011) similarly investigate budgetary projections prepared by 15 EU member states for the purposes of the SGP's excessive deficit procedure. Their study focuses on the politico-institutional determinants of such projections and in a similar manner to Beetsma et al. (2009) highlight an opportunistic motive of policy-makers which is linked to changes in government and election years. They extend consideration of potential political influences of projections errors to the degree of fragmentation in government, which is captured using an indicator of coalition and minority governments; they find the coalition indicator to be statistically significant at the 5% level and associated with increased optimism bias but only when country fixed-effects are included in their regressions. Abbas et al. (2011) study the economic, political and institutional determinants of large, multi-annual fiscal consolidations amongst EU nations using data extracted from national Stability or Convergence Programmes. In contrast to previous studies they find no link between changes in government and deviations from an announced adjustment path but do present evidence that increases in the degree of parliamentary fragmentation and changes in government stability are detrimental to their implementation.

Frankel (2011) and Frankel and Schreger (2013) study the properties of forecasts in real-GDP growth rates and budget balances in a broad sample of 33 countries. The evidence presented in these studies highlights that such projections are optimistic and that such optimism is particularly characteristic of EU member states. They therefore question the effectiveness of the SGP in promoting fiscal discipline amongst these countries but do not include any political variables in their regression analysis and hence cannot examine whether there is heterogeneity in the magnitude of optimism bias across alternative political contexts.

Overall there is empirical support for the proposition that the fragmentation of the government during the design and implementation of national fiscal policies is negatively correlated with fiscal discipline. Whilst much of the existing literature has focused on the implications of such fragmentation in explaining differences in fiscal outcomes there is also a literature which examines the political basis of budgetary projections although within this literature comparatively little work has been conducted to substantiate whether government fragmentation may lead to the submission of optimistic budgetary projections and hence undermine the credibility of the authorities responsible for their production.

1.3.2. Fiscal Institutions and Numerical Fiscal Rules

Conceptual and empirical studies have presented evidence that the fragmentation of policy-makers may shape fiscal allocations to the detriment of maintaining overall budgetary discipline. Existing studies have also emphasised the institutional context within which fiscal policy-makers operate as a means of moderating the budgetary pressures which stem from these sources; collectively referred to as fiscal institutions. Fiscal institutions define the practicalities of the budget process and therefore give it its structure, they split the budget process into its various stages, outline and allocate responsibilities across relevant participants and regulate the flow of information between them; see von Hagen and Harden (1995) and Hallerberg et al. (2009). Beyond defining practicalities these institutions have also been identified as a means to instil fiscal discipline; if the identified biases in fiscal policy-making stems from incongruence in the perceived costs and benefits associated with public activities, then adapting fiscal institutions to realign these costs and benefits could promote fiscal discipline.

Existing empirical studies have found support for the hypothesis that fiscal institutions can improve budgetary discipline. In a sample of 10 new EU entrants Fabrizio and Mody (2006) find more fragmented governments to be associated with larger budget deficits. They also demonstrate that strong fiscal institutions which serve to centralise decision-making over budgetary allocations can moderate the undesirable budgetary influences of this fragmentation. Hallerberg et al. (2009) construct indices of budgeting institutions for 15 EU member states, distinguishing between contracts and delegation forms of fiscal governance. They argue that delegation forms of governance (which emphasis a strong principle of hierarchy) work best in promoting fiscal discipline when the ideological distance between the political parties in government is low, whilst contract based governance (a more collegial approach based upon fiscal limits or targets), is more effective when this distance is high. They find support for the hypothesis that budgeting institutions influence fiscal outturns by moderating ideological fragmentation amongst policy-makers. de Haan et al. (2013) similarly distinguish between EU nations on the basis of either contract or delegation forms of fiscal governance using the indices of Hallerberg et al. (2009). When analysing the relevance of such forms of governance on budget deficits across EU member states they show that strong budgeting institutions (of either variety) reduce deficit biases which results from ideological fragmentation in the government.

Significant interest has been also given to numerical fiscal rules as one means of moderating deficit bias. These rules stipulate limits for summary indicators of fiscal performance, define the procedural aspects of managing deviations from these limits and the corrective actions which will be taken should they be breached. These rules are motivated on the basis they raise the costs which policy-makers perceive to be associated with pursuing policies inconsistent with defined normative benchmarks.

From an empirical perspective, fiscal rules have been demonstrated as an effective tool for encouraging fiscal discipline across EU member states. Debrun et al. (2008) measure the strength of numerical fiscal rules at a national level via a survey of fiscal experts across EU nations and find that stronger and more encompassing rules are associated with improved fiscal outturns. A separate literature examines whether fiscal rules or (to a lesser extent) overall budgeting institutions influence the magnitude of biases in official budgetary projections, as opposed to fiscal outturns. Holm-Hadulla et al. (2012) consider pro-cyclical bias in public expenditure programmes which results from political fragmentation and argue that bias of this form can be mitigated by strong expenditure rules. Beetsma et al. (2009) demonstrate that stronger numerical fiscal rules are effective in moderating optimism bias in projections of overall fiscal balances amongst 14 EU members, whilst similar results which establish a role for numerical fiscal rules are presented by Abbas et al. (2011) and Frankel and Schreger (2013). In contrast von Hagen (2010) examines whether there are any systematic differences in the nature of the bias in official EU budgetary projections by classifying nations on the basis of the predominant form of budgeting institutions (either delegation or contracts). He argues that contracting nations which have strong fiscal rules have tended to submit cautious budgetary projections in comparison to nations who have adopted delegation forms of governance.

Despite empirical evidence generally supportive of their adoption, the proposition that fiscal discipline can be improved through the imposition of stricture, in the form of fiscal rules, is a contentious topic. Such mechanisms have been criticised with regards to their necessity and ongoing legitimacy. In order to be effective the rules must, at some stage, “bite” and therefore constrain the actions of actors in the budget process who would, if left to their own devices, implement undesirable policies. It is argued that once these rules become binding it becomes rational for policy-makers to attempt to remove, alter or evade the constraints imposed upon them and therefore the rules are adjudged to time-consistency; Buiter (2003), Milesi-Ferretti (2003), Debrun (2007) and Wyplosz (2012) are examples of this conceptual line of reasoning.

It is also suggested that these rules might lead governments to obscure a nation’s true budgetary position in order to avoid political or economic sanction. von Hagen and Wolff (2006) present evidence that creative accounting techniques have been utilised by EU member states to avoid falling foul of the deficit limits outlined by the SGP. Whilst Beetsma et al. (2009) have argued that the SGP has caused countries to resort to creative accounting practices in order to demonstrate adherence with certain fiscal targets. Similarly, it has been suggested that these rules might be ‘worse than useless’ if they promote pro-cyclical fiscal policies and/or promote unproductive public expenditures at the expense of productive forms of expenditures; see Eichengreen and Wyplosz (1998) and Krogstrup and Wyplosz (2010).

Finally, it has also been argued that governments can commit to fiscal discipline on a discretionary basis without the need for permanent fiscal rules which seek to tie their hands; therefore rules may serve no useful purpose and thereby act as unnecessary fiscal ornaments, Koptis (2001) and Hallerberg et al. (2007). These arguments endorse those associated with the delegation form of fiscal governance where the budget process can be governed effectively through institutions which promote a strong principle of hierarchy. What matters in such circumstances is not the presence of rules, per se, but rather the incentives which guide the finance minister and his/her ability to exert their budgetary authority. Rules may therefore reinforce or articulate more clearly the finance minister's commitment to fiscal discipline but are not regarded as a central component of such governance arrangements.

1.3.3. The Conditional Impact of Numerical Fiscal Rules on Fiscal Credibility

The previous section provided a review of both conceptual and empirical studies which analyse the political causes of fiscal indiscipline and propose alternative institutional arrangements as a means of moderating their budgetary impact. What is clear from such arguments, and associated empirical evidence, is that enacted budgetary policy does not necessarily reflect the priorities of a unified political entity but instead those of diverse political agents who are characterised by ideological disparities over the appropriate incidences of benefits and costs associated with public sector activities, whereby growing disparities between such groups are viewed as detrimental to maintaining fiscal discipline and the credibility of the fiscal authorities. That being said, whilst greater fragmentation in the budgetary process might be associated with fiscal indiscipline, as well as a tendency to submit biased budgetary projections, it is also argued that one means of moderating the scale of such indiscipline is to adapt the rules and procedures which dictate the formulation and implementation of fiscal policy, e.g. by imposing procedural stricture in the form of numerical fiscal rules.

This chapter examines to what extent increases in the fragmentation of the government influences the magnitude of optimism bias in official budgetary projections and whether such bias can be moderated by fiscal rules. It is therefore adjudged that a conditional, or interactive, relationship is appropriate between fiscal rules and the political context within which national budgetary policy is set. The notion that the effectiveness of fiscal institutions in moderating deficit biases is conditional upon political circumstances has grown in prominence in recent times. de Haan et al. (2013), Hallerberg et al. (2007, 2009) and Wehner (2010) are examples of analytical arguments and empirical evidence which indicates that measures of government fragmentation should be considered jointly and not independently of institutional contexts.

It is on this basis that the following hypotheses are examined:

Hypothesis 1*: When the national budgetary process incorporates weak, or non-existent, numerical fiscal rules then increases in the degree of government fragmentation will cause implemented budgetary adjustment to fall short of that projected, i.e. will be characterised by greater optimism bias.*

Hypothesis 2*: When the national budgetary process incorporates strong numerical fiscal rules then increases in the degree of government fragmentation will have no systematic impact on the tendency to deviate from announced budgetary projections.*

1.4. Empirical Methodology

This section explains the empirical methodology which is adopted to explore the hypotheses that more fragmented governments are prone to optimism bias whilst also recognising that numerical fiscal rules might serve to moderate this bias. Definitions for all variables and their associated sources are outlined in Appendix A.

1.4.1. Baseline Empirical Specification & Methodology

The empirical approach adopted in this chapter assumes that projection errors in overall fiscal balance ratios are determined by a set of economic, political and institutional factors taken to approximate the incentives which face policy-makers. This is in keeping with an existing literature which estimates fiscal policy reaction functions either on a real-time or an ex-post basis; see Galí and Perotti (2003) for a seminal contribution as well as the literature surveys of Golinelli and Momigliano (2009) and Cimadomo (2011).

Given the limited number of data points available on a country-by-country basis adopting a panel approach is deemed necessary, thereby pooling the observations across countries. However, this approach assumes a degree of homogeneity across the countries in the sample and so to mitigate any bias caused by this, potentially invalid, assumption, country-fixed effects are included in all regressions. This means that the point estimates presented are calculated on the basis of variation within countries and thereby ignoring the variation which exists across countries[8]. The benefits of this approach are that the presented results are robust to

[8]A variance decomposition of budgetary projections errors cumulated over a two year period indicates that a high proportion of their total variation can be regarded as within-groups (81.58%) as opposed to between-groups (18.42%).

the possibility of bias caused by the exclusion of unobservable country-specific variables which are correlated with both the explanatory and dependent variables.

The general form of the empirical specification adopted is outlined in equation (1-3):

$$FB\_Cumul\_Error_t^{t+2} = \beta x_t^t + \delta(y_{t+2}^{t+2} - y_{t+2}^t) + \gamma(z_{t+2}^{t+2} - z_t^t) + \phi Pol_t + \omega Pol\_Frag_t + \eta Rules_t + \lambda(Pol\_Frag_t \cdot Rules_t) + (\alpha_i + \theta_t) + \varepsilon_{i,t} \qquad (1\text{-}3)$$

where $FB\_Cumul\_Error_t^{t+2} \equiv (FB_{t+2}^{t+2} - FB_t^{t+2}) - (FB_{t+2}^t - FB_t^t)$ denotes the cumulative projection error in forecasts of the overall fiscal balance over a two year period; $(\alpha_i + \theta_t)$ are fixed-effects included to capture unchanging country-specific factors and effects which are common to all countries in each period (approximated by country and time dummy variables). Economic control variables enter into the specification in three forms (i) variables represented by x_t^t utilise data extracted from the vintage of the original projection's publication and relate to that period, e.g. the fiscal balance-to-GDP ratio for year t as published in year t, (ii) $(y_{t+2}^{t+2} - y_{t+2}^t)$ denotes cumulated projection errors in forecasted economic control variables over a two year period, e.g. projection errors in real-GDP growth rates, and (iii) $(z_{t+2}^{t+2} - z_t^t)$ signifies statistical revisions, or base effects, in economic control variables cumulated over a two year period, e.g. statistical revisions in the initial fiscal balance ratios between year t and year $t+2$. Finally, Pol_t represents political variables which capture changes in the government and its ideology, Pol_Frag_t

alternate measures of government fragmentation, and $Rules_t$ is a time-varying index which captures the strength of numerical fiscal rules in place at a national level.

The time-series and cross-sectional nature of the dataset means that the assumption of independent, identically distributed errors is unlikely to hold. To accommodate this, tests of significance are based upon standard errors which are robust to arbitrary forms of heteroskedasticity and serial correlation up to four lags. Additionally, existing studies have raised the issue of potential endogeneity between projection errors in the fiscal balance-to-GDP ratio and projection errors in real-GDP growth, reflecting the possibility that larger than originally projected budgetary adjustments may lead to greater than expected projection errors in real-GDP growth rates, as opposed to the other way around; see Beetsma et al. (2009) and Abbas et al. (2011). I test whether the estimated coefficients are susceptible to this form of bias by calculating a Sargan-Hansen C-statistic facilitated by the xtivreg2 command of Schaffer (2012). The reported p-values for this test are calculated under a null hypothesis that the suspected endogenous variables can be regarded as exogenous. The instruments utilised are the equally weighted averages of projection errors in real-GDP growth rates for all countries other than the country which is being instrumented[9].

To test the principal hypotheses of this chapter, interaction effects are included between the indicators of political fragmentation and the index of numerical fiscal rules, as captured by $(Pol\_Frag_t \cdot Rules_t)$. These interaction effects allow the

[9]As explained by Abbas et al. (2011), the identifying assumption employed in this case is that the only channel through which other countries growth surprises are related to projection errors is through the real GDP growth surprise in the country in question, and the projection error in an individual country is unrelated to the GDP growth surprises of other countries.

estimated marginal effect of government fragmentation to be shaped by the strength of numerical fiscal rules operating at a national level. These conditional marginal effects are calculated using the following formula:

$$\partial FB\_Error_t^{t+2} \Big/ \partial Pol\_Frag_t = \omega + (\lambda \times Rules_t) \tag{1-4}$$

The conditioning variable ($Rules_t$) varies both across time and countries so to aid the interpretation of these estimated marginal effects I utilise graphical exposition following the approach outlined by Brambor et al. (2006) and Kam and Franzene (2009). Conventional statistical results tables are supplemented with plots of the marginal effects across the observed spectrum of the fiscal rules index. Conditional standard errors are used to derive conditional confidence intervals at both 5% and 10% levels of significance which are plotted alongside the estimated marginal effects. These standard errors are calculated as the square root of the following expression where hats are used to denote sample estimates:

$$\begin{aligned} &Var\big(\omega + (\lambda \times Rules_t)\big) \\ &\quad = Var(\widehat{\omega}) + \big({Rules_t}^2 \times Var(\widehat{\omega})\big) + \big(2 \times Rules_t \times Cov(\widehat{\omega}, \hat{\lambda})\big) \end{aligned} \tag{1-5}$$

1.4.2. Economic Control Variables

I include six economic control variables when estimating equation (1-3) with all data being extracted from country specific SPs. The first variable is the ***Cumulated Projection Error in Real-GDP Growth Rates***, calculated as the difference between the two year cumulative projection in real-GDP growth and observed real-GDP growth over the same period[10], both measured in per-annum %

[10] To be more specific, an annualised growth rate in real-GDP is calculated on the basis of published real GDP projections as $Cumul\_y_{t+2}^{t} = \sqrt{(1 + y_{t+1}^{t})(1 + y_{t+2}^{t})}$. This is deducted from the observed

terms. This variable is included to control for the previously established cyclical nature of the overall budget balance, i.e. its tendency to move in a manner coincident with the state of the overall economy, therefore its anticipated sign is positive.

The second group of economic control variable capture the possibility that governments might be more inclined to stick to their announced budgetary projections when confronting challenging fiscal circumstances, i.e. to capture a fiscal sustainability motive. Three variables are included to reflect the possibility of these effects, the first, the ***Initial Fiscal Balance ratio,*** measured as the year t overall fiscal balance-to-GDP ratio as contained within the SP published towards the end of year (FB_t^t). The second, the ***Initial Gross Government Debt ratio***, measured as the year *t* general government consolidated debt as measured in year ($Gross\_Debt_t^t$). Finally, ***Excessive Fiscal Balance*** is an indicator which captures whether a nation's budget deficit would have been considered as "excessive" from the perspective of the limits stipulated by the SGP at the time of the figure's publication, this is calculated as the difference between (the absolute value of) a nation's initial fiscal balance and the 3% of GDP deficit limit outlined by the Stability and Growth Pact ($|FB_t^t| - 3\%$).

Additional economic control variables include the ***Statistical Revision in the Initial Fiscal Balance (or base effect),*** calculated as the cumulated revisions in the overall fiscal balance-to-GDP ratio over a two year period from its first release ($FB_t^{t+2} - FB_t^t$). This variable is included to reflect that upwards revisions in initial budgetary circumstances may moderate pressure on the government to pursue its originally announced budgetary adjustments. Conversely, downward revisions might

annualised growth rate in real GDP over the same period (calculated in the same manner) in order to calculate a cumulative projection error.

prompt the enactment of additional adjustment relative to that which was originally projected. Finally the projected change in the fiscal balance-to-GDP ratio between years t and t+2 $(FB_{t+2}^{t} - FB_{t}^{t})$ is included as an approximation of the degree of ambition of the original budgetary adjustment, ***Plan Ambition***. This variable is included to investigate whether plan ambition has any systematic influence on deviations from submitted budgetary projections, as more ambitious plans may face larger challenges in their implementation, as identified by Beetsma et al. (2009). Summary statistics for all variables are outlined in Table 1-2.

Table 1-2

Summary Statistics for the Economic, Political and Insitutional Control Variables

		Mean	Std. Dev.	Min	Max
Economic Controls:					
Initial Fiscal Balance, %GDP	Overall	-0.55	2.32	-6.00	4.70
	Between		2.05	-3.02	3.07
	Within		1.20	-3.65	2.72
Real-GDP Projection Error, %	Overall	-0.24	1.10	-2.60	3.70
	Between		0.52	-1.11	0.65
	Within		0.98	-3.29	2.81
Statistical Revision in Initial Balance, %GDP	Overall	-0.03	0.92	-4.30	2.50
	Between		0.52	-1.51	0.53
	Within		0.79	-2.81	1.95
Plan Ambition, %GDP	Overall	0.33	0.98	-2.60	2.70
	Between		0.68	-1.10	1.42
	Within		0.71	-2.49	1.89
General Govt. Debt, %GDP	Overall	63.58	24.36	25.10	118.20
	Between		24.20	36.17	109.50
	Within		6.77	46.29	86.41
Excessive Deficit, %GDP	Overall	0.12	0.43	0.00	3.00
	Between		0.17	0.00	0.46
	Within		0.40	-0.35	2.66
Political Controls:					
Changes in Government	Overall	0.68	0.63	0.00	2.00
	Between		0.25	0.38	1.13
	Within		0.59	-0.45	1.80
Change in Government Ideology	Overall	-0.20	1.34	-4.00	4.00
	Between		0.54	-1.00	1.00
	Within		1.24	-3.57	3.55
Number of Veto-Players	Overall	4.15	1.16	2.00	7.00
	Between		1.04	2.40	5.80
	Within		0.57	2.35	5.85
Maximum Ideological Distance	Overall	0.29	0.27	0.00	1.00
	Between		0.22	0.00	0.73
	Within		0.17	-0.12	0.96
Fiscal Rules Index:					
Numerical Fiscal Rules	Overall	0.46	0.31	0.00	0.98
	Between		0.30	0.00	0.92
	Within		0.12	0.06	0.85

Notes: *Authors own calculations. The Within and Between standard deviations denotes the variation of the variable with respect to country-specific means (Within-Groups), and that between countries (Between-Groups). See chapter text and Appendix A for definitions and the methodology adopted in calculating all variables.*

1.4.3. Political Control Variables

In addition to economic control variable, two political control variables are included which have been identified by existing studies to influence the magnitude of projection errors amongst EU member states, see Beetsma et al. (2009) and Pina and Venes (2011). The first variable captures the number of changes in government which have occurred subsequent to the submission of the initial budgetary projections; ***Changes in Government***. Data for this variable is extracted from the Comparative Political Dataset (CPD) of Armingeon et al. (2010), and identifies changes in government which have result from either (i) elections, (ii) the resignation of the prime minister, (iii) dissension with the government, (iv) a lack of parliamentary support for the government, and finally (v) intervention by the head of state. It is conjectured that new governments may feel less obligated to stick to the budgetary plans announced by their predecessors or seek to demonstrate the shortcomings of the previous government in managing the nation's fiscal affairs.

The second political control variable captures the change in the ideological position (on a left-to-right scale) of the government over the period covered by the budgetary projection: ***Changes in Government Ideology***. This variable is present to test whether shifts in the ideological composition of the government has any systematic influence on projection errors over the projection horizon as identified by Beetsma et al. (2009), e.g. whether right-wing government are likely to pursue additional budgetary adjustment when replacing their left-wing counterparts. Again the data for this variable is extracted from the CPD database.

1.4.4. Measures of Government Fragmentation

To reflect the degree of fragmentation which exists amongst the parties in government, two additional variables are introduced to the empirical specification of equation (1-3). The first is the ***Maximum Ideological Distance***, on a left-right scale, between the political parties which comprise the government. This measure is motivated by the work of Tsebelis (1995, 2002) and has been applied by studies such as Volkerink and de Haan (2001), de Haan et al. (2013) and Hallerberg et al. (2009) in explaining differences in fiscal circumstances amongst EU member states using panel regression methods. Time-varying data on the ideological disposition of each party in government is obtained from the Comparative Manifesto Project (CMP) Database; Budge et al. (2001). This ideology data is then combined with the election data obtained from the Database of Political Institutions (DPI) of Beck et al. (2001)[11]. When calculating the indicator the left-most ideological score is subtracted from the right-most ideological score, this difference is then standardised to run between zero and one on a country-by-country basis.

The second measure of fragmentation is selected to approximate the number of political parties which are (in theory) able to veto the approval of the budget in parliament, thereby holding the position of a veto-player; ***Number of Veto-Players***. This variable is taken from the DPI and for parliamentary systems is coded to be incremented by one for (i) every party in the government coalition so long as the party is needed to maintain a majority and (ii) for every party in the government

[11] In all countries considered except one (the UK) the budget cycle is conducted on a calendar year basis, hence to reflect this, the political variables reflect data relating to the end of each year when the budget was introduced to the national legislature for approval.

coalition that has a position on economic issues closer to the largest opposition party than to the main party in the executive.

1.4.5. Numerical Fiscal Rules

In order to capture the strength of numerical fiscal rules in operation amongst EU member states I utilise the database of these rules maintained by the European Commission and constructed via a survey of fiscal policy experts in the finance ministries of EU capitals, see European Commission (2006)[12]. The definition of a numerical fiscal rule utilised by the questionnaire is that employed by Koptis and Symanski (1998), i.e. "*a permanent constraint on fiscal policy, expressed in terms of a summary indicator of fiscal performance, such as the government deficit, borrowing, debt or a major component thereof".* Only in Greece are there no numerical fiscal rules in operation throughout the entire sample period which conform to this definition.

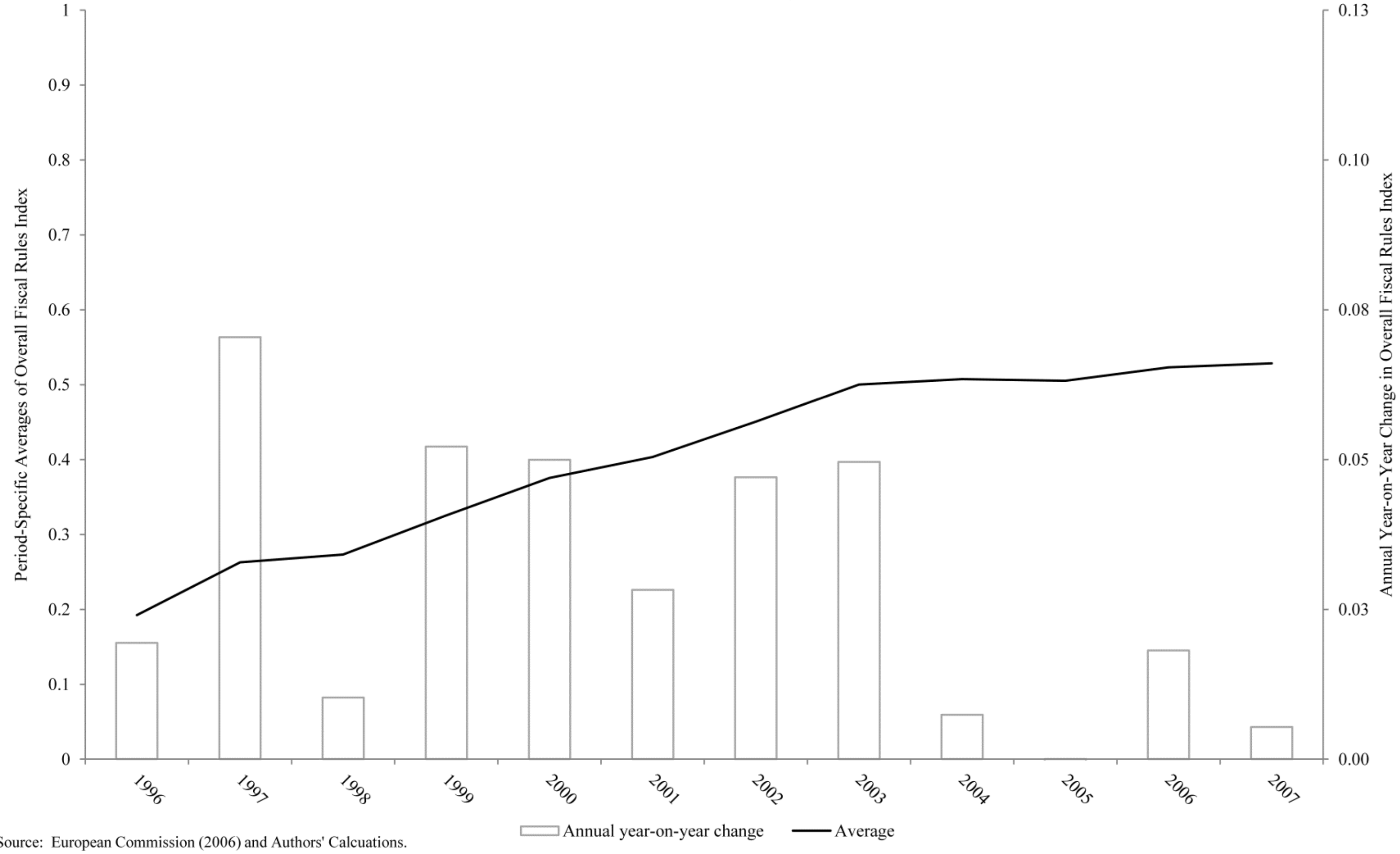
The database is updated annually and assesses the strength of all fiscal rules in operation at a national level on the basis of five criteria: (i) its statutory basis, (ii) the nature of the body in charge of monitoring the rule, (iii) the nature of the body responsible for enforcement, (iv) the mechanisms of enforcement which are in place for the rule and (v) the proportion of general government finances which are covered. Figure 1-4 illustrates the general trend amongst member states towards incorporating numerical fiscal rules into national budgetary processes particularly in the run-up to the launch of the EMU in January 1999. Following on from this point the overall

[12] Data on numerical fiscal rules (at a national level) could also have been sourced from the IMF Fiscal Rules Database: http://www.imf.org/external/datamapper/fiscalrules/map/map.htm . I elect to use the EU database to ensure my results are comparable with other studies, such as Beetsma et al,. (2009) and Abbas et al. (2011).

index exhibits a general upward trend with year-on-year increases until 2004 after which it stabilises at around 0.50 with little subsequent changes. Figure 1-5 and Figure 1-6 demonstrate that there are cross-country differences in the strength of fiscal rules both between and within countries over the sample period. Considering country specific averages for the index (Figure 1-5), there are three broad classifications of countries, the first group: the United Kingdom, Sweden, Denmark, the Netherlands, Spain, Finland and Germany, with index values above the sample mean and therefore could be classified having a budget process which is governed by relatively strong fiscal rules, the second group: Austria, France and Belgium, who appear to exhibit slightly less emphasis on a numerical rules in their national budgetary processes, and a final group which consists of Italy, Portugal, Ireland and Greece, for which rules could be characterised as weak, or non-existent.

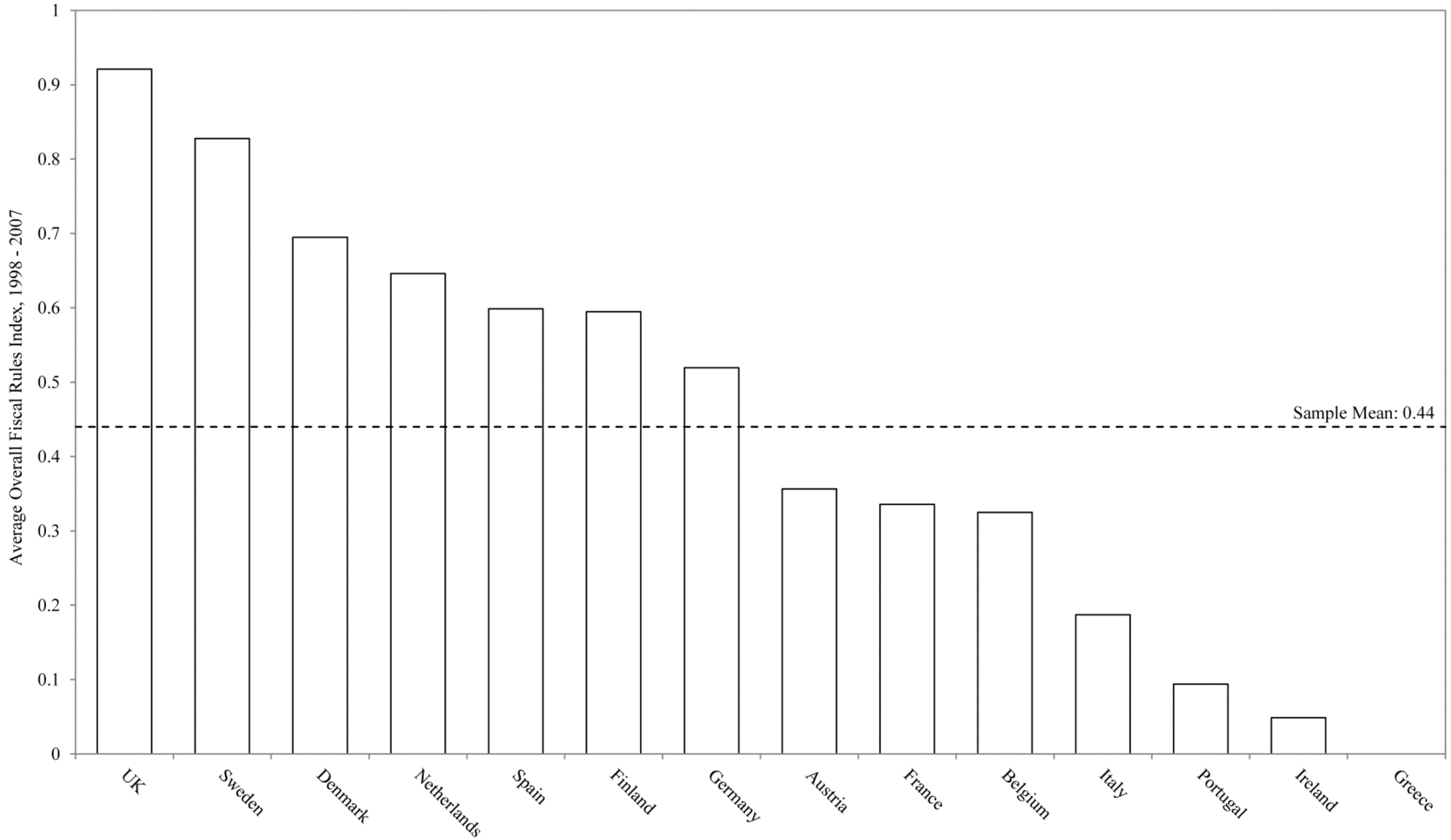
Figure 1-6 illustrates that there is also variation across countries in the average year-on-year change in the fiscal rules index per country. The figure highlights that several countries either made improvements to, or introduced additional, fiscal rules operating within their national budget processes. In particular Belgium, Sweden, Spain, Austria and Denmark are all notable for increasing the strength of their rules on a year-by-year basis by more than the sample average. A second group of countries made more moderate enhancements to their fiscal rules: Finland, Italy, Portugal, France and Ireland, whilst for the final group of countries: the United Kingdom, the Netherlands, Germany and Greece, there was no apparent change in the rules, who in all cases aside from Greece could already have said to have been characterised by strong fiscal rules at the inception of the sample.

Figure 1-4
EC Numerical Fiscal Rules Index, 1996 - 2007



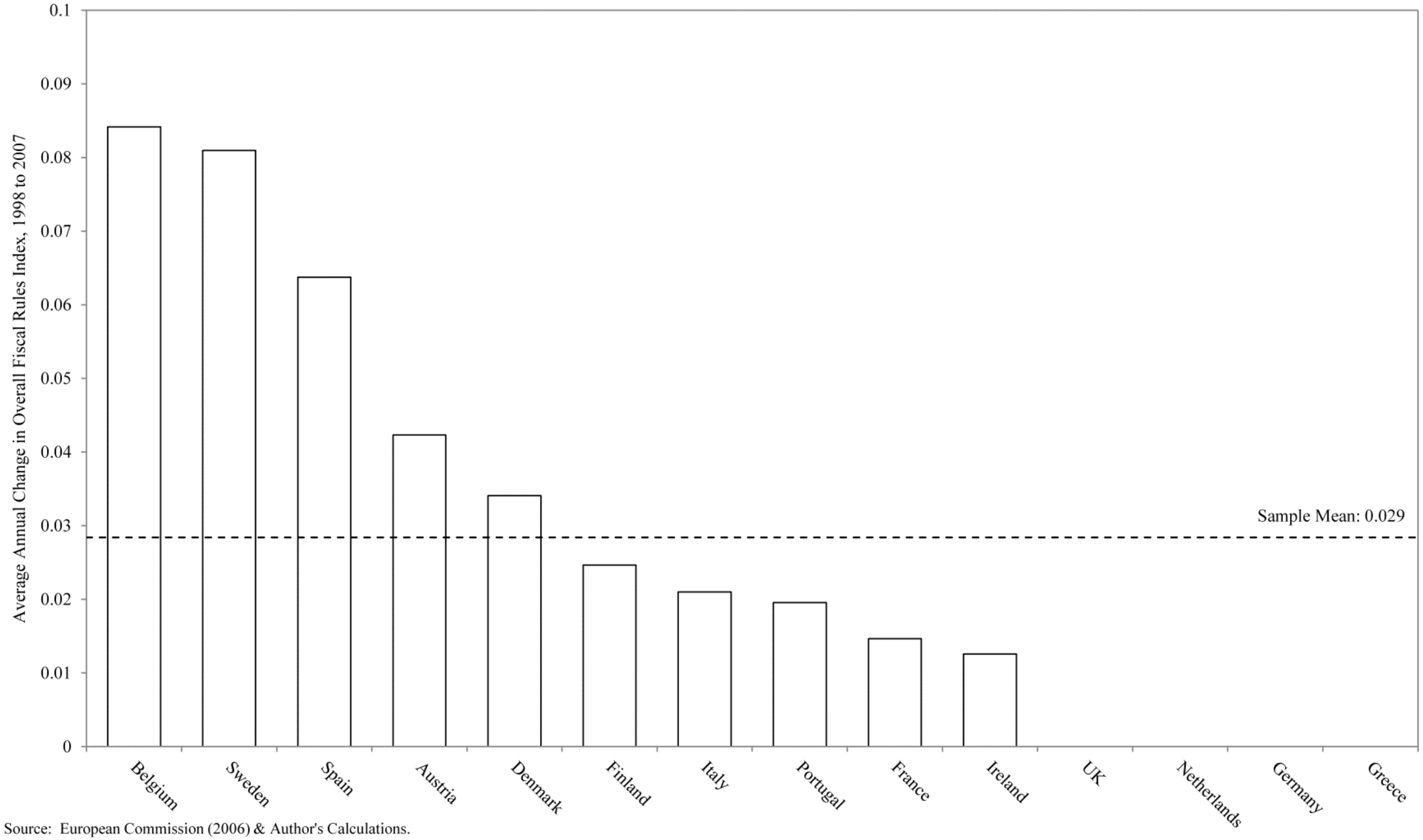
Source: European Commission (2006) and Authors' Calcuations.

Figure 1-5
Average of Numerical Fiscal Rules Index by EU Member State, 1998 - 2007



Source: European Commission (2006) and Aurhor's Calculations.

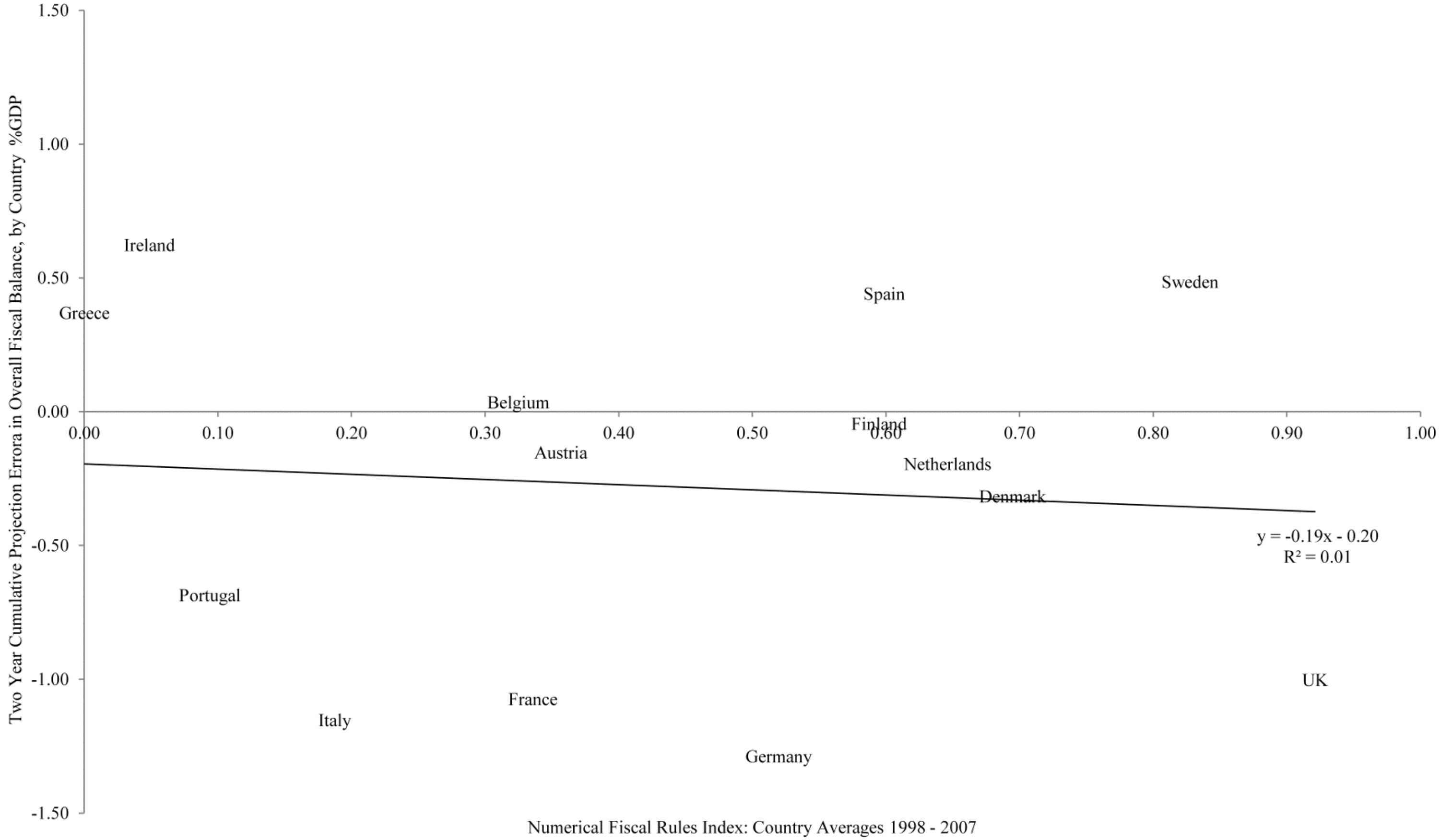
Figure 1-6
Average Annual Change in Numerical Fiscal Rules Index by Country: 1998 - 2007



Source: European Commission (2006) & Author's Calculations.

To examine whether the overall strength of fiscal rules imparts any unconditional influence on fiscal projection errors Figure 1-7 plots the cumulative projection errors in the overall fiscal balance against the cross-country average of the fiscal rules index. There is little indication that this is the case as confirmed by a bivariate regression between these two variables which reveals a negative slope and a coefficient estimate that is insignificant at conventional levels. This relationship is examined in the next section in the context of a potentially interactive relationship and after controlling for the other determinants of projection errors and other country-specific factors.

Figure 1-7
Numerical Fiscal Rules and Two Year Cumulative Projection Errors in Overall Fiscal Balances: 1998 - 2007 Averages



Source: European Commission (2006) and Author's Calculations.

1.5. Empirical Results

1.5.1. Baseline Specifications

Table 1-3 presents the results of the baseline model, equation (1-3), where each column displays the coefficients from a single regression. The first four specifications utilise as their dependent variable projection errors over a one year horizon, both including and excluding a lagged dependent variable and under the assumptions that the projection errors in real-GDP growth can either be regarded as endogenous or exogenous. The final four columns exhibit results based upon using cumulated projection errors over two years as the dependent variable, under the alternative assumption that projection errors in real-GDP growth can be regarded as either endogenous or exogenous and including additional explanatory variables: the general government gross debt ratio and the excessive deficit indicator.

Focusing first upon the final four columns of Table 1-3 and the included economic control variables, the initial fiscal balance is found to always be significant and negative in sign, suggesting that larger budget deficits within a country are associated with tendencies to understate budgetary developments relative to outturns, hence budgetary projections are found to be *less optimistic* as a nation's fiscal position deteriorates. Second, the estimated marginal impact of statistical revisions in the initial fiscal balance ratio is always negative and significant at the 1% level; the negative coefficient implies that upward revisions in the initial fiscal balance ratio coincide with budgetary adjustment lower relative to that originally projected and conversely, negative revisions coincide with more budgetary adjustment relative to what was projected. Thirdly, plan ambition is always significant at the 1% level and negative in sign, hence more ambitious plans (when calculated relative to a country-specific mean) appear prone to difficulties in their implementation. Finally and as expected, real-GDP projection errors are highly significant with a positive coefficient, thereby capturing the tendency for overall budget balances to fluctuate in a manner coincident with the economic cycle. Finally, neither variation in gross government debt ratios nor the magnitude of an "excessive" budget deficit at the time of the projection's publication is found to exhibit any systematic relationship with the dependent variable.

Turning now to the baseline political variables, there is evidence that changes in the government over the course of the two year period lead to negative projection errors, an effect which is statistically significant at the 1% level, hence new government do not demonstrate a tendency to adhere to the budgetary plans set by their predecessors. There is some evidence to suggest that ideological changes in the government subsequent to the submission of the original projections influence budgetary projection errors, the estimated coefficient is negative and significant at the 10% level when the gross debt ratio and excessive deficit indicator are omitted from the specification. The negative coefficient suggests that shifts to right during budget implementations are associated with additional budgetary adjustment relative to projections; conversely, shifts to the left are associated with a reduction in budgetary adjustment again relative to what was originally anticipated.

Finally, based upon the Sargan-Hansen test of exogeneity, I cannot reject the null that projection errors in real-GDP growth are exogenous to projection errors in overall fiscal balance-to-GDP ratios, therefore subsequent empirical models are estimated in the absence of instrumental variables.

Table 1-3

Baseline Results for One Year & Two Year Cumulative Projection Errors in Overall Fiscal Balances: EU-14, 1998-2007

	One Year Projection Errors				*Two Year Cumulative Projection Errors*			
	FE		*FE-IV*		*FE*		*FE-IV*	
	(1a)	(1b)	(1c)	(1d)	(2a)	(2b)	(2c)	(2d)
Lagged Projection Error	0.18*	-	0.18*	-	-	-	-	-
	(0.11)		(0.11)					
Initial Fiscal Balance	- 0.27***	- 0.23***	- 0.27***	- 0.23***	- 0.62***	- 0.66***	- 0.62***	- 0.66***
	(0.09)	(0.08)	(0.09)	0.08	(0.13)	(0.13)	(0.13)	(0.13)
Statistical Revision (Base Effect)	- 0.26**	- 0.25**	- 0.26**	- 0.25**	- 0.61***	- 0.63***	- 0.61***	- 0.63***
	(0.11)	(0.11)	(0.11)	0.11	(0.11)	(0.11)	(0.10)	(0.11)
Plan Ambition	- 0.36***	- 0.34***	- 0.36***	- 0.34***	- 0.52***	- 0.51***	- 0.52***	- 0.51***
	(0.12)	(0.11)	(0.12)	0.11	(0.15)	(0.13)	(0.15)	(0.13)
GDP Projection Error	0.40***	0.36***	0.40***	0.36***	0.51***	0.57***	0.51***	0.58***
	(0.09)	(0.09)	(0.09)	0.09	(0.11)	(0.10)	(0.11)	(0.09)
Changes in Government	- 0.35***	- 0.34***	- 0.35***	- 0.34***	- 0.38***	- 0.40***	- 0.38***	- 0.40***
	(0.13)	(0.12)	(0.13)	0.12	(0.13)	(0.14)	(0.13)	(0.14)
Changes in Govt. Ideology	- 0.15	- 0.15	- 0.15	- 0.15	- 0.15*	- 0.13	- 0.15*	- 0.13
	(0.09)	(0.10)	(0.09)	(0.10)	(0.09)	(0.09)	(0.09)	(0.09)
Initial Gross Government Debt	-	-	-	-	-	- 0.02	-	- 0.02
						(0.02)		(0.02)
Magnitude of Excess Deficit	-	-	-	-	-	- 0.05	-	- 0.05
						(0.17)		(0.17)
Observations	110	111	110	111	101	101	101	101
Within-Groups R^2	0.52	0.51	0.52	0.51	0.73	0.74	0.73	0.74
Sargan-Hansen Exog. Test (p-value)	-	-	0.79	0.84	-	-	0.96	0.77

Notes: **Significant at 10%. **Significant at 5%. ***Significant at 1%. Standard errors are reported in parentheses below each point estimate, these standard errors are calculated to be robust to arbitrary form heteroskedasticity and serial correlation up to 4 lags. The exogeneity of instrumented variables is tested via the Sargan-Hansen distance test, the p-values reported are calculated under the null hypothesis that the variable can be regarded as exogenous. All estimations are carried out using the stata command xtivreg2, see Schaeffer (2010) for further details. The instrument used for the real-GDP projection errors is the unweighted average of real-GDP projection error in all other countries other than the one being instrumented. Both time and country fixed-effects are included in all specifications.*

1.5.2. Interactive Specifications

Table 1-4 expands upon specification (2c) of Table 1-3 by incorporating the alternative measures of fragmentation which characterises the government, both independently of and interacted with the numerical fiscal rules index. The most important implications of these results are that the more fragmented the government is the more optimistic are its budgetary projections relative to outturns unless the budget process is governed by strong numerical fiscal rules. In particular increases in the number of veto-players and the ideological distance between parties in government are associated with larger, negative projection errors, i.e. are found to coincide with greater optimism bias, but the positive coefficients on the interaction terms with the numerical rules index signifies that these institutional constraints serve to moderate the bias which stems from these sources. The point estimates suggest that a one standard deviation increase in the number of veto-players in government (in the absence of numerical fiscal rules) is associated with a projection error in the overall balance of -0.41%, whilst a similar increase in the ideological distance between the parties in government coincides with a projection error of -0.45%[13].

This point is confirmed visually by examining the estimated conditional marginal effects of increments in government fragmentation alongside conditional confidence intervals for these effects at the 5% and 10% level. The solid line in Figure 1-8 indicates how the marginal impact of changes in the number of veto-players in government varies with the strength of numerical fiscal rules in operation

[13] These marginal effects are calculated using the data presented in columns (3a) and (3b) of Table 1-4, the standard deviations in the measures of fragmentation are shown in Table 1-2.

at a national level; the dashed lines shows the 90% and 95% confidence intervals for these marginal effects. In-line with the results in Table 1-4, marginal increases in government fragmentation are associated with an optimism bias in official budgetary projections for a relatively wide range of values for the rules index. However, from values of the numerical fiscal rules index of around 0.40 onwards, somewhere between Germany (0.52) and Belgium (0.31), this marginal effect ceases to be statistically significant at conventional levels. Similar, results are presented in Figure 1-9 when considering the maximum ideological difference between parties in government, whereby marginal increases in government fragmentation is associated with an optimism bias in official budgetary projections for a relatively wide range of values for the numerical fiscal rules index (up to approximately 0.40) at the 5% level of significance.

Despite the two measures of government fragmentation being positively correlated with each other[14] I also examine a joint specification which includes both variables and their interaction with the numerical fiscal rules index. The results for this joint specification are provided in column (3c) of Table 1-4 and the associated marginal effects are plotted in Figure 1-10 and Figure 1-11. The principal results do not change substantively although the interaction term between the fiscal rules index and maximum ideological distance indicator is no longer significant at conventional levels and the value at which the plotted marginal effects cease to be significant is now lower for the ideological difference indicator (approximately 0.35).

[14] The correlation between the two variables is 0.49.

Table 1-4

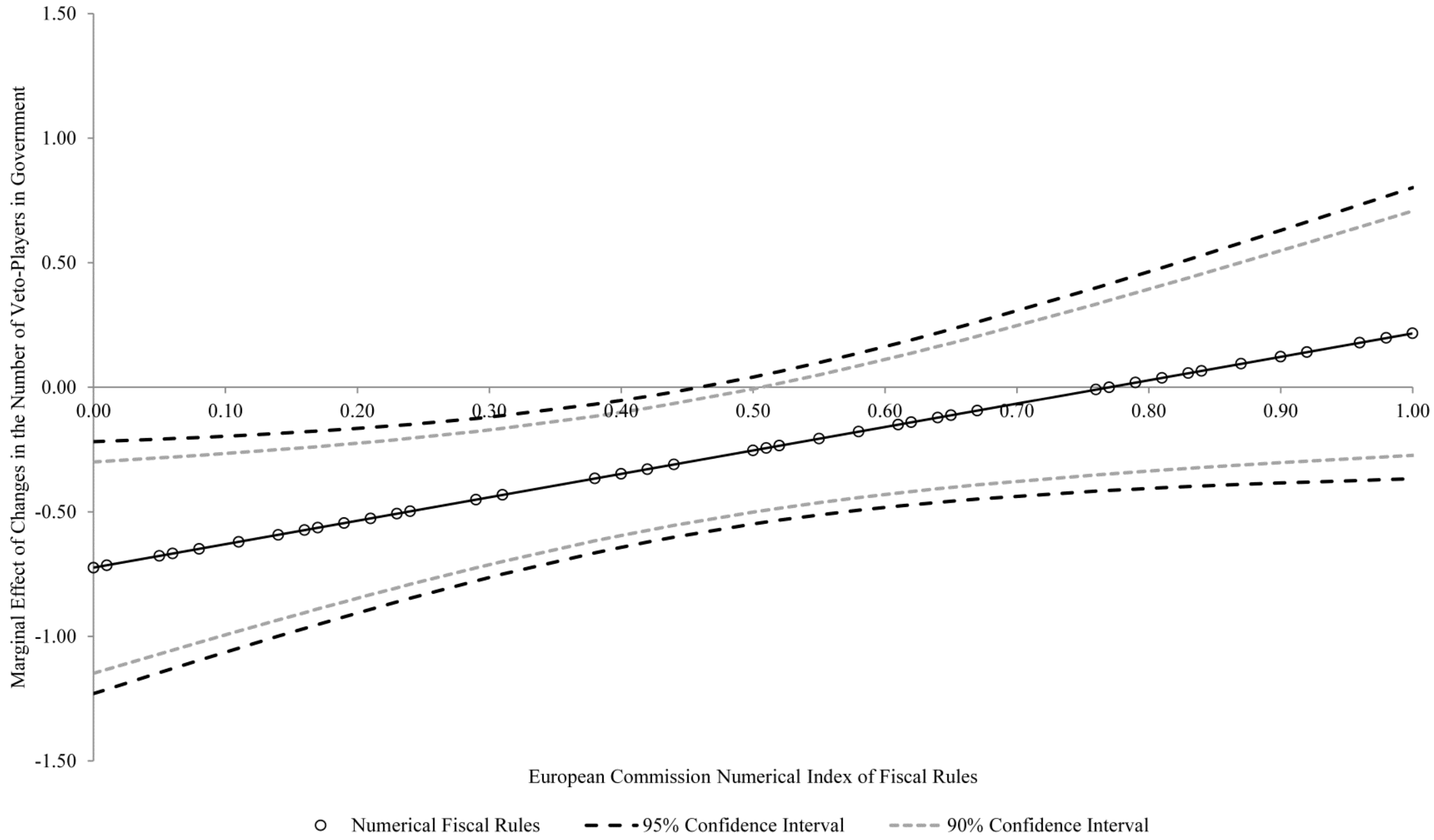
Political Fragmentation, Numerical Fiscal Rules and Two Year Cumulative Projection Errors: EU-14, 1998-2007

	Baseline	*Political Fragmentation*		*Interactive Specifications*		
	(1)	(2a)	(2b)	(3a)	(3b)	(3c)
Initial Fiscal Balance	- 0.66***	- 0.66***	- 0.79***	- 0.82***	- 0.71***	- 0.77***
	(0.13)	(0.13)	(0.14)	(0.12)	(0.13)	(0.12)
Statistical Revision (Base Effect)	- 0.63***	- 0.67***	- 0.67***	- 0.64***	- 0.63***	- 0.64***
	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)	(0.10)
Plan Ambition	- 0.51***	- 0.59***	- 0.63***	- 0.61***	- 0.56***	- 0.60***
	(0.13)	(0.14)	(0.14)	(0.14)	(0.13)	(0.14)
GDP Projection Error	0.58***	0.55***	0.52***	0.55***	0.52***	0.55***
	(0.09)	(0.11)	(0.10)	(0.10)	(0.10)	(0.11)
Changes in Government	- 0.40***	- 0.35**	- 0.33**	- 0.28**	- 0.32**	- 0.25*
	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)	(0.14)
Changes in Govt. Ideology	- 0.13	- 0.12	- 0.15*	- 0.15*	- 0.12	- 0.12*
	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Initial Gross Government Debt	- 0.02	- 0.014	0.0036	0.0041	0.014	0.01
	(0.02)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Magnitude of Excess Deficit	- 0.05	- 0.054	- 0.18	- 0.21	- 0.20	- 0.23
	(0.17)	(0.17)	(0.18)	(0.16)	(0.18)	(0.17)
Number of Veto-Players	-	- 0.17	- 0.26*	- 0.72***	-	- 0.61***
		(0.15)	(0.16)	(0.26)		(0.20)
Maximum Ideological Distance	-	- 1.04	- 0.67	-	- 2.63**	- 1.96**
		(0.74)	(0.69)		(1.04)	(0.83)
EC Fiscal Rules Index	-	-	2.14**	- 1.16	0.60	- 2.08
			(1.07)	(1.93)	(1.15)	(1.75)
*Rules * Veto-Players*	-	-	-	0.94**	-	0.87**
				(0.47)		(0.38)
*Rules * Max Ideological Distance*	-	-	-	-	3.03*	2.44
					(1.80)	(1.76)
Observations	101	101	101	101	101	101
Within-Groups R^2	0.74	0.75	0.76	0.77	0.76	0.77

Notes: **Significant at 10%. **Significant at 5%. ***Significant at 1%. Standard errors are reported in parentheses below each point estimate, these standard errors are calculated to be robust to arbitrary form heteroskedasticity and serial correlation up to 4 lags. All estimations are carried out using the stata command xtivreg2, see Schaeffer (2010) for further details. Both time and country fixed-effects are included in all specifications.*

Figure 1-8

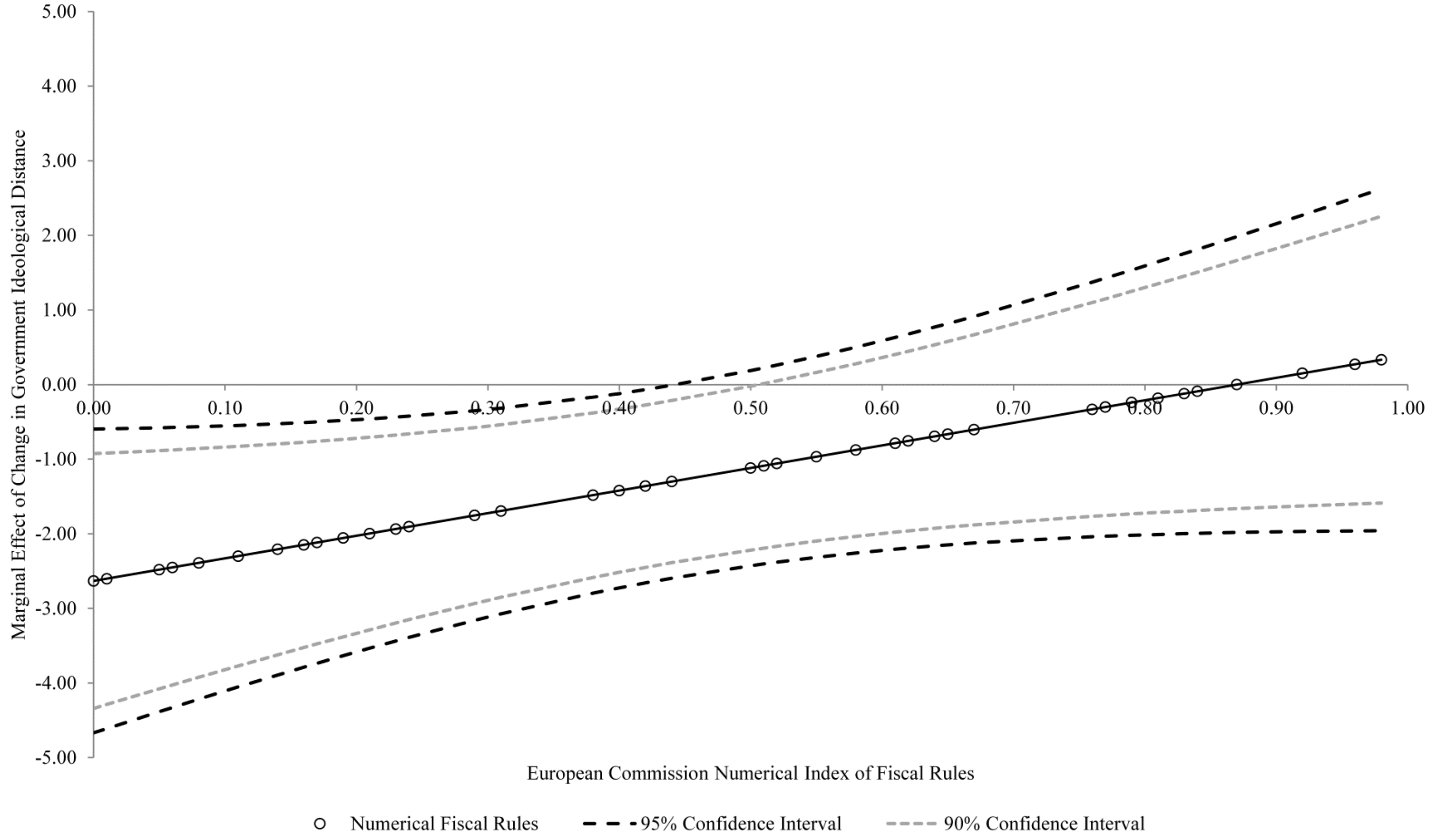
Interactive Marginal Effects: Changes in Number of Government Veto-Players and Numerical Fiscal Rules



Source: Author's Calculations based upon Table 1-4

Figure 1-9

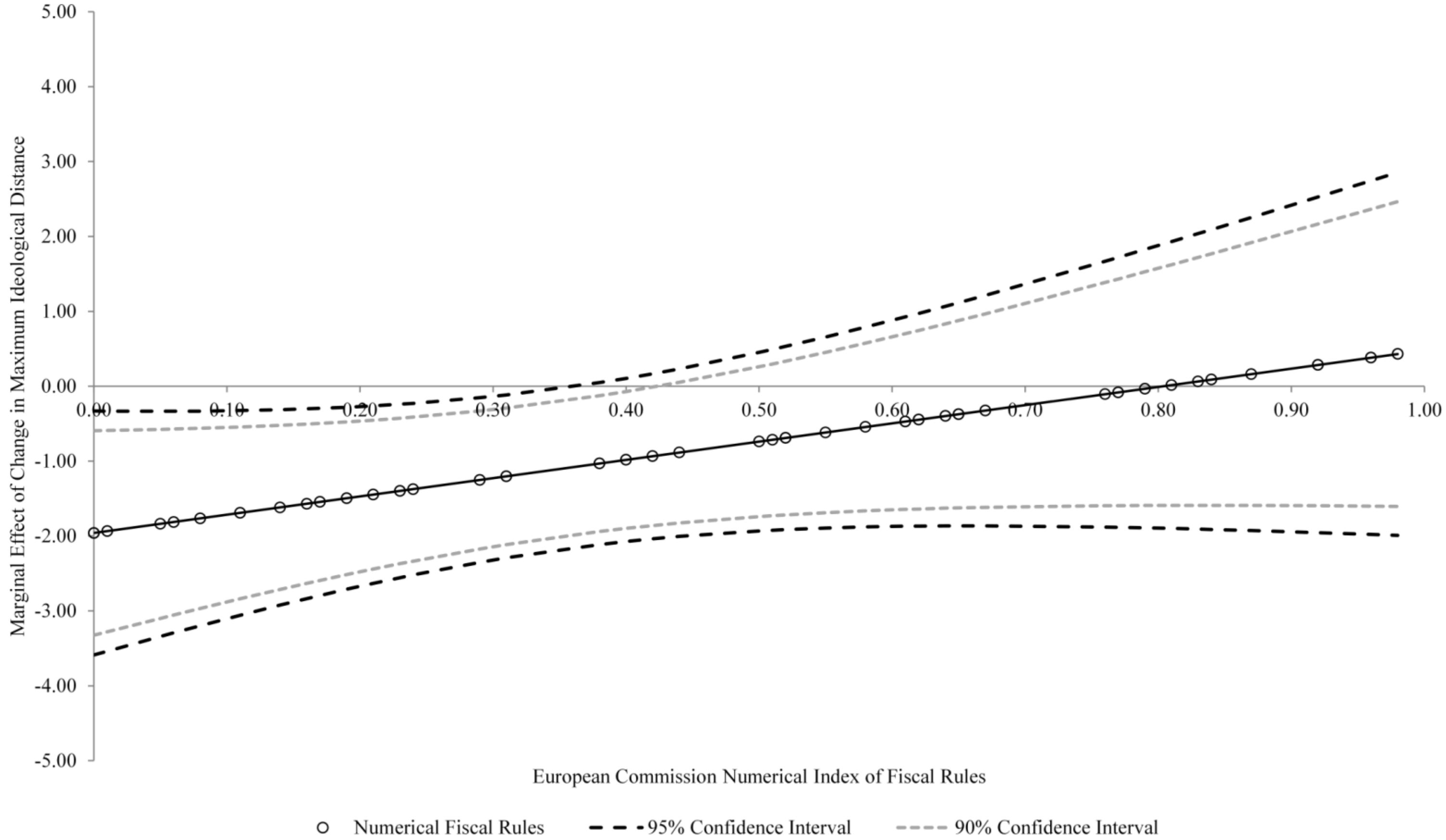
Interactive Marginal Effects: Change in Maximum Ideological Distance and Numerical Fiscal Rules



Source: Author's Calculations based upon Table 1-4

Figure 1-10

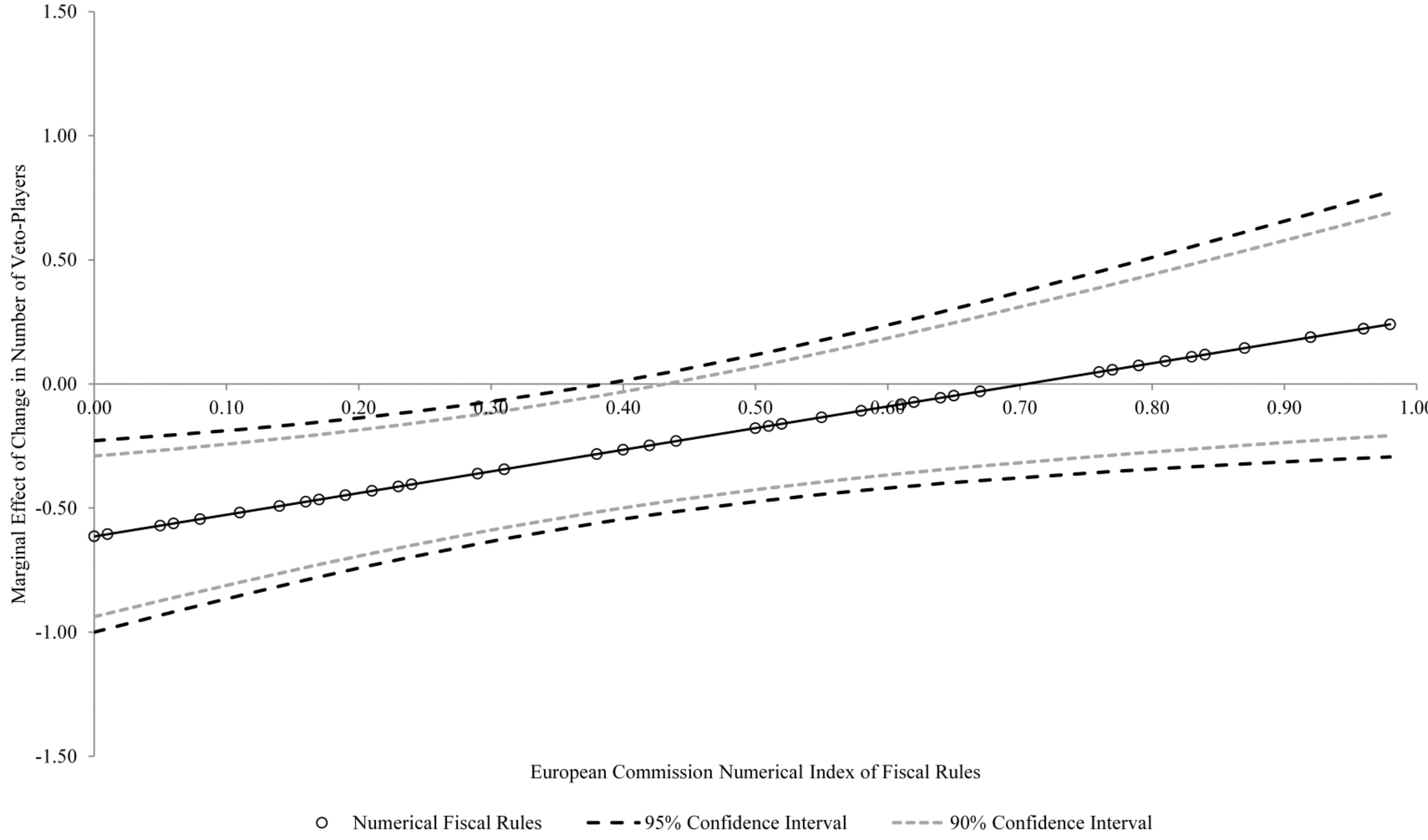
Interactive Marginal Effects: Change in Maximum Ideological Distance and Numerical Fiscal Rules, Joint Specification



Source: Author's Calculations based upon Table 1-4

Figure 1-11

Interactive Marginal Effects: Change in Number of Veto-Players and Numerical Fiscal Rules, Joint Specification



Source: Author's Calculations based upon Table 1-4

1.5.3. Tests of Robustness

I implement a series of tests to examine the robustness of my principal results. In the first instance I examine two alternative measures of government fragmentation; the first is calculated as the probability that two seats picked at random from the parties which form the government will be from different political parties and is sourced from the DPI database. I estimate a specification which includes this indicator as the exclusive measure of government fragmentation and its interaction with the fiscal rules index, I find that neither the coefficient on this indicator nor its interaction term to be significant at conventional levels. The second indicator is the effective number of parties in government, as per Laakso and Taagepera (1979), which I calculate as the reciprocal of the sum of squared seat shares across all parties represented in the government. I find that neither this indicator nor its interaction term with the fiscal rules index is significant at conventional levels. I believe these findings demonstrate the importance of allowing all political parties to influence the composition of the budget and its allocations regardless of their size, i.e. even small political parties in broader coalitions can potentially impact budgetary policy if the seats they hold are required in order to pass the budget.

I also examine the relative importance of time-variation in the fiscal rules index in comparison to government fragmentation in these results. To do so, I estimate two further specifications which either (i) fix the numerical fiscal rules index at the country-specific sample averages and allow the degree of government fragmentation to vary over the sample period, including an interaction term between these two variables, or (ii) fix the government fragmentation indicator at its sample average per country and allow the numerical fiscal rules index to vary over the sample period, again including an interaction term between these two variables. On the basis of this exercise I find that allowing for time-variation in the fiscal rules index appears to be important for reported results as the coefficient for this index and its interaction with the (time-invariant) indicator of government fragmentation are statistically significant at the 10% and 5% levels, respectively. In contrast they are not significant at conventional levels when I allow government fragmentation to vary in the sample but fix the value of the numerical fiscal rules at its country-specific average.

I also investigate whether changes in the fragmentation of the parties in opposition has any systematic influence on official budgetary projections, motivated by the work of Falcó-Gimeno and Jurado (2011). I re-estimate specification (3a) of Table 1-4 including a variable which measures the probability that two seats picked at random amongst the opposition will belong to different parties, as well as interacting this variable with the numerical fiscal rules index. The results indicate that increases in the fragmentation of opposition parties are associated with increases in the magnitude of optimism bias although such effects are also moderated by strong numerical fiscal rules. This suggests that a cohesive opposition can be effective in compelling national governments to stick to their announced budgetary plans, conversely, government may feel less obligated to stick to their announced budgetary target in the absence of a strong opposition, although it also appears that fiscal rules can counterbalance such effects and promote the production of unbiased budgetary projections.

1.6. Conclusions

The sovereign debt crisis has reaffirmed the perception that that harmonised budgetary policies amongst the members of a monetary union are vital for the on-going stability of such arrangements. Existing studies have argued that the institutional framework adopted by the EU to achieve this aim placed undue reliance on budgetary projections produced by national fiscal agencies. These studies have highlighted the relevance of these official projections in the context of alternative, predominantly political, motives which influence the actions of policy-makers and lead them to submit optimistic assessments of future budgetary developments, i.e. demonstrating that these projections are characterised by an optimism bias. Biases of this nature presumably undermine the credibility of national fiscal agencies and work against the efforts of the EC in monitoring and instilling fiscal discipline amongst member states.

Using a panel dataset of economic, political and institutional variables for 14 EU member states this chapter has presented evidence reconfirming that the official budgetary projections of 14 EU nations are (collectively) characterised by optimism bias, particularly at projection horizons beyond one year. The existing literature has then been extended by demonstrating that a systematic link exists between the magnitude of this optimism bias and the degree of fragmentation which characterises the government; whereby greater fragmentation of this type coincides with a tendency to submit more optimistic assessments of future budgetary circumstances. Numerical fiscal rules were also considered as one mechanism for improving the credibility of these projections and it has been shown that these forms of budgetary stricture are an effective means of reducing optimism bias which stems from these sources. Crucial to establishing this relationship is the inclusion of interaction terms between measures of government fragmentation and a quantitative index capturing the strength of numerical fiscal rules at a national level.

These results have considerable policy relevance. They demonstrate that the ability of numerical rules to improve the credibility of official budgetary projections is contingent upon the political contexts which they operate within. They therefore provide qualified support for the introduction of these rules at a national level in so far as they target the sources of political failure which are perceived to give rise to biases in fiscal policy-making. This evidence also cautions against placing excessive reliance on such institutional mechanisms in political circumstances which cannot be characterised as fragmented or where such fragmentation is unlikely to present on the basis of prevailing electoral rules. They also suggest that modifications to electoral systems which aim to promote greater democratic representativeness should be cognisant of the potential fiscal impact of such changes and therefore seek to moderate their budgetary influence through appropriate reforms to national fiscal institutions, e.g. accompanying such changes with the introduction of fiscal rules. My results also provide methodological guidance for future research into this topic, highlighting that studies which do not include interaction terms, of the kind presented here, risk overlooking relevant conditional effects and hence misinterpreting the effectiveness of fiscal institutions in promoting fiscal discipline.

Future research could examine the effectiveness of alternative forms of fiscal governance (Delegation and Contracts) in improving the credibility of official budgetary projections or to consider whether certain types of fiscal rules are more effective than others. Additionally, indicative evidence has been presented which identifies a link between the cohesiveness of the political parties in opposition and the magnitude of optimism bias in submitted budgetary projections. Further data could be gathered to investigate the importance of the opposition more thoroughly. Future work could also (i) consider the impact of the economic and sovereign debt crisis on the apparent forecasting biases in official budgetary projections produced by EU member states, (ii) consider separately positive and negative projection errors and analyse potential asymmetries in parameter estimates, and (iii) examine alternative sources of fiscal rules data and the impact on the principal results, e.g. the IMF database of fiscal rules. Finally, whilst the political unit of interest in this chapter has been the political parties which together comprise the government, it could be examined whether the number of spending ministers in the cabinet is systematically related to the presence of optimism bias and similarly to assess the effectiveness of fiscal rules in these contexts.

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Appendix A. Data Appendix

Table 1-5
Data Appendix

Variable	Units	Description	Time Period	Frequency	Source
Projection Error in Overall Fiscal Balances	%GDP	Difference between one-year and two-year cumulative projected and observed changes in the overall fiscal balance-to-GDP ratio.	1998 - 2007	Annual	EU Stability Programmes
Projection Error in Real-GDP Growth Rate	%, pa	Difference between one-year and two-year cumulative projected and observed real-GDP growth rates.	1998 - 2007	Annual	EU Stability Programmes
Initial Fiscal Balance	%GDP	Value of overall fiscal balance-to-GDP ratio at the end of year for the publication of budgetary projections.	1998 - 2007	Annual	EU Stability Programmes
Initial Gross Government Debt	%GDP	Value of general government gross debt-to-GDP ratio at the end of year for the publication of budgetary projections.	1998 - 2007	Annual	EU Stability Programmes
Excessive Deficit Indicator	%GDP	Absolute difference between the Initial Fiscal Balance and 3% of GDP budget deficit limit of the SGP.	1998 - 2007	Annual	EU Stability Programmes
Statistical Revision in Initial Fiscal Balance	%GDP	Difference between Initial Fiscal Balance and its revised value over one-year or cumulated over two-years.	1998 - 2007	Annual	EU Stability Programmes
Plan Ambition	%GDP	The projected change in the Overall Fiscal Balance-to-GDP ratio.	1998 - 2007	Annual	EU Stability Programmes
Changes in Government	-	The number of changes in government subsequent to the publication of the budgetary projections.	1998 - 2007	Annual	Comparative Political Database
Government Gap	-	The difference in left-to-right ideology between the previous government and that which replaces it.	1998 - 2007	Annual	Comparative Political Database
Maximum Ideological Difference	-	The maximum difference in left-to-right ideological scores between the parties in government.	1998 - 2007	Annual	Comparative Manifesto Project and the Database of Political Institutions
Number of Veto-Players in Government	-	The number of political parties able to veto the approval of the budget in parliament.	1998 - 2007	Annual	Database of Political Institutions
Numerical Fiscal Rules Index	-	Numerical Index measuring the strength of numerical fiscal rules at a national level.	1998 - 2007	Annual	European Commission

Chapter 2

Default Risk Premia on EMU Sovereign Debt: Systematic Default Risk & Fiscal Indicators

"...diversification enables the investor to escape all but the risk resulting from swings in economic activity - this type of risk remains even in efficient combinations. And, since all other types can be avoided by diversification, only the responsiveness of an asset's rate of return to the level of economic activity is relevant in assessing *its risk."*

William F. Sharpe (1964)

2.1. Introduction

One of the principal tenets of modern asset pricing theory states that the risk premium a financial asset commands is determined by its exposure to systematic risk, i.e. risk which cannot be eliminated through diversification; see Sharpe (1964), Lintner (1965), Merton (1973) and Ross (1976). In theory, knowledge of the magnitude of systematic risk each asset represents should be sufficient to explain observed dispersion in the prices of such securities, with other asset specific characteristics contributing no additional explanatory power. These propositions contrast with the approach adopted by existing empirical studies which have utilised country-specific fiscal indicators, e.g. public debt-to-GDP and budget deficit-to-GDP ratios, to explain financial market pricing of default risk across alternate sovereign issuers and thereby overlook the potential importance of systematic risk factors in the explaining the pricing behaviour of financial markets.

This chapter examines whether measures of systematic default risk are sufficient to explain pricing disparities on long-term sovereign debt securities issued by EMU member states and contrasts the explanatory power of these measures with conventional fiscal indicators. With this aim, excess returns on these securities are calculated as the difference between their monthly total returns and those of a comparable German benchmark security, adopted as (a proxy for) the risk-free rate. These calculations are conducted over a period of January 1999 to June 2012 and therefore include a significant portion of the recent sovereign debt crisis. The magnitude of systematic default risk each issuer represents is estimated as the sensitivity of their excess returns to common factors which approximate aggregate default risk; this sensitivity is referred to as an issuer's default beta. Two empirical methodologies are then employed to examine the ability of these default betas to characterise differences in excess returns across issuers and to compare their explanatory power with country-specific fiscal indicators which have been utilised in existing empirical studies to measure sovereign default risk.

The first methodology (the *portfolio approach)* involves constructing ranked portfolios of EMU sovereign debt by sorting issuers on the basis of either their default betas or the observed values of the fiscal indicators. The properties of these ranked portfolios are then compared to examine the ability of these variables to explain differences in excess returns across issuers and to understand how these variables are themselves related. On the basis of this approach I find that portfolios constructed so as to contain securities issued by sovereign nations exhibiting weaker fiscal positions are characterised by high default betas, with the converse also being true. These results demonstrate that default betas and fiscal indicators embody similar types of risk.

Using the portfolio methodology it is also found that the variation shared by default betas and fiscal indicators help to understand the relative pricing of these securities in sample periods which both include and exclude the sovereign debt crisis. When considering a period running from January 1999 to December 2007 it is found that a portfolio comprised of debt securities issued by nations representing greater default risk (measured on the basis of either default betas or the fiscal indicators), earned a statistically significant risk premium of between 0.18% and 0.24% per annum in comparison to a portfolio of securities issued by nations representing lower default risk. Default betas are also found to be systematically related to sovereign bond returns over a longer sample period which includes events relating to the recent EMU sovereign debt crisis. In this case, a portfolio containing securities issued by sovereign nations with high default betas is characterised by relative losses of between 3.62% and 4.70% per annum when compared to portfolios containing the securities of issuers with lower default betas. In contrast, the differences in return between alternative portfolios constructed by ranking issuers using the fiscal indicators are not statistically different from zero in this longer sample period. These results establish a role for both measures of systematic default risk and fiscal indicators in the pricing of long-term EMU sovereign debt and provide some evidence that default betas should be preferred to fiscal indicators in characterising excess returns over sample periods which include the recent sovereign debt crisis.

The findings of the portfolio approach are supplemented by running cross-sectional regressions of excess returns on default betas and the fiscal indicators, following the approach pioneered by Fama and Macbeth (1973). Using this methodology the economic and statistical relevance of systematic default risk in the pricing of EMU sovereign debt is examined both independently of, and alongside, the fiscal indicators. The results obtained via this method are similar to those obtained via the portfolio approach. When considering a sample period running from January 1999 to December 2007 it is demonstrated that countries which represented greater default risks, i.e. higher debt-to-GDP ratios, budget deficit-to-GDP ratios and default betas, commanded a, statistically significant, risk premium of between 0.16% and 0.19% per annum although no clear evidence is found to suggest favouring default betas over the fiscal indicator in explaining the dispersion in excess returns for this sample period. The best performing empirical specification (highest average R^2) contains both forms of variable despite neither type being statistically significant at conventional levels. Considering longer time periods which include the sovereign debt crisis, the results presented provide only weak evidence to suggest a preference for default betas over fiscal indicators when seeking to characterise observed differences in excess returns. In this extended sample, issuers exhibiting higher systematic default risks are characterised by relative losses of between -2.06% and -2.60% per annum in comparison to issuers which represent lower levels of default risks, although again the best performing specification, in terms of average R^2, includes both default betas and budgetary fundamentals.

Both methodologies also provide evidence that the Yield-To-Maturity (YTM) of a sovereign bond conveys information relevant for explaining cross-sectional differences in excess returns. There is a statistically significant relationship between a bonds YTM and these returns both in a portfolio sense and as indicated by the cross-sectional regressions. As noted by Gebhardt et al. (2005) a bond's YTM can be regarded as a catch-all variable for other influences in relative bond pricing, such as differences in liquidity or tax treatment. When included in the cross-sectional regressions alongside the fiscal indicators and defaults betas it is found that, on average, 53% of the cross-sectional variation in one-month ahead excess returns can be explained over a sample period from January 1999 to December 2007 and up to 62% when the sample period is extended to June 2012.

Overall, this chapter contributes to an existing literature which examines the relevance of systematic risks in asset pricing by expanding such topics to consider the relative default risks which exist amongst the issuers of EMU sovereign debt. The results presented provide new evidence which establish a role for both fiscal indicators and systematic default risk in the pricing of sovereign debt securities in sample periods which both include and exclude the recent sovereign debt crisis. However, the most robust finding of this chapter is that overlaps exists between measures of systematic default risk and conventional fiscal indicators in approximating the default risks of alternate sovereign issuers, this finding highlights potential difficulties in attempts to identify distinct risk premia for such variables.

The rest of this chapter is structured as follows. In Section 2.2, I present the asset pricing theory which provides the basis for my empirical work and that of the existing literature. Section 2.3 reviews studies from an existing literature which empirically examines default premia in the markets of corporate and government bond in the US and EMU. Section 2.4 reports summary statistics for my dataset, outlines the procedure adopted in estimating systematic default risk and examines the correlation structure of the excess returns series using principal component analysis. In Section 2.5 I explain the portfolio method and present associated results. In Section 2.6 I outline the Fama and Macbeth (1973) cross-sectional methodology and discuss the results obtained via this method before finally concluding in Section 2.7.

2.2. Asset Pricing Theory and its Empirical Application

One of the principal tenets of modern asset pricing theory states that the risk premium a financial asset commands is determined by its exposure to systematic risk, i.e. risk which cannot be eliminated by diversification; see Sharpe (1964), Lintner (1965), Merton (1973) and Ross (1976). Knowledge of other asset-specific characteristics should, in theory, exhibit limited marginal explanatory power over the returns on financial assets when considered alongside measures of systematic risk. The purpose of this section is to provide theoretical support for these propositions which serve as the basis for the empirical analysis conducted in subsequent sections.

2.2.1. The Stochastic Discount Factor Representation of Asset Pricing

As outlined by Cochrane (2005) nearly all models of asset pricing can be regarded as specialisations of a general discount factor model where the current price of an asset (p_t) equals the expected discounted value of its future payoffs (x_{t+1}), it is advocated that a valuable framework in this context is the *Stochastic Discount Factor* (SDF) representation of asset pricing. The SDF framework is perceived as particularly useful given that prominent asset pricing models can be regarded as specialisations of its general form (e.g. the CAPM, APT and I-CAPM), it applies universally across asset classes, and the requirement for only a minimal number of assumptions in its derivation.

Central to the SDF representation, and any model of asset pricing, is the notion that financial securities represent claims to both risky and delayed payoffs, therefore when attempting to value financial securities it is necessary to account for both of these features. The SDF representation does so through its central pricing equation which is outlined in equation (2-1):

$$p_t = E_t[m_{t+1} \cdot x_{t+1}] \tag{2-1}$$

where

$$m_{t+1} = \delta \frac{u'(c_{t+1})}{u'(c_t)} \tag{2-2}$$

m_{t+1} denotes the SDF which captures the rate at which investors are willing to substitute consumption at time t (c_t) for consumption in time $t+1$ (c_{t+1}), x_{t+1} is the asset's payoff in period $t+1$ and $u'(\cdot)$ is the first derivative of the investor's utility function. In terms of its economic content, the SDF measures the ratio of the marginal utility of consumption in period $t+1$ to period t multiplied by the investor's subjective rate of time preference, δ, which captures time impatience. Equation (2-1) is derived from, and therefore retains the properties associated with, standard first order conditions for an optimum, which in this context implies that: an investor will continue to buy an asset so long as the loss in utility from doing so, in terms of time t consumption, is less than the increase in (discounted and expected) utility associated with the additional consumption obtained from a further unit of the asset's payoff in the following period, $t+1$.

As argued by Cochrane (2005), all asset pricing models amount to alternative ways of connecting the SDF to data and thereby represent attempts to model the growth in the marginal utility of consumption and time-impatience of investors. A few simple manipulation of equation (2-1) can be conducted to derive the *expected return – beta representation* of asset pricing, a common starting point for a considerable amount of empirical analysis in the finance literature. Dividing equation (2-1) by the current price of the asset (p_t) provides an expression in terms of gross return[15] between periods t and $t+1$, which is denoted by R_{t+1}:

$$1 = E_t(m_{t+1} \cdot R^i_{t+1}) \tag{2-3}$$

applying the following covariance decomposition, $cov(m,x) = E(mx) - E(m)E(x)$ and substituting in the following expression for the risk-free rate[16], $R^f = {}^1/_{E(m_{t+1})}$, equation (2-3) can be rearranged as follows:

$$1 = E(m_{t+1}) \cdot E\left(R^i_{t+1}\right) + cov(m_{t+1}, R^i_{t+1}) \tag{2-4}$$

alternatively

$$E\left(R^i_{t+1}\right) - R^f = -R^f cov(m_{t+1}, R^i_{t+1}) \tag{2-5}$$

equation (2-5) outlines that that the expected return of asset i in excess of the risk-free rate is proportional to (minus) the covariance of its gross rate-of-return with the SDF. Intuitively, assets which pay a high return in good times (when investors already have a high level of consumption) and pay a low return in bad times (when consumption is low), must offer an expected return in excess of the risk-free rate in order to be held, i.e. a positive risk premium $\left(E\left(R^i_{t+1}\right) - R^f\right) > 0$. Assets which have zero covariance with the SDF, i.e. those which have no systematic risk, yield no

[15] Gross returns are commonly used across the empirical finance literature instead of prices given they can typically be regarded as stationary and, unlike prices, meaningful averages can be taken across securities.

[16] Given the risk free rate (denoted by R^f_{t+1}) is known ahead of time:

$1 = E_t(m_{t+1} \cdot R^i_{t+1})$ can be written as $1 = E_t\left(m_{t+1} \cdot R^f_{t+1}\right) = E_t(m_{t+1}) \cdot R^f_{t+1}$ as shown.

risk correction regardless of how volatile their individual returns might be. Through some further rearrangements this risk premium can be decomposed as follows:

$$E\left(R_{t+1}^{i}\right) - R^{f} = \frac{cov\left(m_{t+1}, R_{t+1}^{i}\right)}{var(m_{t+1})} \cdot -var(m_{t+1}) \cdot R^{f} \tag{2-6}$$

equivalently

$$E\left(R_{t+1}^{i}\right) = R^{f} + \beta^{i} \cdot \lambda_{t} \tag{2-7}$$

where

$$\beta^{i} = \frac{cov\left(m_{t+1}, R_{t+1}^{i}\right)}{var(m_{t+1})} \tag{2-8}$$

and

$$\lambda_{t} = -\left(\frac{var(m_{t+1})}{E(m_{t+1})}\right) \tag{2-9}$$

equation (2-7) indicates that the gross expected return of asset i in excess of the risk-free rate can be captured by two components. The first is its degree of systematic risk,β^{i}, measured as the covariance of its expected gross return with the SDF scaled by the variance of the SDF, and the second, λ_{t}which is common across all assets. λ_{t} is frequently referred to as the price of risk and β^{i} as an asset's quantity of risk, or its *beta.*

Understanding and measuring the sources of aggregate risk which drive the returns on assets is the central objective of asset pricing. Considerable amounts of empirical work in this area are cast in terms of expected return-beta representations of factor models, such as equation (2-7), where factors are selected on the basis of being plausible approximations of the growth in investor's marginal utility, and proceeding on the basis that the consumption based expression equation (2-2) can be approximated by a linear factor structure of the following general form:

$$m_{t+1} = \delta \frac{u'(c_{t+1})}{u'(c_t)} \approx a + b' f_{t+1} \tag{2-10}$$

where a and b are parameters to be estimated and f_{t+1} are the factors which approximate the growth in marginal utility. In many economic models consumption is assumed to be some combination of: the returns on broad portfolios of financial assets, interest rates, economic growth rates, other macroeconomic variables such as investment, or indicators which forecast such variables, such as the slope of the yield curve. They therefore either reflect or predict the overall state of the economy and capture particularly bad states of nature during which an investor would be willing to trade off some of their overall average returns to ensure that their consumption does not suffer too much in these bad states. These variables can therefore be considered as approximations for, or forecasts of, an investor's consumption. Equation (2-7) can also be considered in the following multi-beta form:

$$E_t(R^i) = \gamma + \beta' \lambda \tag{2-11}$$

where β denotes (multiple) regression coefficients derived by regressing asset-specific returns, or portfolios containing such assets, on the selected factors, and γ and λ are parameters to be estimated. In the case of the conventional CAPM a single factor is used, the rate of return on the wealth portfolio, frequently approximated by the returns on broad based equity market indices, such as the S&P 500, in excess of a short-term government interest rate. Whilst alternative models of asset pricing, including the Intertemporal-CAPM (I-CAPM) of Merton (1973), consider multiple factors (also known as state variables) which are selected on the basis that they forecast changes in asset returns or the income of the investor, e.g. projections of GDP growth, inflation rates, changes in unemployment rates and variation in the term structure of interest rates.

2.3. Existing Empirical Evidence

The preceding section presented a simplified model of asset pricing which provides a conceptual basis for existing literatures that analyse the returns on financial assets and relate such returns to alternative measures of systematic risk. Despite its applicability across asset classes, the empirical application of asset pricing theories encapsulated by the SDF representation have principally focused on characterising the returns of ordinary shares, or common stock. Studies which apply such principles in the context of other asset classes are relatively scarce in comparison, e.g. corporate and government bonds.

The work presented in this chapter relates excess returns on long-term EMU sovereign debt to measures of systematic default risk and country-specific indicators of overall fiscal solvency which are based upon national budgetary fundamentals. This analysis is therefore connected with existing literatures which analyse the common risk factors that drive the returns on government and corporate bonds as well as that of a separate literature which examines differentials in the YTM on long-term EMU sovereign debt and seeks to explain such disparities using country-specific indicators. This section provides a review of studies from both literatures.

2.3.1. Empirical Finance Literature: Excess Returns & Systematic Risk

Existing empirical evidence demonstrates that corporate bonds share a high degree of common variation which reflects their exposure to alternative forms of aggregate risk which investors face but cannot diversify away. It therefore frequently demonstrated that the returns on these securities can be represented by a relatively parsimonious empirical specification which includes two factors which approximate default and term risk.

In consideration of monthly excess returns for portfolios of US government and corporate bonds, Fama and French (1993) find that a high proportion of the observed variation in the returns on these portfolios can be captured by factors which reflect unanticipated changes in interest rates (a term factor) and fluctuations in the economic conditions which alter the likelihood of an issuer defaulting on its outstanding obligations (a default factor). The term factor is estimated as the difference between long and short-term interest rates on US government bonds and the default factor by the difference in return on long-term US government bonds and that on a long-term index of US corporate bonds.

Gebhardt et al. (2005) examine a broad sample of US corporate bonds and similarly employ a two factor model with each factor reflecting either aggregate term or default risk. They demonstrate the relevance of these factors for explaining cross-sectional differences in the returns on portfolios containing these assets as well as individual securities. They extend the literature by considering how these measures of systematic default and term risks fare against individual security characteristics (a bond's Macaulay duration and its issuer's credit rating) in explaining the cross-section of corporate bond returns by employing both Fama and Macbeth (1973) cross-sectional regressions and a portfolio methodology. They conclude that default betas are better at explaining these returns in comparison to an issuer's credit rating but find only weak evidence in support of term betas over a bond's Macaulay duration. Lin et al. (2011) also employ a multi-factor pricing model which includes the original Fama and French factors to study excess returns on US corporate bonds, they find that these factors are significant in characterising corporate bonds returns alongside a liquidity factor.

Further evidence which suggests that variation in the returns on corporate bonds capture aggregate risks is presented by Collin-Dufresne et al. (2001) who investigate changes in US corporate bond credit spreads. They present evidence that only a small proportion of the variation in credit spreads can be captured by firm-specific factors as implied by structural models of default and conclude that credit spreads are driven by risk factors which are common across all corporate bonds. Similar evidence is presented by Elton et al. (2001) who demonstrate that the majority of the spread between corporate and government bonds reflects compensation for bearing systematic risks.

Whilst the aforementioned studies have focused exclusively upon US bond pricing there is now a nascent literature which has extended consideration of such topics to the market for Euro denominated corporate bonds. With this aim Klein and Stellner (2013) analyse the excess returns on corporate bonds in the Euro area from 1999 to 2010 using a multi-factor pricing model which includes term, default and alternative broad market factors (motivated by the CAPM). They document the properties of betas estimated using these factors and find them to be relevant for corporate bond pricing in the Euro area, they also suggest that their work could be extended by considering European government bonds. In a similar manner, Aussenegg et al. (2013) employ a multi-factor model to examine common risk factors in the markets for Euro denominated corporate bonds, contrasting the explanatory power of such factors for excess returns before and following on from the financial crisis. They extend the literature by incorporating factors which reflect supplementary dynamics in interest rate and default term structures and their results confirm a role for both default and term factors in the pricing of EMU corporate bonds.

Overall the evidence presented by this segment of the empirical finance literature establishes that there is a significant degree of common variation in the excess returns on US and EMU corporate bonds. Furthermore, it has been demonstrated that the variation in these returns can be captured by a multi-factor model where particular emphasis is attributed to two risk factors, each with a specific economic interpretation. The first is linked to unexpected changes in interest rates, or the term structure, and the second to changes in default probabilities associated with fluctuations in overall economic conditions. In the case of the US there is also evidence that the characteristics of a bond, such as its duration and credit rating, are correlated with measures of systematic default and term risk, and that estimates of the sensitivity of bond returns (or portfolios of these securities) to these aggregate factors perform better than asset-specific characteristics when attempting to explain observed cross-sectional disparities in returns.

2.3.2. Existing Empirical Evidence on EMU Sovereign Default Risk Premia

There is now a large empirical literature which examines differences in the YTM on long-term debts of sovereign nations and attempts to relate such differences to country-specific characteristics which reflect relative default risks across issuers. Such studies have grown in both prominence and relevance following on from events associated with the recent sovereign debt crisis and have principally focused upon debt securities issued and guaranteed by member states of the EMU.

One prominent finding of this literature is that there is significant amount of joint variation in yield differentials across sovereign issuers and that this shared variation can be captured by global risk factors. Early analysis of this manner is presented by Codogno et al. (2003) who examine YTM and swap spreads on EU sovereign debt over the period of 1999 to 2002. They demonstrate that these spreads are characterised by a high degree of common variation across issuers and find that this variation is related to risk premia on other financial market assets, notably, the spread in YTM on US corporate bonds and US Treasuries. Debt-to-GDP ratios are found to matter in explaining these yield differentials but only when interacted with the global risk factor and for certain countries, i.e. country specific indicators are found to exhibit limited unconditional explanatory power over YTM spreads in the EU. For the same sample period, Geyer et al (2004) also provide evidence that developments in YTM spreads on EMU sovereign debt are strongly related to corporate bond spreads in the euro area. They interpret this credit spread as approximating aggregate default risks and hence conclude that default risk is an important component of yield spreads on EMU government bonds.

For a more recent sample period which ends in 2010 and in consideration of a broader sample of sovereign issuers from both advanced and developing countries, Longstaff et al. (2011) employ principal component techniques and panel regressions to examine variation in sovereign Credit Default Swap (CDS)[17] premia. In-line with other studies they demonstrates a high degree of joint variation in measures of default risk across sovereign issuers and that a high proportion of such variation can be captured by global risk factors which are linked to US stock and high-yield bond markets.

In a sample which also includes the financial crisis period von Hagen et al. (2011) analyse yield spreads on EMU debt. They find that the spread between BBB rated US corporate bonds and US Treasuries was a significant determinant of EMU yield spreads during the crisis period, particularly from the collapse of Lehman Brothers in September 2008; they suggest that their findings demonstrate a role for increased risk aversion amongst financial market investors in driving spreads following on from this point. Their results are also notable due to the inclusion of interaction terms between a BBB credit spread and country-specific fiscal indicators; they demonstrate that these interaction terms are significant following on the collapse of Lehman Brothers. Similarly Barrios et al. (2009), Haugh et al. (2009) and Favero and Missale (2012) identify a significant role for interaction terms between budgetary fundamentals and alternative global risk factors when seeking to explain yield differentials on EMU sovereign debt in samples which include the early crisis period, whilst Attinasi et al. (2009) and Sgherri and Zoli (2009) find that common risk factors were important in driving spreads across the EMU in sample periods

[17] Credit Default Swaps are a form of derivative instrument for which its buyer will be compensated for losses incurred in the event of a default or other credit event stipulated by the terms of the agreement.

which include the financial crisis but that only a limited influence is exerted by country-specific fiscal indicators.

Across the studies considered there is a limited degree of empirical evidence to suggest that fiscal indicators exert a significant influence over sovereign default premia when considered independently from global risk factors, i.e. the coefficients on these variables are either not statistically distinguishable from zero or can only account for a small proportion of the variation in measures of default premia. The apparent lack of any compelling evidence to suggest that sovereign default premia reflect national budgetary circumstances has led some to question the efficacy of financial markets in pricing sovereign default risk; Favero and Missale (2012) and De Grauwe and Ji (2012) are examples of recent studies which have argued that markets mispriced the risks associated with holdings of sovereign debt in periods both prior to the crisis and following on from this point.

2.4. Data and Methodology

2.4.1. Sample Details

To examine the nature of the relative default risks posed by EMU sovereign issuers this chapter compares the returns on monthly investments in the long-term debt of ten sovereign issuer to that of an equivalent benchmark security of the German government, adopted as (a proxy for) the risk free rate. The government bond data are taken from Reuters Datastream, cover the period of January 1999 to June 2012 and includes sovereign debt issued by Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain. The sample period starts in 1999 at the launch of the European Monetary Union for all countries considered aside from Greece (joining subsequently in January 2001 and is therefore excluded from the analysis until this point) and encompasses events relating to the recent financial and sovereign debt crisis.

I restrict consideration to EMU sovereign nations and this sample period given these countries shared a common currency over this time. This eliminates the need to disaggregate risk premia associated with default risk from those which could be related to other factors, most notably currency risk. Controlling for currency risk would be necessary in a broader sample of countries or by including observations prior to January 1999, when sovereign debts across these nations were issued in local currencies. An alternative approach could be adopted by utilising CDS; however as a relatively new form of financial instrument this would shorten the length of the time series that could be considered.

The returns on EMU sovereign debt are calculated using monthly total return indices for ten-year benchmark bonds made available on Reuters Datastream. These total return indices are based upon single bonds which are selected to be the most representative security within this maturity band at each point in time. In general the benchmark bond is the latest issue but consideration is also given to the issue's yield, liquidity, issue size and coupon; see Thomson Reuters (2010). The formula adopted for calculating the total returns indices (TRI) is as follows

$$TRI_{i,t} = TRI_{i,t-1} \frac{P_{i,t} + A_{i,t} + G_{i,t}}{P_{i,t-1} + A_{i,t-1}} \qquad (2\text{-}12)$$

$$TRI_{i,0} = 100$$

where $P_{i,t}$ denotes the clean price of the bond in time t, $A_{i,t}$ is the accrued interest payable to the bond holder following the ex-coupon date[18], and $G_{i,t}$ the value of any coupons received from period $t-1$ to t. The gross returns on the debt of each sovereign issuer (i) and for each month[19] (t) are calculated as follows

$$Return_{i,t} = \frac{TRI_{i,t}}{TRI_{i,t-1}} - 1 \qquad (2\text{-}13)$$

and excess returns are calculated as the difference between the return on each nation's benchmark debt and that on an equivalent investment in a benchmark securities issued and guaranteed by the German Government ($Return_{Ger,t}$)

$$Excess\_Return_{i,t} = Return_{i,t} - Return_{Ger,t} \qquad (2\text{-}14)$$

[18] The clean price plus accrued interest is referred to as the "dirty price" of a bond.

[19] Where an annualised return is referred to this is calculated using monthly returns as $(1 + Return_{t,i})^{12} - 1$

In addition to excess returns the dataset also consists of annual data on budgetary fundamentals (budget deficits and outstanding government debts, both as a ratio of GDP), monthly averages of the YTM on ten-year benchmark debt for each issuer and monthly total return data for Euro and US dollar denominated corporate bonds indices. The country-specific fiscal indicators were sourced from the European Commission's annual macro-economic database, AMECO, whilst the additional financial market data is taken from Reuters Datastream. Details of all variables used are provided in Table 2-12 of Appendix A.

Two default factors are utilised to approximate aggregate default. The first is the difference in monthly total return on a broad index of EMU BBB corporate bonds and that of a comparable AAA-AA index; both with a base currency of Euros. The second is the difference in monthly return on a broad index of US BBB corporate bonds and that of a comparable AAA-AA index; with a base currency of US dollars. Monthly total returns for each index are calculated in a similar fashion to that for benchmark sovereign debt although the corporate bond indices are maintained by Bank of America-Merrill Lynch and made available for download via Datastream[20].

This choice of default factors is motivated by the empirical literature which examines the relative returns on corporate bonds. Evidence from this literature suggests that risk premia on corporate bonds of different issuers share a significant degree of variation and that this variation can be approximated by observed differences in the returns on broad indices of corporate bonds. However, whilst

[20] Details on the rules and methodology adopted to construct these indices are available at http://www.mlindex.ml.com/

several studies utilise data on US corporate bonds I also calculate a separate default factor based upon indices of EMU corporate bonds.

A factor related to unexpected changes in interest rates, or term risk, is not included. This chapter focuses principally upon explaining cross-country differences in the excess returns on sovereign debt securities on the basis of the degree of default risk each issuer represents. The analysis presented therefore focuses exclusively on ten-year benchmark bonds during the sample period and does not consider other points on the term structure. Whilst expanding beyond the ten-year point would increase the sample size it would also necessitate that risk corrections are carried out to isolate default from term premia and hence serve to distract from the central focus of study.

2.4.2. Summary Statistics: Excess Returns, Default Factors & Budgetary Fundamentals

Table 2-1 outlines summary statistics for excess returns on ten-year EMU sovereign debt over the following time periods: January 1999 to December 2007, January 1999 to September 2009 and January 1999 to June 2012. The first period runs from the launch of the EMU in January 1999 up to December 2007, a period during which markets are adjudged to have only loosely discriminated across sovereign issuers in terms of the default risk they represented, see De Grauwe and Ji (2012). The second period includes data relating to the global financial crisis and ends in September 2009, whilst the final period covers the EMU sovereign debt crisis until June 2012 when the European Central Bank pledged large-scale liquidity support to EMU sovereign issuers in the form of Outright Monetary Transactions (OMT).

I consider initially summary statistics for the period of January 1999 to December 2007. The (equally weighted) average excess return on EMU sovereign debt over this period was 0.035% per month or approximately 0.42% per annum[21]. On the basis of a standard deviation of 0.25% I reject the null hypothesis that this excess return is equal to zero based upon a conventional t-test. Excess returns are positive across all issuers and statistically significant at conventional levels in the cases of Austria, Belgium, Greece, Portugal and Spain. The issuer with the largest excess returns over this period is Greece, 0.072% per month or 0.87% per annum. The smallest average excess return is that of France which is 0.005% per month, or 0.06% per annum, and for which I cannot reject the null that this value is equal to zero.

[21] For reference, the average monthly total return on ten-year German benchmark debt was 0.40% per month, or 4.97% per annum for this period and 0.44% per month (4.42% per annum) over the full sample period of January 1999 to June 2012.

Table 2-1

Summary Statistics for Monthly Excess Returns on Ten-Year EMU Sovereign Debt

Sample Period & Issuer	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Autocorrelation		
						Lag 1	Lag 2	Lag 12
January 1999 - December 2007								
Austria	0.036%	0.20%	-0.84%	0.78%	108	-0.095	0.016	-0.205
Belgium	0.039%	0.20%	-0.66%	0.69%	108	-0.172	0.043	0.012
Finland	0.021%	0.19%	-0.70%	0.64%	108	-0.172	-0.055	0.077
France	0.005%	0.34%	-1.68%	1.04%	108	-0.441	0.309	0.020
Greece	0.072%	0.25%	-0.66%	0.86%	84	0.076	-0.103	0.134
Ireland	0.028%	0.25%	-0.84%	0.78%	108	-0.217	-0.079	-0.042
Italy	0.035%	0.25%	-0.75%	0.65%	108	-0.227	-0.008	0.045
Netherlands	0.027%	0.18%	-0.63%	0.56%	108	-0.194	0.170	-0.009
Portugal	0.062%	0.37%	-0.81%	2.31%	108	-0.262	-0.056	-0.156
Spain	0.034%	0.18%	-0.49%	0.53%	108	-0.085	0.081	0.046
Equally Weighted Average	0.035%	0.25%	-1.68%	2.31%	1056	-	-	-
January 1999 - September 2009								
Austria	0.016%	0.42%	-1.70%	2.28%	129	0.055	0.229	-0.038
Belgium	0.052%	0.55%	-1.77%	4.69%	129	0.318	0.029	-0.034
Finland	0.013%	0.30%	-1.43%	1.09%	129	0.033	0.242	-0.021
France	-0.0003%	0.38%	-1.68%	1.54%	129	-0.286	0.189	0.072
Greece	0.027%	1.01%	-5.02%	5.08%	105	0.252	0.310	0.047
Ireland	-0.022%	0.99%	-5.95%	5.82%	129	0.161	0.010	0.039
Italy	0.024%	0.52%	-2.62%	2.52%	129	0.159	0.237	0.007
Netherlands	0.020%	0.34%	-1.38%	1.97%	129	0.046	0.120	0.040
Portugal	0.048%	0.68%	-1.88%	3.22%	129	0.022	0.021	0.032
Spain	0.021%	0.44%	-1.69%	2.57%	129	0.189	0.088	0.051
Equally Weighted Average	0.020%	0.60%	-5.95%	5.82%	1266	-	-	-

Table 2-1 (cont.)

Summary Statistics forMonthly Excess Returns on Ten-Year EMU Sovereign Debt

Sample Period & Issuer	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Autocorrelation		
						Lag 1	Lag 2	Lag 12
January 1999 - June 2012								
Austria	-0.004%	0.59%	-2.66%	2.28%	162	-0.083	0.223	0.127
Belgium	0.005%	1.09%	-5.70%	4.69%	162	0.007	-0.075	0.139
Finland	0.003%	0.35%	-1.43%	1.09%	162	-0.120	0.191	0.062
France	-0.037%	0.59%	-2.58%	1.76%	162	-0.220	0.092	0.004
Greece	-1.131%	6.68%	-45.51%	27.58%	138	-0.182	0.154	0.084
Ireland	-0.128%	2.56%	-13.93%	12.07%	162	-0.034	-0.008	0.045
Italy	-0.094%	1.75%	-10.82%	7.88%	162	0.031	-0.061	-0.011
Netherlands	0.008%	0.39%	-1.38%	1.97%	162	-0.118	0.066	0.020
Portugal	-0.216%	3.46%	-14.60%	19.62%	162	-0.106	0.126	-0.067
Spain	-0.139%	1.74%	-8.87%	5.49%	162	-0.127	-0.038	0.058
Equally Weighted Average	-0.159%	2.57%	-45.51%	27.58%	1596	-	-	-

Notes: *Excess returns are calculated as the difference between the monthly total return on ten-year, euro-denominated benchmark sovereign debt for each issuer relative to Germany, the figures reported are the averages of these monthly returns over the sample periods shown for each issuer. Calculations are based upon data sourced from Reuters Datastream who are also responsible for the selection of the benchmark securities.*

Next I consider the summary statistics which include the period up to September 2009. From this point the nature of returns on sovereign debt changed given the onset of the global financial crisis, the (equally weighted) average excess return on EMU sovereign debt over this period is now calculated as 0.020% per month, or 0.24% per annum, but given the increase in the standard deviation of the data series it is not possible to reject the null hypothesis that this value equals zero. Such findings are similarly characteristic of excess returns calculated on an individual issuer basis which are now smaller and exhibit larger standard deviations, again meaning that the null hypothesis of zero excess return cannot be rejected for any individual issuer.

Finally, the summary statistics for the full sample period make clear the significant impact of the European sovereign debt crisis on relative bond pricing in the EMU. Average excess returns are now negative and with a substantial increase in their standard deviation. Of notable interest is the large negative monthly return observed in May 2012 when holders of Greek benchmark debt experienced a loss of 45.51% on their holdings. This coincided with the Greek government agreeing a write-down of certain outstanding financial obligations with its creditors. The average monthly excess returns on debt issued by Ireland, Italy, Spain and Portugal were similarly negative when considering this longer sample period, with excess returns of -0.13%, -0.094%, -0.14% and -0.22% respectively. In contrast the returns on the benchmark debt of Belgium, Finland and the Netherlands were marginally positive, 0.005%, 0.003% and 0.008% respectively, thereby demonstrating the growing divergences in excess returns across issuers.

Table 2-2 reports correlation matrices for excess returns over the following sample periods: January 2001[22] to December 2007, January 2008 to September 2009 and October 2009 to June 2012. These sample periods are chosen to demonstrate the changing nature of the correlation structure between sovereign issuers over the sample period. The summary statistics demonstrate the high degree of correlation in the excess returns series across sovereign issuers and the changing nature of these correlations. The average pairwise correlations across all issuers are 0.66, 0.74 and 0.39 for the periods considered and range from 0.52 to 0.84 for the period ending in December 2007, 0.52 to 0.91 for the financial crisis period ending in September 2009 and -0.39 to 0.79 from October 2009 to June 2012.

[22] The period of calculation runs from January 2001 and not January 1999 to allow the returns on Greek sovereign debt to feature in the Table.

Table 2-2

Correlation Matrices of Excess Returns on 10 year EMU Sovereign Debt

January 2001 - December 2007	*Austria*	*Belgium*	*Finland*	*France*	*Greece*	*Ireland*	*Italy*	*Netherlands*	*Portugal*	*Spain*
Austria	1.00									
Belgium	0.83	1.00								
Finland	0.68	0.65	1.00							
France	0.58	0.62	0.59	1.00						
Greece	0.80	0.75	0.65	0.61	1.00					
Ireland	0.69	0.74	0.74	0.58	0.63	1.00				
Italy	0.73	0.65	0.62	0.58	0.82	0.63	1.00			
Netherlands	0.66	0.63	0.63	0.58	0.56	0.56	0.59	1.00		
Portugal	0.68	0.67	0.58	0.52	0.70	0.57	0.70	0.81	1.00	
Spain	0.78	0.84	0.62	0.57	0.66	0.67	0.59	0.61	0.67	1.00
January 2008 - September 2009										
Austria	1.00									
Belgium	0.57	1.00								
Finland	0.88	0.68	1.00							
France	0.79	0.53	0.70	1.00						
Greece	0.86	0.54	0.81	0.75	1.00					
Ireland	0.77	0.52	0.53	0.68	0.72	1.00				
Italy	0.87	0.63	0.89	0.72	0.84	0.54	1.00			
Netherlands	0.80	0.65	0.76	0.83	0.90	0.75	0.82	1.00		
Portugal	0.88	0.61	0.74	0.77	0.81	0.88	0.78	0.82	1.00	
Spain	0.65	0.70	0.68	0.80	0.80	0.72	0.66	0.91	0.73	1.00

Table 2-2 (cont.)

Correlation Matrices of Excess Returns on 10 year EMU Sovereign Debt

October 2009 - June 2012	*Austria*	*Belgium*	*Finland*	*France*	*Greece*	*Ireland*	*Italy*	*Netherlands*	*Portugal*	*Spain*
Austria	1.00									
Belgium	0.71	1.00								
Finland	0.79	0.59	1.00							
France	0.65	0.55	0.58	1.00						
Greece	0.32	0.25	0.16	0.06	1.00					
Ireland	0.44	0.55	0.32	0.30	0.41	1.00				
Italy	0.48	0.67	0.37	0.49	0.42	0.52	1.00			
Netherlands	0.35	0.23	0.65	0.48	-0.39	0.03	0.08	1.00		
Portugal	0.53	0.30	0.30	0.27	0.44	0.48	0.38	-0.16	1.00	
Spain	0.48	0.73	0.36	0.29	0.39	0.67	0.79	0.08	0.31	1.00

Notes: *Reported are the correlations between the excess returns on ten-year EMU sovereign debt over alternate time horizons. The average pairwise correlations are 0.66, 0.74 and 0.39 for the periods of January 2001 to December 2007, January 2008 to September 2009 and October 2009 to June 2012, respectively. 840, 210 and 330 observations are respectively used in the calculations.*

Table 2-3 exhibits summary statistics for the EMU and US default factors. Average excess returns in both cases are found to be small, negative and not statistically different from zero over the period of January 1999 to December 2007; such findings are consistent with those of Gebhardt et al. (2005) who report small differences in the excess returns on US corporate bonds and US Treasuries. In the sample periods which include the start of the financial crisis, returns on BBB rated corporate bonds, on average, exceeded those of AAA-AA rated bonds in the case of the US default factor whilst this difference is negative in the case of the EMU factor, with neither difference being statistically different from zero. There has also been an increase in the standard deviation of both series since the start of the crisis. Both factors exhibit a high degree of correlation, with correlation coefficients ranging from 0.72 to 0.75 across the sample periods considered.

Finally, Table 2-4 displays summary statistics for the fiscal indicators. For all countries these indicators deteriorate over the crisis period with average budget deficits and gross public debts ratios increasing for all issuers. Countries experiencing particularly large deteriorations in these measures include Greece, Ireland, Portugal and Spain, but in all cases (except for Finland) the average values of these indicators are in breach of the reference values stipulated by the Stability and Growth Pact; a budget deficit ratio of 3% and gross general government debt ratio of 60%. There is also a high degree of cross-country variation in the indicators which for gross government debt-to-GDP the values range from 45.40% in the case of Finland to 146.63% for Greece, and from -0.55% again in the case of Finland to -15.01% for Ireland when considering the period from December 2008 to June 2012.

Table 2-3

Summary Statistics for EMU and US Default Factors

	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Autocorrelations		
						Lag 1	Lag 2	Lag 12
January 1999 - December 2007								
EMU BBB - AAA Corporate Bond Spread	-0.0005%	0.34%	-1.68%	1.07%	108	0.142	-0.106	-0.036
US BBB - AAA Corporate Bond Spread	-0.0030%	0.64%	-2.79%	2.62%	108	0.217	0.096	0.015
Default Factor Correlation: 0.73								
January 1999 - September 2009								
EMU BBB - AAA Corporate Bond Spread	-0.02%	0.70%	-5.06%	2.30%	129	0.476	0.177	0.014
US BBB - AAA Corporate Bond Spread	0.05%	1.15%	-8.04%	4.90%	129	0.269	0.171	-0.018
Default Factor Correlation: 0.75								
January 1999 - June 2012								
EMU BBB - AAA Corporate Bond Spread	-0.02%	0.71%	-5.06%	2.30%	162	0.381	0.119	0.011
US BBB - AAA Corporate Bond Spread	0.08%	1.05%	-8.04%	4.90%	162	0.268	0.165	-0.003
Default Factor Correlation: 0.72								

Notes: *Default factors are defined as the difference in returns on portfolios of BBB and AAA-AA indices of EMU and US corporate bonds. The indices used to calculated returns are maintained by Bank of America - Merill Lynch but were sourced from Reuters Datastream.*

Table 2-4

Summary Statistics on Gross Government Debt and Fiscal Balance Ratios in EMU Member States

	Gross Government Debt (%GDP)					General Government Fiscal Balance (%GDP)				
	Mean	Standard Deviation	Minimum	Maximum	Number of Observations	Mean	Standard Deviation	Minimum	Maximum	Number of Observations
January 1999 - December 2007										
Austria	64.75	2.11	60.22	66.82	9	-1.64	1.18	-4.45	-0.05	9
Belgium	98.61	9.38	84.01	113.57	9	-0.31	0.83	-2.49	0.41	9
Finland	42.09	3.03	35.16	45.69	9	3.95	1.60	1.72	7.02	9
France	61.70	3.44	56.94	66.67	9	-2.65	0.85	-4.07	-1.51	9
Greece	102.28	3.96	94.86	107.47	7	-5.23	1.30	-7.59	-3.10	7
Ireland	31.82	6.51	24.62	46.97	9	1.58	1.52	-0.35	4.71	9
Italy	106.39	2.96	103.28	113.01	9	-2.85	1.09	-4.45	-0.83	9
Netherlands	51.58	3.98	45.29	61.13	9	-0.48	1.48	-3.12	1.97	9
Portugal	60.69	7.09	50.67	71.69	9	-4.05	1.05	-6.53	-3.08	9
Spain	48.53	8.19	36.30	62.42	9	0.24	1.22	-1.23	2.37	9
Equally Weighted Average	66.84	25.73	24.62	113.57	88	-1.14	2.87	-7.59	7.02	88
December 2008 - June 2012										
Austria	70.25	3.71	63.83	74.56	5	-3.04	1.29	-4.49	-0.93	5
Belgium	95.48	3.59	89.20	99.94	5	-3.41	1.50	-5.54	-1.01	5
Finland	45.40	6.63	33.94	53.14	5	-0.55	2.64	-2.49	4.39	5
France	80.85	7.42	68.21	90.05	5	-5.56	1.61	-7.54	-3.33	5
Greece	146.63	24.07	112.90	176.68	5	-10.60	2.87	-15.63	-6.82	5
Ireland	84.00	26.90	44.50	117.62	5	-15.01	8.59	-30.86	-7.36	5
Italy	117.48	6.68	106.09	126.51	5	-3.92	1.02	-5.45	-2.71	5
Netherlands	63.86	3.59	58.46	68.84	5	-3.67	2.25	-5.60	0.52	5
Portugal	97.56	16.66	71.69	119.07	5	-6.65	2.86	-10.15	-3.63	5
Spain	64.52	15.09	40.17	86.09	5	-8.58	2.32	-11.18	-4.50	5
Equally Weighted Average	86.60	31.21	33.94	176.68	50	-6.10	5.27	-30.86	4.39	50

Notes: *The data shown are extracted from the European Commission's Annual Macroeconomic Database (AMECO). Both gross government debt and the general government fiscal balance are measured in accordance with the Excessive Deficit Reporting procedures outlined by the Stability and Growth Pact. Both variables are calculcated as a proportion of national GDP.*

2.4.3. Principal Components Analysis of Excess Returns on EMU Sovereign Debt

To investigate further the correlation structure of excess returns across issuers I utilise Principal Components Analysis (PCA). PCA allows a set of potentially correlated observations to be reduced into a set of linearly uncorrelated values called Principal Components (PCs). This transformation is conducted such that the first PC of the data series represents the linear combination of the data which exhibits the largest possible variance, whilst the second PC is calculated to have the largest variance of linear combinations which are constrained to be orthogonal to the first PC, with this process being repeated when calculating further PCs.

Table 2-5 reports the variance explained by the first four PCs of the excess returns series over the alternate sample periods considered. For the periods of January 2001 to December 2007 and January 2008 to September 2009 the first PC explains a high proportion of the total variation in EMU excess returns (69% and 77% respectively) with further PCs capturing only marginal additional variation exhibited by the data series. This demonstrates the strong degree of joint variation which exists in EMU sovereign debt markets and echoes the findings of existing studies in the literature. In contrast, the first PC calculated over the period October 2009 to June 2012 explains only 48% of the series variance with the second PC accounting for a further 20%.

Table 2-5

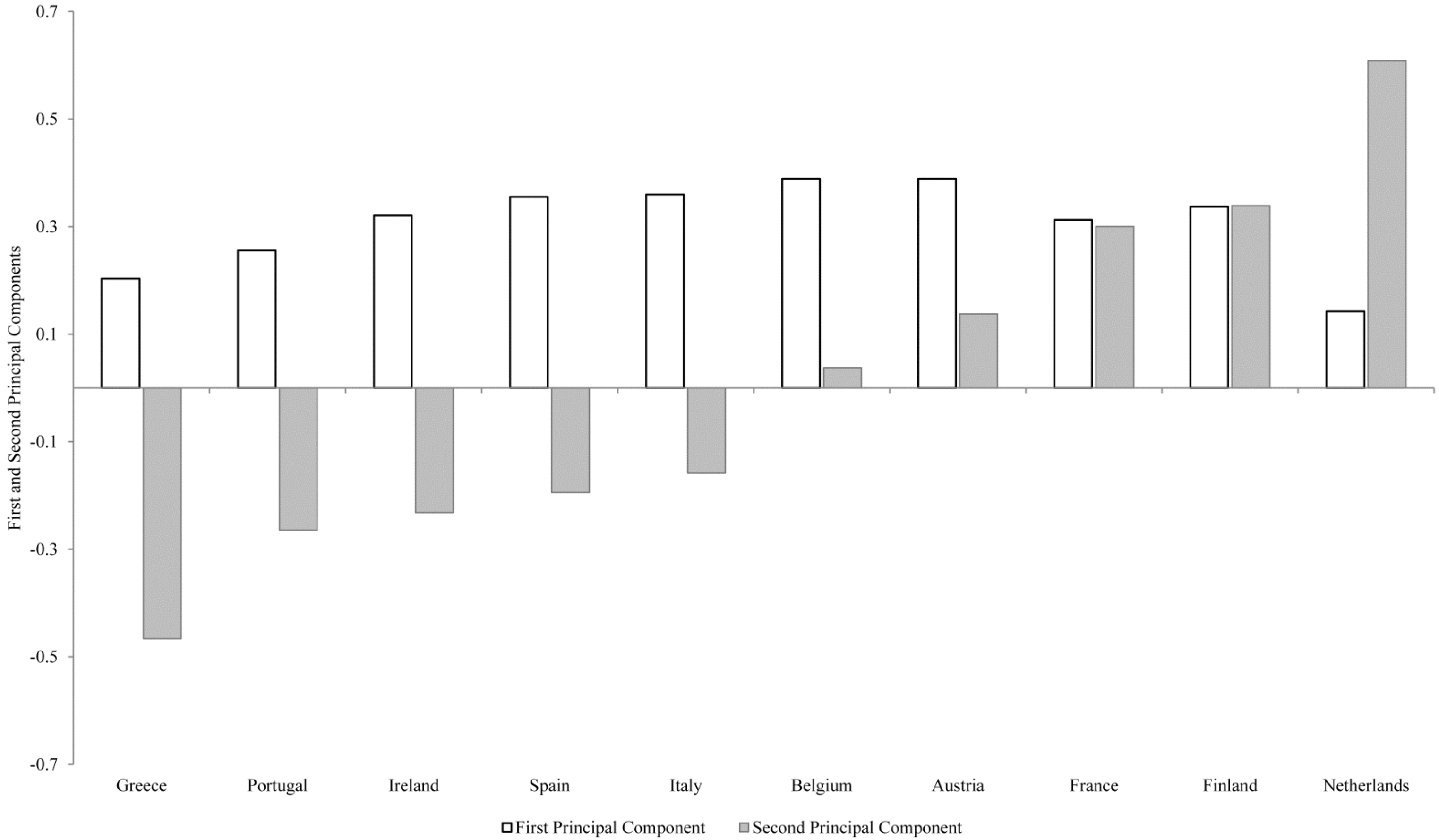
Principal Components Analysis: Excess Returns on EMU Sovereign Debt

Principal Components:	Proportion of Total Variance (%)	Cumulative Variance Explained (%)
January 2001 - December 2007		
1	0.69	0.69
2	0.06	0.76
3	0.06	0.81
4	0.05	0.87
Residual	0.13	1.00
January 2008 - September 2009		
1	0.77	0.77
2	0.07	0.84
3	0.06	0.90
4	0.04	0.94
Residual	0.06	1.00
October 2009 - June 2012		
1	0.48	0.48
2	0.20	0.68
3	0.10	0.78
4	0.06	0.84
Residual	0.16	1.00

Notes: *This table reports the proportion and cumulated variance explained by the first four principal components of the excess returns data series. The number of observations for each period are 84, 21 and 33.*

Figure 2-1 plots the loadings of the first two PCs across sovereign issuers during the period which includes the EMU sovereign debt crisis. The first PC is found to load almost uniformly across all issuers and hence could be interpreted as capturing a parallel shift factor in the excess returns series, a similar feature was found to be characteristic of sovereign CDS premia as demonstrated by Longstaff et al. (2011). In comparison, the second PC loads positively on the excess returns of Austria, Belgium, Finland, France and the Netherlands, and negatively on those of Greece, Ireland, Italy, Portugal and Spain. Hence the second PC appears to discriminate between developments in Southern and Northern member states over this period.

Figure 2-1
First and Second Principal Components of Excess Returns on EMU Sovereign Debt: October 2008 to June 2013

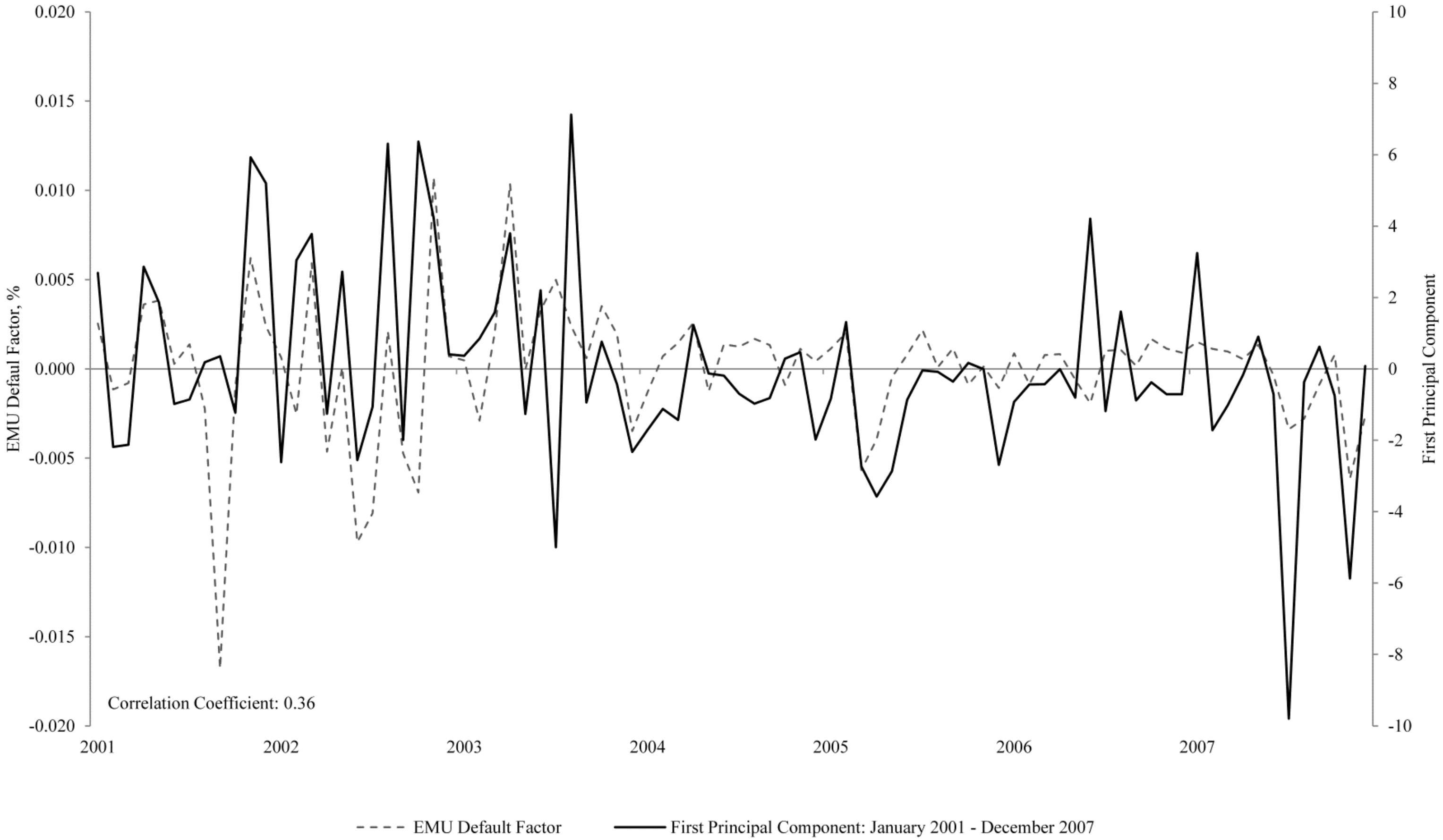


Source: Reuters Datastream & Author's Calculations

Time-series plots of the first PC alongside the EMU default factor are shown in Figure 2-2, Figure 2-3 and Figure 2-4 for the alternate sample periods. The correlations between these PCs and the EMU default factor series are 0.36, 0.73 and 0.53, respectively, demonstrating a tendency for the excess returns on EMU sovereign debt to move in line with this default factor. The correlation coefficient between the US and EMU default factors is high for the full sample period (0.71), but the US factor only exhibits lower correlations of 0.30, 0.48 and 0.14 with the first PC of the excess returns series over these periods.

Figure 2-2

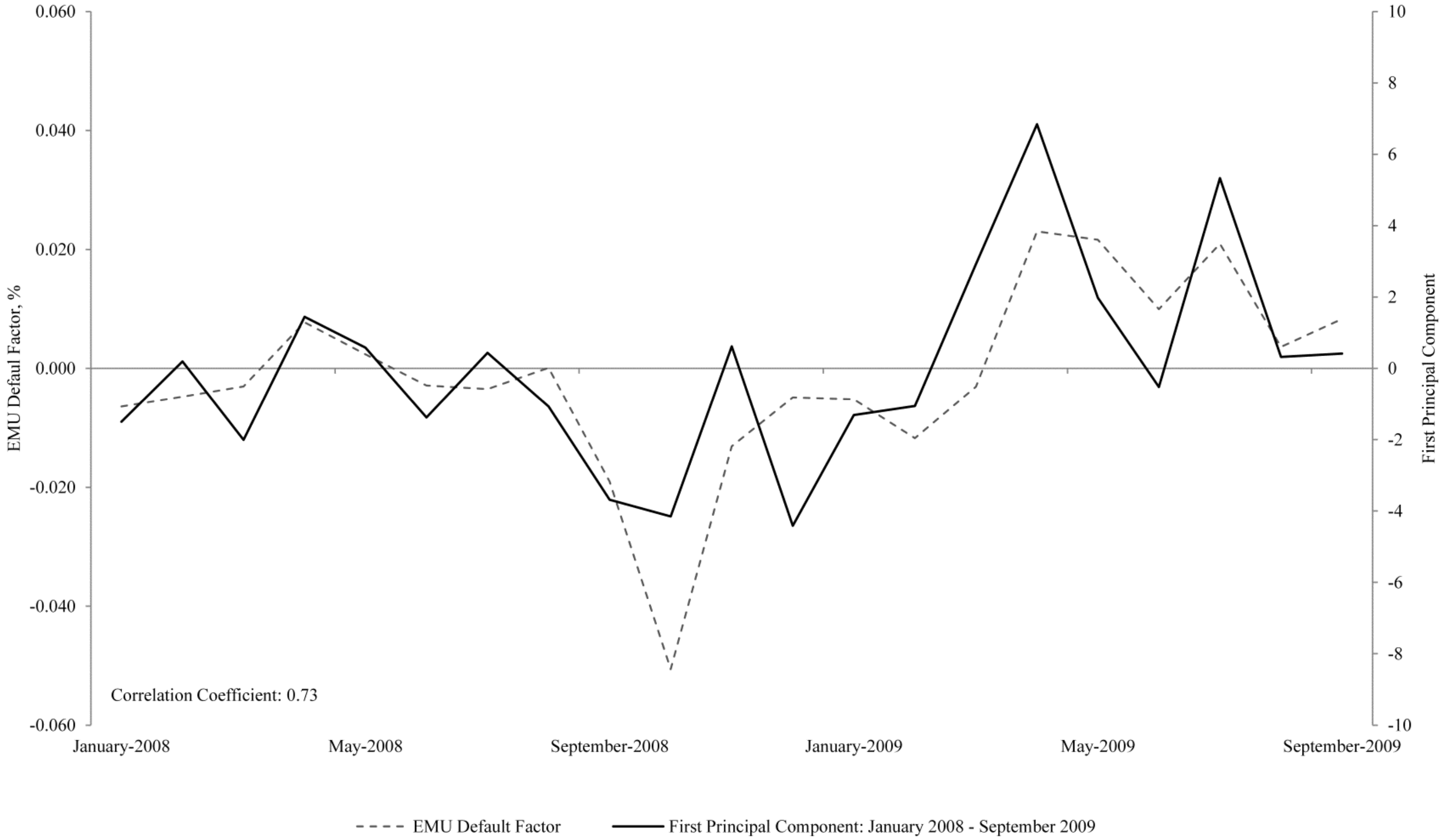
First Principal Component of Excess Returns and EMU Default Factor: January 2001 - December 2007



Source: Reuters Datastream and Author's Calculations

Figure 2-3

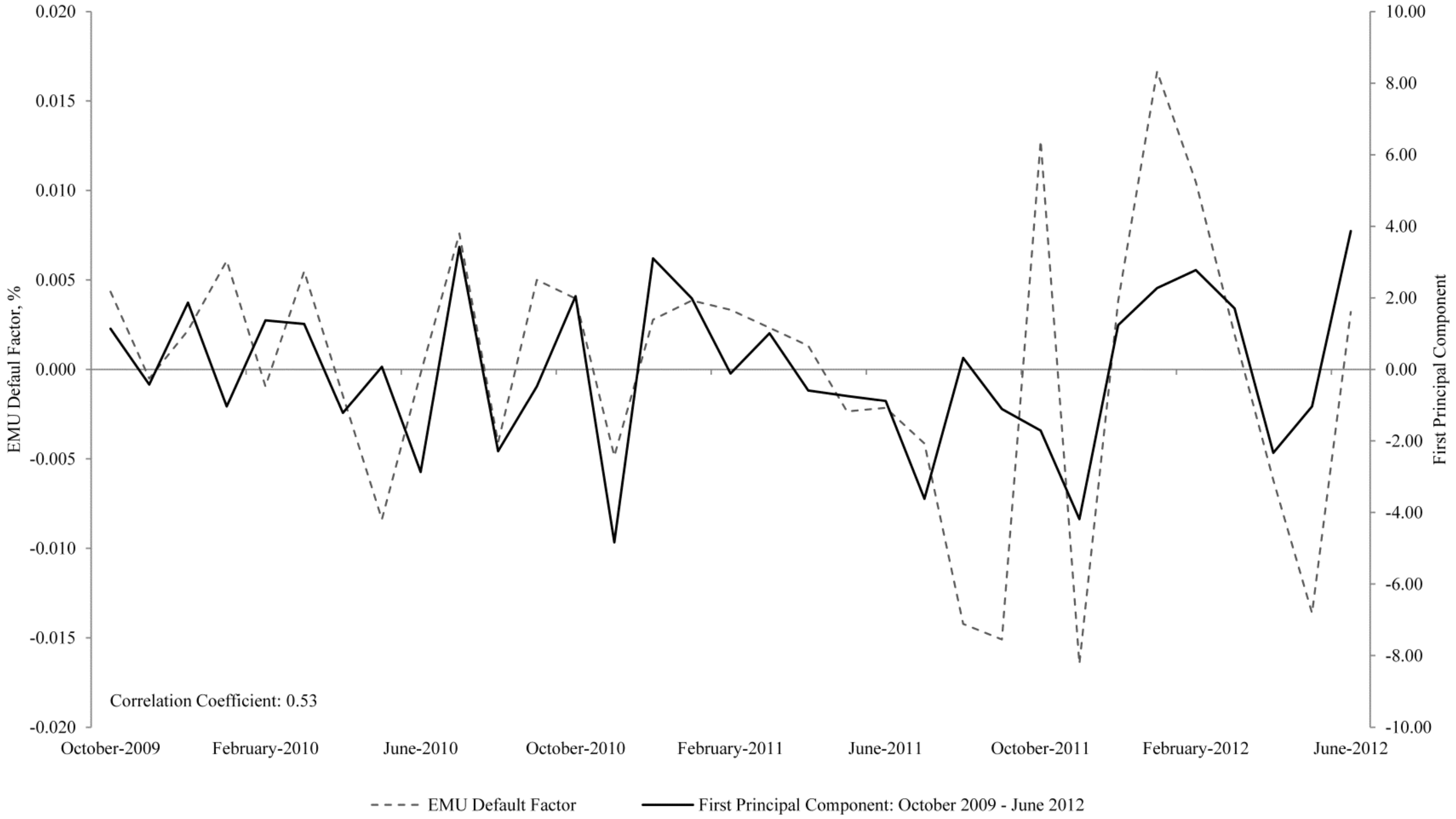
First Principal Component of Excess Returns and EMU Default Factor: January 2008 - September 2009



Source: Reuters Datastream and Author's Calculations

Figure 2-4

First Principal Component of Excess Returns and EMU Default Factor: October 2009 - June 2012



Source: Reuters Datastream and Author's Calculations

2.4.4. Measuring Systematic Default Risk: Default Betas

To approximate the magnitude of systematic default risk each sovereign issuer represents the sensitivity of the excess returns on its ten-year debt to each default factors is calculated; this sensitivity is referred to as an issuer's default beta. These default betas measure the covariance of excess returns on sovereign debt with the relative returns on BBB and AAA-AA rated corporate bonds which are taken to approximate aggregate default risks which investors face but cannot diversify away. Default betas are obtained by regressing each issuer's monthly excess returns on the EMU and US default factors and a constant:

$$ExcessReturn_{i,t} = \alpha + \beta_i DefaultFactor_t + \varepsilon_{i,t} \tag{2-15}$$

These regressions are estimated on a rolling basis using up to 60 months (five years) of prior data and only when there are at least 24 months (two years) of returns available for estimation. This means that the first reported default beta is estimated using data from January 1999 to December 2000 (for all issuers excluding Greece) and the final estimate is calculated using information from July 2007 to June 2012. Default betas are calculated on a rolling basis to allow for time variation in their values, in a manner consistent with the approach adopted by other studies in the literature, e.g. Gebhardt al. (2005), Lin et al. (2011) and Klein and Stellner (2013).

Summary statistics relating to outcome of this estimation procedure are outlined in Table 2-6. For the period of January 2001 to December 2007 average default betas for each issuer and both default factors are positive and there is heterogeneity across issuer in their estimated magnitudes. For the EMU factor the estimated default betas range from 0.06 in the case of France and the Netherlands, to

0.25 in the case of Greece and 0.22 for Portugal, while average default betas based upon the US default factor range from 0.01 for the Netherlands to 0.11 for Greece over this period. The estimated default betas are higher in the sample period running from January 2008 to September 2009 and the mean t-statistics are higher than the critical values associated with conventional levels of statistical significance in the case of both default factors. For this period there are again differences across issuers in average default betas which in the case of the EMU factor range from 0.22 for Finland and France to 0.90 for Greece and for the US factor from 0.07 for Finland to 0.41 again for Greece. The estimated default betas are observed to be the largest during the sovereign debt crisis and exceed the sample average in the cases of Greece, Ireland, Italy and Portugal.

Finally, Table 2-7 demonstrates the positive correlation between default betas and gross government debt-to-GDP ratios, which are 0.26 and 0.43 for EMU and US default betas from January 2001 to December 2007, and the negative correlation between default betas and fiscal balance-to-GDP ratios across issuers, -0.27 and -0.33 for EMU and US default betas, respectively, over the same period; indicating that the estimated default betas and budgetary fundamentals share common information about default risk amongst EMU issuers. For the latter sample periods the correlation between EMU or US default betas, and gross government debt-to-GDP ratios is found to be very high, 0.80 and 0.74, respectively, demonstrating the scale of overlap in the manner of risks these measures represent.

Table 2-6

Summary Statistics, Default Betas: EMU & US Default Factors

	EMU Default Factor						US Default Factor					
	Mean	Standard Deviation	Mean t-statistic	Minimum	Maximum	Number of Observations	Mean	Standard Deviation	Mean t-statistic	Minimum	Maximum	Number of Observations
January 2001 - December 2007												
Austria	0.17	0.07	1.76	0.08	0.40	84	0.08	0.03	1.88	0.04	0.16	84
Belgium	0.13	0.06	1.44	0.04	0.34	84	0.06	0.02	1.36	-0.01	0.16	84
Finland	0.10	0.04	1.41	0.03	0.24	84	0.03	0.01	1.04	0.00	0.06	84
France	0.06	0.06	0.92	-0.22	0.16	84	0.04	0.02	1.03	0.00	0.11	84
Greece	0.25	0.07	2.11	0.13	0.42	60	0.11	0.04	1.81	0.05	0.19	60
Ireland	0.19	0.16	1.62	0.08	0.74	84	0.01	0.06	0.78	-0.15	0.12	84
Italy	0.13	0.08	1.55	-0.26	0.30	84	0.06	0.04	1.38	-0.05	0.13	84
Netherlands	0.06	0.02	0.97	0.02	0.12	84	0.01	0.04	0.70	-0.10	0.08	84
Portugal	0.22	0.09	2.17	0.09	0.51	84	0.06	0.06	1.74	-0.10	0.17	84
Spain	0.09	0.04	1.92	-0.07	0.27	84	0.04	0.03	1.50	-0.06	0.13	84
Equally Weighted Average	0.14	0.10	-	-0.26	0.74	816	0.06	0.08	-	-0.15	0.62	816
January 2008 - September 2009												
Austria	0.36	0.11	7.16	0.28	0.46	21	0.15	0.04	4.16	0.04	0.21	21
Belgium	0.42	0.18	5.10	0.27	0.77	21	0.16	0.07	2.73	0.05	0.27	21
Finland	0.22	0.08	3.64	0.16	0.34	21	0.07	0.04	2.28	-0.03	0.13	21
France	0.22	0.08	4.63	0.14	0.41	21	0.08	0.05	2.47	0.02	0.15	21
Greece	0.90	0.34	9.20	0.50	1.15	21	0.41	0.13	5.41	0.19	0.59	21
Ireland	0.57	0.25	5.59	0.21	0.88	21	0.12	0.10	2.17	-0.05	0.32	21
Italy	0.56	0.19	8.07	0.29	0.80	21	0.26	0.07	5.41	0.11	0.35	21
Netherlands	0.27	0.12	4.89	0.38	0.38	21	0.11	0.03	2.93	0.03	0.15	21
Portugal	0.52	0.16	5.91	0.34	0.73	21	0.19	0.07	3.05	0.06	0.31	21
Spain	0.36	0.15	4.57	0.22	0.68	21	0.13	0.07	2.35	0.01	0.24	21
Equally Weighted Average	0.44	0.23	-	0.14	1.15	210	0.17	0.12	-	-0.05	0.59	210

Table 2-6 (cont.)

Summary Statistics, Default Betas: EMU & US Default Factors

	EMU Default Factor						US Default Factor					
	Mean	Standard Deviation	Mean t-statistic	Minimum	Maximum	Number of Observations	Mean	Standard Deviation	Mean t-statistic	Minimum	Maximum	Number of Observations
October 2009 - June 2012												
Austria	0.48	0.02	6.75	0.45	0.53	33	0.21	0.01	4.16	0.20	0.23	33
Belgium	0.40	0.06	2.80	0.32	0.51	33	0.14	0.01	2.73	0.11	0.16	33
Finland	0.24	0.01	4.61	0.22	0.27	33	0.14	0.00	2.28	0.13	0.14	33
France	0.23	0.02	3.81	0.19	0.27	33	0.06	0.00	2.47	0.05	0.07	33
Greece	1.46	0.63	3.05	0.89	0.89	33	0.56	0.19	5.41	0.36	1.06	33
Ireland	0.94	0.14	3.24	0.62	1.12	33	0.10	0.04	2.17	0.02	0.14	33
Italy	0.77	0.18	5.56	0.58	1.23	33	0.37	0.04	5.41	0.33	0.48	33
Netherlands	0.30	0.02	5.35	0.31	0.31	33	0.13	0.00	2.93	0.12	0.13	33
Portugal	0.70	0.12	2.78	0.50	0.99	33	0.17	0.04	3.05	0.12	0.29	33
Spain	0.52	0.14	2.82	0.31	0.83	33	0.12	0.02	2.35	0.08	0.18	33
Equally Weighted Average	0.60	0.44	-	0.19	1.23	330	0.20	0.16	-	0.02	1.06	330

Notes: *Default betas are estimated by regressing monthly excess returns on either the EMU or US default factor and a constant for each issuer. These regressions are estimated on a rolling basis using up to 60 months (five years) of prior data and only when there are at least 24 months (two years) of returns are available. For all countries the first default beta estimated relates to January 2001 except in the case of Greece for which the first beta estimate is for January 2003. Default factors are defined as the difference in returns on portfolios of BBB and AAA-AA indices of EMU and US corporate bonds.*

Table 2-7

Correlation Matrices of Fiscal Indicators, EMU Default Betas & US Default Betas

January 2001 - December 2007	*Gross Govt. Debt, %GDP*	*Fiscal Balance, %GDP*	*EMU Default Beta*	*US Default Beta*
Gross Govt. Debt, %GDP	1.00			
Fiscal Balance, %GDP	-0.63	1.00		
EMU Default Beta	0.26	-0.27	1.00	
US Default Beta	0.43	-0.33	0.66	1.00
January 2008 - September 2009				
Gross Govt. Debt, %GDP	1.00			
Fiscal Balance, %GDP	-0.43	1.00		
EMU Default Beta	0.63	-0.58	1.00	
US Default Beta	0.67	-0.36	0.76	1.00
October 2009 - June 2012				
Gross Govt. Debt, %GDP	1.00			
Fiscal Balance, %GDP	-0.21	1.00		
EMU Default Beta	0.80	-0.36	1.00	
US Default Beta	0.74	0.01	0.82	1.00

Notes: *Reported are the sample correlations between the Gross Government Debt-to-GDP ratio, fiscal balance-to-GDP ratio, EMU Default Beta and US Default beta for all issuers. The number of observations used in each case are 810, 210 and 330.*

2.5. Portfolio Approach: Fiscal Indicators and Default Betas

In this section a portfolio approach is adopted to examine the extent to which default betas and fiscal indicators can explain differences in the excess returns on EMU sovereign debt and how these variables are themselves related. Ranked portfolios are constructed by sorting sovereign issuers on the basis of a certain variable of interest; either fiscal indicators or default betas, the properties of these portfolios are compared to analyse the extent to which they overlap in the risk exposures they represent and whether these variables are systematically related to variation in excess returns on EMU public debt securities.

2.5.1. Description of Methodology

I construct portfolios of long-term EMU sovereign debt using the following procedure: for each month in the sample I sort all sovereign issuers by a particular variable of interest, i.e. its default beta, gross government debt-to-GDP ratio or fiscal balance-to-GDP ratio. The issuers are then divided into two portfolios of approximately equal size by comparing the variable of interest with its median value across all issuers for this period, thereby generating "High" and "Low" portfolios of benchmark EMU sovereign debt. I then calculate excess returns for each portfolio as the equally weighted average of the observed returns of the bonds within each portfolio over the next month. I similarly calculate an equally weighted average of all other (unsorted) variables of interest in my sample and finally, I calculate the time-series averages for each variable and the excess returns on each portfolio for alternate sample periods.

As noted by Fama and Macbeth (1973) analysing the properties of portfolios in comparison to individual securities offers a solution to an "error-in-variables" problem which results from the fact that the true value of β for each security is unknown and we must work with its estimated value. Furthermore, Cochrane (2005) highlights that betas associated with portfolios of assets may be more stable over time and that adopting an approach based upon portfolios of assets also closely mimics what financial investors do in practice. However, given the cross-sectional dimension considered here is small in comparison to studies which consider corporate bonds or common stocks, measurement error may still characterise the betas calculated at a portfolio level.

2.5.2. Portfolio Approach: Results

The outcomes of the sorting procedure are presented in Table 2-8 and Table 2-9 for EMU and US default factors, respectively. The adopted procedure is unsurprisingly successful in generating portfolios with distinct values for the sorted variable of interest which increase in value from the low to the high portfolio and can be regarded as statistically different from each other. Of greater interest are the characteristics of these portfolios in relation to the other (unsorted) variables and in this case the constructed portfolios demonstrate the overlaps which exist between the measures of systematic default risk and fiscal indicators. Portfolios of securities constructed so as to contain issuers with higher default betas are similarly characterised by larger budget deficits and higher gross debt ratios than countries with lower default betas, with these differences being statistically significant at conventional levels. Conversely, portfolios constructed so as to contain issuers with weaker fiscal circumstances are characterised by higher degrees of systematic default risk, with these differences again being statistically significant at conventional levels. On the basis of this evidence it is apparent that the fiscal indicators and default betas embody similar forms of risk.

For the period of January 2001 to December 2007, average excess returns increase from the low to high portfolio but only in the case of portfolios constructed by ranking on the basis of US default betas, gross government debt-to-GDP ratios and YTM is this difference statistically significant at the 10% level. The average differences in excess returns of 0.015% per month for the gross government debt-to-GDP portfolio, 0.020% per month for US default betas and 0.017 for YTMs imply risk premia of approximately 0.18%, 0.24% and 0.20% per annum, respectively for bearing default risk in EMU sovereign debt markets over this period.

Table 2-8

Ranked Portfolios of EMU Sovereign Debt: EMU Default Factor

	January 2001 - December 2007			***January 2001 - September 2009***			***January 2001 - June 2012***		
	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)
Panel A: EMU Default Factor, Default Beta									
Observations		84			105			138	
EMU Default Beta	0.08	0.20	11.62	0.12	0.28	13.29	0.17	0.42	13.76
Budget Deficit / GDP	-0.23	-2.24	-2.54	-0.86	-3.16	-1.65	-1.69	-4.67	-2.64
Public Debt / GDP	58.67	70.44	1.34	58.91	74.04	0.98	62.38	83.14	1.90
Yield to Maturity	4.23	4.30	13.95	4.20	4.35	7.20	3.98	5.26	5.86
Excess Return	0.025%	0.038%	1.52	0.027%	0.016%	-0.26	0.013%	-0.39%	-1.96
Panel B: Fiscal Balance-to-GDP									
Observations		84			105			138	
EMU Default Beta	0.13	0.15	1.97	0.17	0.22	9.10	0.24	0.34	9.32
Budget Deficit / GDP	0.96	-3.57	-16.91	0.38	-4.51	-6.91	-0.56	-5.89	-6.53
Public Debt / GDP	52.64	77.32	5.34	56.78	74.92	1.97	63.37	90.99	2.90
Yield to Maturity	4.23	4.30	4.80	4.23	4.32	9.22	4.04	5.20	5.59
Excess Return	0.025%	0.038%	0.43	0.027%	0.015%	-0.35	-0.111%	-0.26%	-0.92

Table 2-8 (cont)	*January 2001 - December 2007*			*January 2001 - September 2009*			*January 2001 - June 2012*		
	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)
Panel C: Gross Govt. Debt-to-GDP									
Observations		84			105			138	
EMU Default Beta	0.13	0.15	2.61	0.17	0.22	5.66	0.22	0.37	8.22
Budget Deficit / GDP	0.32	-2.86	-5.64	-0.56	-3.52	-2.91	-1.66	-4.74	-3.76
Public Debt / GDP	45.31	85.55	34.63	46.90	87.43	20.30	52.23	94.76	17.83
Yield to Maturity	4.23	4.31	13.82	4.22	4.46	13.60	4.17	6.26	5.57
Excess Return	0.024%	0.039%	1.65	0.009%	0.033%	1.30	-0.043%	-0.33%	-1.58
Panel D: Yield-to-Maturity									
Observations		84			105			138	
US Default Beta	0.12	0.20	12.49	0.15	0.28	11.58	0.19	0.42	11.98
Budget Deficit / GDP	-0.07	-2.65	-5.87	-0.63	-3.59	-3.08	-1.42	-5.09	-3.62
Public Debt / GDP	50.42	81.56	8.24	52.30	82.93	4.64	57.45	89.81	6.80
Yield to Maturity	4.22	4.34	42.09	4.19	4.39	9.91	3.96	5.26	5.99
Excess Return	0.025%	0.042%	1.82	0.024%	0.017%	-0.23	0.009%	-0.381%	-1.88

Notes: *Each month bonds are sorted into portfolios based upon either their default beta, fiscal balance-to-GDP ratio or Gross Govt. Debt-to-GDP ratio. Default betas are estimated over rolling five-year periods for each bond. Time-series averages of the characteristics of the constructed portfolios are reported. t-statistics are presented under a null hypothesis that the calculated differences between the characteristics of each portfolio are equal to zero. Equal weights are used when averaging across issuers.*

Table 2-9

Ranked Portfolios: US Default Factor

	January 2001 - December 2007			***January 2001 - September 2009***			***January 2001 - June 2012***		
	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)
Panel A: US Default Factor, Default Beta									
Observations		84			105			138	
US Default Beta	0.02	0.07	18.95	0.03	0.11	14.89	0.05	0.15	16.83
Budget Deficit / GDP	-0.33	-2.12	-2.12	-1.13	-2.88	-1.09	-2.81	-3.54	-0.51
Public Debt / GDP	50.72	79.39	6.33	50.72	81.24	3.57	58.69	87.43	5.23
Yield to Maturity	4.23	4.30	9.23	4.23	4.33	8.15	4.28	4.96	5.01
Excess Return	0.022%	0.042%	1.94	0.041%	0.002%	-1.45	-0.033%	-0.34%	-2.21
Panel B: Fiscal Balance-to-GDP									
Observations		84			105			138	
US Default Beta	0.04	0.05	5.79	0.06	0.08	6.47	0.09	0.11	5.26
Budget Deficit / GDP	0.96	-3.57	-16.91	0.38	-4.51	-6.91	-0.56	-5.89	-6.53
Public Debt / GDP	52.64	77.32	5.34	56.78	76.84	1.97	63.37	82.67	2.90
Yield to Maturity	4.23	4.31	16.62	4.22	4.34	9.22	4.17	5.07	5.59
Excess Return	0.025%	0.038%	1.49	0.027%	0.015%	-0.35	-0.111%	-0.26%	-0.92

Table 2-9 (cont.)	*January 2001 - December 2007*			*January 2001 - September 2009*			*January 2001 - June 2012*		
	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)	Low Portfolio	High Portfolio	t(diff)
Panel C: Gross Govt. Debt-to-GDP									
Observations		84			105			138	
US Default Beta	0.03	0.07	17.13	0.04	0.10	17.13	0.06	0.14	18.08
Budget Deficit / GDP	0.32	-2.86	-5.64	-0.56	-3.52	-2.91	-1.66	-4.74	-3.76
Public Debt / GDP	45.31	85.55	34.63	46.90	87.43	20.30	52.07	94.51	18.08
Yield to Maturity	4.23	4.30	13.82	4.23	4.32	13.60	4.04	5.20	5.57
Excess Return	0.024%	0.039%	1.65	0.009%	0.034%	1.30	-0.043%	-0.33%	-1.58
Panel D: Yield-to-Maturity									
Observations		84			105			138	
US Default Beta	0.04	0.08	12.68	0.05	0.11	13.57	0.07	0.15	16.45
Budget Deficit / GDP	-0.07	-2.65	-5.87	-0.63	-3.59	-3.08	-0.07	-5.09	-3.62
Public Debt / GDP	50.42	81.56	8.24	52.30	82.93	4.64	57.45	89.81	6.80
Yield to Maturity	4.22	4.34	38.30	4.19	4.39	42.82	4.22	4.34	49.09
Excess Return	0.025%	0.042%	1.82	0.027%	0.018%	-0.21	0.01%	-0.38%	-1.88

Notes: *Each month bonds are sorted into portfolios based upon either their default beta, fiscal balance-to-GDP ratio or Gross Govt. Debt-to-GDP ratio. Default betas are estimated over rolling five-year periods for each bond. Time-series averages of the characteristics of the constructed portfolios are reported. t-statistics are presented under a null hypothesis that the calculated differences between the characteristics of each portfolio are equal to zero. Equal weights are used when averaging across issuers.*

When the sample period is extended to September 2009 the differences in excess returns across the portfolios are no longer statistically different from zero regardless of the variable-of-interest used to rank the issuers. Finally, for the full sample period running up to June 2012 and hence including data relating to the EMU sovereign debt crisis, the difference in portfolio excess returns is negative in all cases with this difference statistically significant at the 5% level when portfolios are constructed by sorting issuers using their US default beta and at the 10% level of significance when ranking on EMU default factors and a bond’s YTM. Excess returns are not statistically different across the portfolios when portfolios are constructed on the basis of the fiscal indicators, hence there is some evidence to suggest that default betas are better at characterising differences in average returns on EMU sovereign debt across issuers when the sample period includes the recent sovereign debt crisis.

Overall, the results based upon the portfolio methodology suggest that in the sample period of January 2001 to December 2007 investors earned a risk premium of approximately 0.18% or 0.24% per annum as compensation for bearing default risk in EMU sovereign debt and there was little evidence to suggest a preference for either betas or fiscal indicators in characterising differences in excess returns across issuers over this period. When considering a sample period which includes events pertaining to the EMU sovereign debt crisis the differences in excess returns between high and low portfolios are found to be negative, reflecting the losses experienced by investors in holdings of sovereign debt issued by nations of weaker credit quality, and the results indicate some preference for default betas in characterising the differences in returns across issuers over this time period.

2.6. Fama and Macbeth Cross-Sectional Regressions

2.6.1. Description of Methodology

In theory, knowledge of the magnitude of systematic risk each issuer represents should be sufficient to explain cross-sectional differences in observed excess returns. In this section asset specific data is utilised to run cross-sectional regressions of the excess returns on fiscal indicator, default betas and/or the YTM on the benchmark bonds of each issuer. This approach therefore utilises the variation in betas and fiscal indicators which might exist within portfolios, are potentially relevant for explaining differences in returns but subsequently ignored when a portfolio approach is adopted.

The relationship between excess returns, default betas and the fiscal indicators is examined using the cross-sectional regression approach pioneered by Fama and Macbeth (1973). This methodology involves running multiple cross-sectional regressions of one month ahead (asset-specific) excess returns on combinations of default betas, fiscal indicators and the YTM on bonds at each month in the sample period, these cross sectional regressions taking the following general form:

$$\begin{aligned} Excess\_Return_{i,t+1} \\ &= \alpha_t + \gamma_t DefaultBeta_{i,t} \\ &+ \sum \theta_{j,t} Fiscal\_Indicator_{i,t} + \delta_t YTM_{i,t} + \varepsilon_{i,t} \end{aligned} \tag{2-16}$$

where $Excess\_Return_{i,t+1}$ is the one month ahead excess return on each issuer's ten year benchmark bond relative to Germany, $DefaultBeta_{i,t}$ is the default beta for the issuer for the month at time t based upon a time-series regression of its excess returns on either the EMU or US default factor over the preceding 24 to 60 months, $Fiscal\_Indicator_{i,t}$ corresponds to the indicators which capture a nation's overall fiscal position, i.e. either gross government debt-to-GDP ratio or the budget deficit-to-GDP ratio and $YTM_{i,t}$ is the Yield-To-Maturity on the ten year benchmark security of each issuer. The time series averages of the estimated slope and conventional Fama and Macbeth standard errors are utilised to examine the relative informativeness of each type of variable in explaining differences in excess returns:

$$\hat{\gamma} = \frac{1}{T}\sum \hat{\gamma}_t \;\; and \;\; \hat{\theta}_j = \frac{1}{T}\sum \hat{\theta}_{j,t} \tag{2-17}$$

Fama and Macbeth standard errors correct for cross-sectional dependence in the returns across issuers, see Petersen (2007); a feature which has been identified in the previous section as characteristic of the excess returns series in EMU sovereign debt. The sampling variation in the coefficients estimated is calculated as follows:

$$\sigma^2(\hat{\gamma}) = \frac{1}{T^2}\sum (\hat{\gamma}_t - \hat{\gamma})^2, \quad \sigma^2(\hat{\theta}_j) = \frac{1}{T^2}\sum \left(\hat{\theta}_{j,t} - \hat{\theta}_j\right)^2 \tag{2-18}$$

Time series averages of t-statistics based upon the expressions in equation (2-18) and the time-series average R^2 of these the regressions are also calculated and reported on separately for the sample periods considered.

2.6.2. Results

The results of the Fama and Macbeth cross-sectional regressions are presented in Table 2-10. Panel A displays results for the sample period of January 2001 to December 2007 and Panel B from January 2001 to June 2012. For both sample periods multiple specifications are estimated: using only the fiscal indicators, the estimated default betas or a bond's YTM as well as joint specifications which include combinations of these three types of variable.

Table 2-10

Fama and Macbeth Cross-Sectional Regression Results

	Fiscal Balance, %GDP	Gross Govt. Debt, %GDP	EMU Default βeta	US Default βeta	Yield-to-Maturity	Average R^2
Panel A: January 2001 - December 2007						
Fiscal Balance Only	-0.0000319*	-	-	-	-	0.18
	(1.82)					
Gross Government Debt Only		0.00000330*	-	-	-	0.19
		(1.71)				
Joint Fiscal Indicators Specification	-0.0000226	0.00000211	-	-	-	0.29
	(1.10)	(0.99)				
EMU default betas only	-	-	0.000501	-	-	0.20
			(0.50)			
US default betas only	-	-	-	0.00314*	-	0.19
				(1.67)		
Fiscal Indicators & EMU default betas	-0.0000240	0.00000200	-0.000446	-	-	0.42
	(1.15)	(0.92)	(0.49)			
Fiscal Indicators & US default betas	-0.0000197	0.00000108	-	0.00248	-	0.42
	-(0.81)	(0.51)		(1.06)		
YTM Only	-	-	-	-	0.00125*	0.24
					(1.72)	
YTM, Fiscal Indicators & US default betas	0.00000148	-0.00000146	-	0.000749	0.00201*	0.56
	(0.05)	(0.62)		(0.26)	(1.82)	
YTM, Fiscal Indicators & EMU default betas	-0.00000646	-0.000000380	-0.00100	-	0.00177*	0.53
	(0.30)	(0.17)	(1.09)		(1.95)	

Table 2-10 (cont.)	Fiscal Balance, %GDP	Gross Govt. Debt, %GDP	EMU Default βeta	US Default βeta	Yield-to-Maturity	Average R^2
Panel B: January 2001 - December 2012						
Fiscal Balance Only	0.000373	-	-	-	-	0.20
	(1.23)					
Gross Government Debt Only	-	-0.0000789*	-	-	-	0.22
		(1.84)				
Joint Fiscal Indicators Specification	0.0000601	-0.0000762*	-	-	-	0.35
	(0.40)	(1.80)				
EMU default betas only	-	-	-0.0087771***	-	-	0.27
			(2.46)			
US default betas only	-	-	-	-0.0173187**	-	0.23
				(2.11)		
Fiscal Indicators & EMU default betas	-0.0000508	0.00000609	-0.00811**	-	-	0.47
	(0.39)	(0.19)	(2.08)			
Fiscal Indicators & US default betas	0.000314	-0.0000144	-	-0.0109	-	0.39
	(1.14)	(0.46)		(1.47)		
YTM Only	-	-	-	-	-0.00153	0.31
					(1.46)	
YTM, Fiscal Indicators & US default betas	0.000272	0.0000169	-	-0.0102	0.000443	0.62
	(0.91)	(0.84)		(1.27)	(0.33)	
YTM, Fiscal Indicators & EMU default betas	-0.0000425	0.0000192	-0.00674*	-	0.00120	0.59
	(0.30)	(0.69)	(1.62)		(0.72)	

Notes: *This table presents the results from Fama and Macbeth cross-sectional regressions whereby the excess returns on individual securities are regressed on either fiscal indicators and/or default betas each month in the sample period. The reported point estimates are the time-series averages of the monthly estimates over alternate sample periods. t-statistics are reported beneath the point estimates which are calculated using conventional Fama and Macbeth standard errors, i.e. correcting for cross-sectional dependence. * 10% Significance, ** 5% Significance, *** 1% Significance*

The results relating to the period of January 2001 to December 2007 reinforce those based upon the portfolio methodology presented in Panel A of Table 2-10. When considered in isolation from default betas, the fiscal balance-to-GDP ratio and the gross government debt-to-GDP ratios are both significant at the 10% level in explaining cross-country differences in returns over this period, the estimated coefficients suggest that a disparity across issuer in their fiscal balance ratio of -4.50% is associated with a risk premium of approximately 0.19% per annum whilst a difference in the gross government debt-to-GDP ratio of 40% equates to a premium of 0.16% per annum[23]. The evidence suggests these fiscal indicators embody similar forms of risk as neither is statistically significant at conventional levels when considered in a joint specification which explains, on average, 29% of cross-sectional differences in one-month ahead excess returns over this sample period.

I consider next the alternative measures of systematic default risk for each issuer, as presented by EMU and US default betas. The coefficient for EMU default betas whilst positive is not statistically significant from zero at conventional levels; this corresponds with the results based upon the portfolio approach, where excess returns could not be considered as statistically different across portfolios sorted on the basis of EMU default betas. In contrast, the coefficient on US default betas is positive and statistically different from zero at the 10% level; the results suggest that an increase in the magnitude of an issuer's default beta of 0.05 corresponded to a risk

[23] A deterioration in the fiscal balance-to-GDP ratio of 4.5% and an increase in gross government debt-to-GDP of 40% corresponds roughly to the difference in the equally weighted average of these variables for ranked portfolios of high and low values for these indicators; see Panels B and C of Table 2-8 and Table 2-9.

premium of circa 0.19% per annum[24], which is comparable to the results based upon fiscal indicators. The average R^2 indicates that, on average, 19% of one-month ahead cross-sectional variation in excess returns can be explained by US default betas alone. Joint specifications which include both the fiscal indicators and default betas over this period demonstrate the overlaps in explanatory power which these two types of variable represent. In contrast to previous results no single variable is found to be statistically significant at conventional levels (despite this previously being the case) and the joint specification has an average R^2 of 0.42. This again corroborates the notion that budgetary fundamentals and measures of systematic default risk are similar in the types of risk which they measure.

Results based upon a longer sample period and thereby including events pertaining to the global financial crisis and EMU sovereign debt crisis similarly reconfirm the results based upon the portfolio approach (Panel B of Table 2-10). For the full sample period of January 2001 to June 2012 and considering only the fiscal indicators as explanatory variables, gross government debt-to GDP ratios are found to be statistically significant at the 10% level when considered either independently or alongside the fiscal balance-to-GDP ratio indicator. In a similar manner both EMU and US default betas are found to be statistically significant at the 5% level in characterising excess returns across issuers over this period. However, when included alongside each other in a joint specification there is some evidence to favour the use of default beta based upon the EMU default factor as EMU default betas retain their explanatory power in the presence of the fiscal indicators which

[24] 0.05 corresponds to the difference in the equally weighted average of US default betas for ranked portfolios of high and low values for this indicator; see Panel A of Table 2-9.

now cannot be regarded as statistically different from zero at conventional levels. Although, the best performing specification for this longer period includes both fiscal indicators and EMU default betas, a specification which demonstrate that, on average, 47% of the variation in one-month ahead excess returns in EMU sovereign debts can be explained by measures of default risk.

Finally, I include the yield-to-maturity of ten-year benchmark debt from the previous month for each issuer alongside the estimated measures of systematic default risk and budgetary fundamentals. As noted by Gebhardt et al. (2005) a bond's yield-to-maturity could be construed as a catch-all variable for other influence in relative bond pricing, such as differences in liquidity or tax treatment. For the period which omits the crisis this variable enters with a positive coefficient and is statistically significant at conventional levels when included alongside default betas. In the extended sample period the YTM exhibits no statistically significant explanatory power in explaining the excess returns across issuers and the coefficient on EMU default betas cannot be statistically distinguished from zero, hence there is evidence of overlap in the explanatory power of a bonds yield-to-maturity and its degree of systematic default risk. The results based upon this specification also suggest that an average of 59% and 62% of the variation in one-month ahead excess returns can be explained by specifications which include a bond's yield-to-maturity alongside default betas calculated using EMU and US default factors, respectively.

2.6.3. Risk-Adjusted Returns

As default betas are estimated with error I also examine the pricing of EMU sovereign debt utilising risk-adjusted returns, following the approach advocated by

Brennan et al. (1998) and Gebhardt et al. (2005). Risk-adjusted returns are calculated for each month and issuer by subtracting from excess returns the product of estimated default betas $(\widehat{\beta_i})$ and the relevant default factor, this exercise is conducted for both EMU and US default betas:

$$RiskAdj\_Return_{i,t} = Excess\_Return_{i,t} - (\widehat{\beta_i} \cdot DefaultFactor_t) \qquad (2\text{-}19)$$

Using these risk-adjusted returns Fama and Macbeth regressions are estimated which exclude the estimated default betas as explanatory variables given they are utilised in the construction of the dependent variables, these cross-sectional regressions are of the following form:

$$RiskAdj\_Return_{i,t} = \alpha_t + \sum \theta_{j,t} Fiscal\_Indicator_{i,t} + \delta_t YTM_{i,t} + \varepsilon_{i,t} \qquad (2\text{-}20)$$

Results based upon risk-adjusted excess returns are presented in Table 2-11 with Panels A and B utilising a risk-adjustment based upon the EMU default factor and Panels C and D in the case of the US default factor. Considering first the results for the period of January 2001 to December 2007 (Panels A and C), none of the previously reported conclusions change materially, after controlling for the impact of default betas the coefficients on the fiscal balance and gross government debt ratios are not significant at conventional levels when considering either independently or jointly with each other. In contrast, the YTM of a bond retains its significance in characterising returns over these sub-periods following on from the risk correction.

Table 2-11

Fama and Macbeth Cross-Sectional Regression Results: Risk-Adjusted Excess Returns

	Fiscal Balance, %GDP	Gross Govt. Debt, %GDP	Yield-to-Maturity, %	Average R^2
Panel A: EMU Risk Adjustment, January 2001 - December 2007				
Fiscal Balance Only	-0.0000280	-	-	0.17
	(1.61)			
Gross Government Debt Only	-	0.00000309	-	0.19
		(1.56)		
Joint Fiscal Indicators Specification	-0.0000190	0.00000205	-	0.29
	(0.94)	(0.94)		
YTM Only			0.00123*	0.23
			(1.68)	
YTM & Fiscal Indicators	0.00000567	-0.00000116	0.00201**	0.43
	(0.26)	-(0.48)	(2.04)	
Panel B: EMU Risk Adjustment, January 2001 - December 2012				
Fiscal Balance Only	0.0003738	-	-	0.20
	(1.20)			
Gross Government Debt Only	-	-0.0000781*	-	0.22
		(1.80)		
Joint Fiscal Indicators Specification	0.0000644	-0.0000755*	-	0.35
	(0.42)	-(1.77)		
YTM Only	-	-	-0.00105	0.30
			-(0.99)	
YTM & Fiscal Indicators	-0.00006510	-0.00001010	-0.000157	0.49
	(0.38)	(0.48)	(0.13)	

Table 2-11 (cont.)	Fiscal Balance, %GDP	Gross Govt. Debt, %GDP	Yield-to-Maturity, %	Average R^2
Panel C: US Risk Adjustment, January 2001 - December 2007				
Fiscal Balance Only	-0.0000237	-	-	0.17
	(1.40)			
Gross Government Debt Only	-	0.00000291	-	0.17
		(1.52)		
Joint Fiscal Indicators Specification	-0.0000160	0.00000192	-	0.27
	(0.79)	(0.89)		
YTM Only	-	-	0.00088	0.22
			(1.17)	
YTM & Fiscal Indicators	0.00000898	-0.00000119	0.00175*	0.41
	(0.41)	-(0.50)	(1.73)	
Panel D: US Risk Adjustment, January 2001 - December 2012				
Fiscal Balance Only	0.000370	-	-	0.20
	(1.21)			
Gross Government Debt Only	-	-0.0000824*	-	0.21
		(1.91)		
Joint Fiscal Indicators Specification	0.0000455	-0.0000809*	-	0.34
	(0.31)	(1.90)		
YTM Only	-	-	-0.00147	0.30
			(1.33)	
YTM & Fiscal Indicators	-0.0000900	-0.00001160	0.00081	0.48
	(0.53)	(0.55)	(0.68)	

Notes: *This table presents the results from Fama and Macbeth cross-sectional regressions which utilise risk-adjusted excess returns. These returns for individual securities are regressed on either fiscal indicators and/or a bond's Yield-To-Maturity each month in the sample period. The reported point estimates are the time-series averages of the monthly estimates over alternate sample periods. t-statistics are reported beneath the point estimates which are calculated using conventional Fama and Macbeth standard errors, i.e. correcting for cross-sectional dependence. * 10% Significance, ** 5% Significance, *** 1% Significance.*

The results covering the period of January 2001 to December 2012 (Panels B and D), demonstrate that after conducting risk-adjustments the gross government debt of an issuer is systematically linked to differences in excess returns across issuers at the 10% level when considered in isolation or jointly with the fiscal balance ratio but not when included alongside a bond's YTM. These results contradict the findings implied by Table 2-10, whereby no link was found to exist between gross government debt ratios and excess returns in specifications which included EMU default betas. Hence, whilst there is a significant degree of overlap between default betas and fiscal indicators I am led to reject the proposition that measures of systematic default risk are sufficient to characterise excess returns in markets for EMU sovereign debt.

2.7. Conclusions

This chapter has compared the ability of measures of systematic default risk and fiscal indicators to explain observed variation in the excess returns on EMU sovereign debt over a sample period which runs from January 1999 to June 2012. Using two distinct methodologies it has been demonstrated that measures of systematic default risk and these fiscal indicators share important information about the default risks which EMU sovereign issuers represent. More specifically, portfolios constructed so as to contain debt securities issued by nations representing higher levels of systematic default risk are found to be characterised by weaker fiscal circumstances, with the converse also being true. In a similar manner, it is shown using Fama and Macbeth cross-sectional regressions that when considered independently of each other, both fiscal indicators and default betas are significant in explaining cross-sectional differences in one-month ahead excess returns on these securities yet cannot be regarded as statistically significant from zero in joint specifications, despite these empirical models exhibiting an average R^2 of 0.47.

New evidence has also been presented which demonstrates the relevance of this (shared) variation in explaining difference in excess returns across issuers in sample periods which include and exclude the financial and sovereign debt crisis. It has been shown that differences in these excess returns are systematically related to the nature of the default risks which issuers represent. In a sample period of January 1999 to December 2007, portfolios generated so as to contain the debt securities of issuers representing higher default risk (measured by either default betas or fiscal indicators) earned a statistically significant risk premium of between 0.18% and

0.24% per annum in comparison to issuers of lower default risk. In a similar manner, results based upon cross-sectional regressions indicate that disparities in these excess returns can be systematically attributed to variation across issuers in the selected fiscal indicators and default betas, with estimated risk premia of between 0.16% and 0.19% per annum over the same (pre-crisis) period. Results based upon sample periods which include the sovereign debt crisis also demonstrate that measures of systematic default risk and these fiscal indicators can explain observed divergences in these returns, with investors experiencing large losses on holdings in EMU debt securities in a manner proportionate to the magnitude of default risks these issuers represented.

The results presented provide little evidence to substantiate the proposition that measures of systematic default risk are sufficient to explain observed variation in the returns on these securities. Whilst in sample periods including the sovereign debt crisis measures of systematic risk (based upon an EMU default factor) retain their statistical significance in cross-sectional regressions which also include fiscal indicators (with the coefficients on these fiscal indicators not being statistically different from zero), this result is not maintained when using risk-adjusted returns. Furthermore, as the best performing empirical specification includes both default betas and fiscal indicators I am led to reject the claim that knowledge of the magnitude of systematic default risk each issuer represents is sufficient to explain differences in the excess returns on these securities which stem from the prospect of an issuer defaulting on its obligations.

Overall, this chapter contributes to an existing literature which examines the relevance of systematic risks in the pricing of financial assets by expanding such topics to consider the relative default risks which exist amongst the issuers of sovereign debt in the EMU. The results presented provide new evidence establishing that fiscal indicators and systematic default risk matter in the pricing of EMU sovereign debt for sample periods which include and exclude the recent sovereign debt crisis. However, the most robust finding of this chapter is that overlaps exists between default betas and fiscal indicators in the manner of risks they embody, this suggests methodological difficulties in attempts to identify distinct risk premia for such variables.

Prospective future research could apply these concepts in a broader sample of sovereign nations (perhaps using data on sovereign CDS) which would facilitate the construction of portfolios sorted on a multi-variant basis and allow comparisons to be made between EMU and non-EMU issuers. Additionally, further dimensions of systematic risk could be incorporated into the factor model and allow the relevance of these additional risk dimensions to be examined for pricing EMU sovereign debt, e.g. term and/or a more direct measure of liquidity risk. From a purely methodological perspective, alternative estimation procedures could be adopted when calculating an issuer's degree of systematic risk, perhaps reflecting the non-constant variance of the return and default factor series which is particularly notable since the onset of the financial crisis. Future research could potentially use real-time data for the fiscal variables to analyse if financial markets respond to updates or revisions in this data and/or whether measuring fiscal variables at a higher frequency materially impacts the presented results. Additionally, the results indicate that fiscal indicators and default betas are significant predictors of the cross-section of excess returns on EMU sovereign debt, at least over forecast horizons of one month. Further forecasting exercises could be conducted to examine this predictive ability in more detail, perhaps considering horizons beyond one month or to identify the macroeconomic factors which cause credit spreads, and hence default risk premia on EMU sovereign debt, to fluctuate over time. Finally, future research could build upon the principal components analysis portion of the chapter to consider in more detail the cross-dependencies and transmission of default risks amongst EMU nations, particularly between core and peripheral member states, as in Afonso et al. (2014)

2.8. Bibliography

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Appendix A. Data Appendix

Table 2-12
Data Appendix

Variable	Units	Description	Time Period	Frequency	Source
Excess Returns	%	Difference in total holding return on ten-year, benchmark sovereign debt for each issuer relative an equivalent investment in debt issued by the German Government.	January 1999 - June 2012	Monthly	Reuters Datastream
Risk-Adjusted Excess Returns	%	Excess returns minus the product of an issuer default beta and its respective default factor.	January 1999 - June 2012	Monthly	Reuters Datastream
EMU Default Factor	%	Difference in total holding return between a broad index of BBB rated and AAA-AA rated Euro denominated corporate bonds.	January 1999 - June 2012	Monthly	Reuters Datastream & Bank of America Merrill Lynch
US Default Factor	%	Difference in total holding return between a broad index of BBB rated and AAA-AA rated US dollar denominated corporate bonds.	January 1999 - June 2012	Monthly	Reuters Datastream & Bank of America Merrill Lynch
Gross Government Debt Ratio	%GDP	The general government gross debt-to-GDP ratio for each sovereign issuer.	1999 - 2012	Annual	AMECO Database of the European Commission
Fiscal Balance Ratio	%GDP	The overall fiscal balance-to-GDP ratio for each sovereign issuer.	1999 - 2012	Annual	AMECO Database of the European Commission
Yield-to-Maturity on EMU Sovereign Debt	%	The yield-to-maturity on ten-year benchmark sovereign debt for each issuer.	January 1999 - June 2012	Monthly	Reuters Datastream

Chapter 3

Macroeconomic Imbalances & Sovereign Default Risk during the Economic and Financial Crisis

"This is, at its bottom, a balance of payments crisis. Resolving payments crises inside a large, closed economy requires huge adjustments, on both sides. That is truth. All else is commentary."

Martin Wolf

Financial Times, December 2011

3.1. Introduction

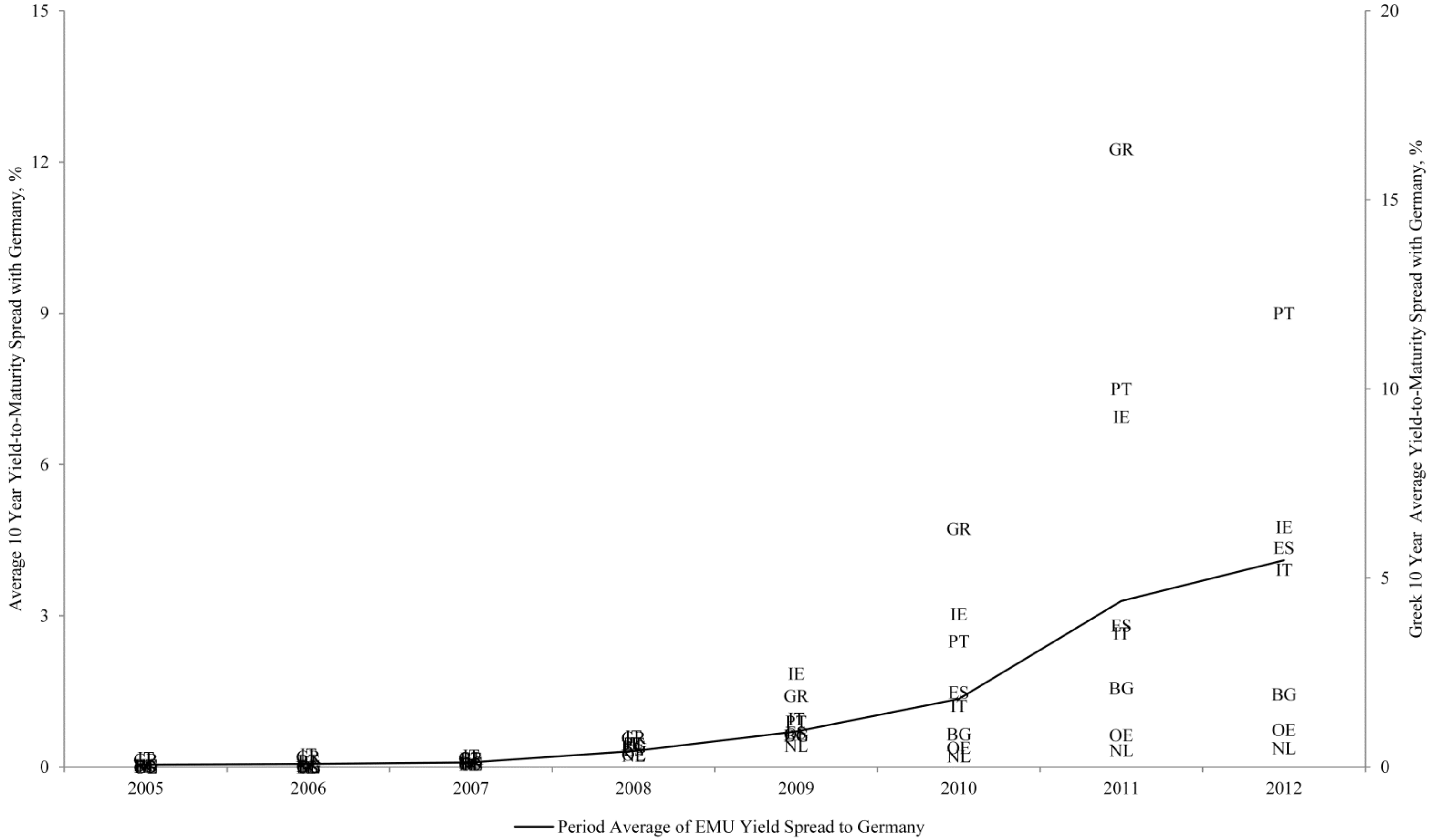
The economic and financial crisis has rekindled interest in understanding what factors influence financial market perceptions of sovereign risk and how such perceptions manifest through asset prices. Figure 3-1 illustrates the relative costs of public debt issuance amongst EMU member states over the period of 2005 to 2012, where Germany has been selected as the reference issuer[25]. The figure captures two pertinent empirical characteristics of these spreads. First, as represented by the solid line, there has been an increase in the average costs of debt issuance across the countries considered, rising from 0.07% in 2005 to approximately 5.5% in 2012. And second, there has been a significant upsurge in the dispersion of these costs; in 2012 they ranged from 0.38% for the Netherlands to more than 9.0% for Portugal whilst in 2005 this range extended from 0.0001% for Austria to 0.21% in the case of Greece.

There is now an expansive empirical literature which seeks to explain these dual developments by utilising panel regression methods. Recent contributions to this literature have highlighted that there are (at times) substantial discrepancies between the spreads implied by this class of model and the value of spreads observed in practice, particularly since the advent of the sovereign debt crisis in late 2009. Such evidence has been utilised to substantiate arguments that financial markets have incorrectly priced the relative risks associated with these securities given that their prices cannot be systematically related to an assumed fundamental basis.

[25] The spread in the yield-to-maturity on long-term public debt securities has become a barometer of the relative risks financial markets perceive to be associated with investments in these securities.

Figure 3-1

Yield-to-Maturity Spreads on Ten Year EMU Sovereign Debt relative to Germany: 2005 - 2012



Source: Reuters Datastream and Author's Calculations

This chapter examines to what extent these shortcomings stem from a failure to reflect the scale of macroeconomic imbalances which exist amongst EMU member states, which have perhaps moulded financial market perceptions of the relative default risks these issuers represented. The relevance of these imbalances for the pricing of EMU sovereign risk is investigated by estimating panel data models which either include or exclude variables approximating their scale. In the first instance estimation is conducted on the assumption that yield spreads can be exclusively determined by (i) the relative default risks sovereign issuers represent, approximated by differences in debt-to-GDP ratios, projected budget deficit-to-GDP ratios and squared values of these variables to capture the possibility of a non-linear relationship, (ii) differences in liquidity risk across issuers, and (iii) time-variation in the general price of risk, also referred to as global risk factors. On this basis the findings of the existing literature are re-established as it is demonstrated that substantial discrepancies exist between the spreads observed in practice and those implied by the model, which can only account for approximately 40% of their overall variation during the sovereign debt crisis.

This benchmark model is then expanded to include the following additional fundamental determinants of these spreads: (i) the scale of macroeconomic imbalances which existed across member states at the advent of the crisis, as approximated by the 2006 current account-to-GDP ratio, both independent of and interacted with national fiscal positions, (ii) developments in these current account positions subsequent to the start of the sovereign debt crisis, and (iii) projection errors in real-GDP growth rates across member states, calculated in real-time using data extracted from the OECD's economic outlook publication. The principal finding of this chapter is that once these additional factors are incorporated, the benchmark model is able to explain up to 82% of the observed variation in YTM spreads during the sovereign debt crisis. These results re-establish a link between observed yield spreads and their fundamental basis as well as providing empirical support for the notion that the sovereign debt crisis is, at its heart, a balance-of-payments crisis; Wolf (2011). Its resolution therefore hinges upon the introduction of a permanent adjustment mechanism for imbalances of this nature as well as improvements in national fiscal positions.

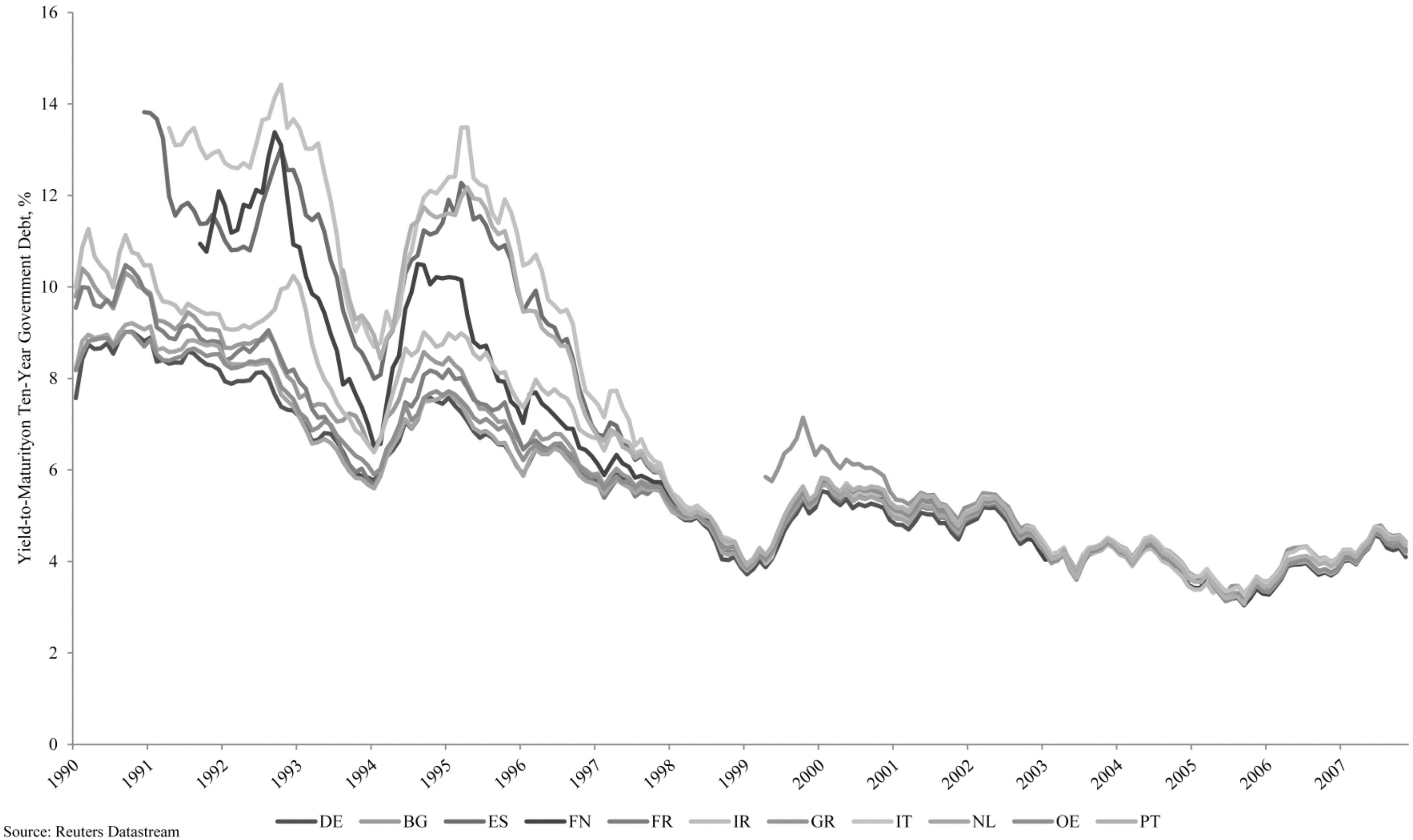
The rest of this chapter is structured as follows. In Section 3.2 I present a descriptive account of evolutions in sovereign risk premia amongst EMU member states from 1999 to 2012 and link these developments to the empirical literature. In Section 3.3 I describe the sample and methodology which is used to construct the benchmark specification. Section 3.4 reports and discusses empirical results based upon the benchmark model as well as that of an extended imbalances specification. Section 3.5 concludes, discusses the policy relevance of my results and highlights potential avenues for future research.

3.2.Sovereign Risk Premia in the EMU: 1999 - 2012

3.2.1. The Pre-Crisis Period: 1999 – 2007

The launch of the European Monetary Union (EMU) in January 1999 led to the creation of a large market for euro denominated public debt and the introduction of a harmonised monetary policy amongst its members. These events are perceived to have eliminated many of the relative risks historically associated with investments in foreign currency public debt amongst these nations, most notably depreciation or currency risk; see Pagano and Von Thadden (2004). As testament to this, in the run up to the launch of the EMU there was a notable convergence in the nominal interest rates on outstanding public debt of member states which is illustrated be Figure 3-2. This trend was particularly pronounced amongst "non-core" EMU member states such as Ireland, Italy, Portugal, Spain and Greece, for which yields on outstanding debts declined and came into line with those of "core" member states such as Germany, the Netherlands, France, Belgium and Austria.

Figure 3-2
Yield-to-Maturity on EMU Sovereign Debt: 1990 - 2007



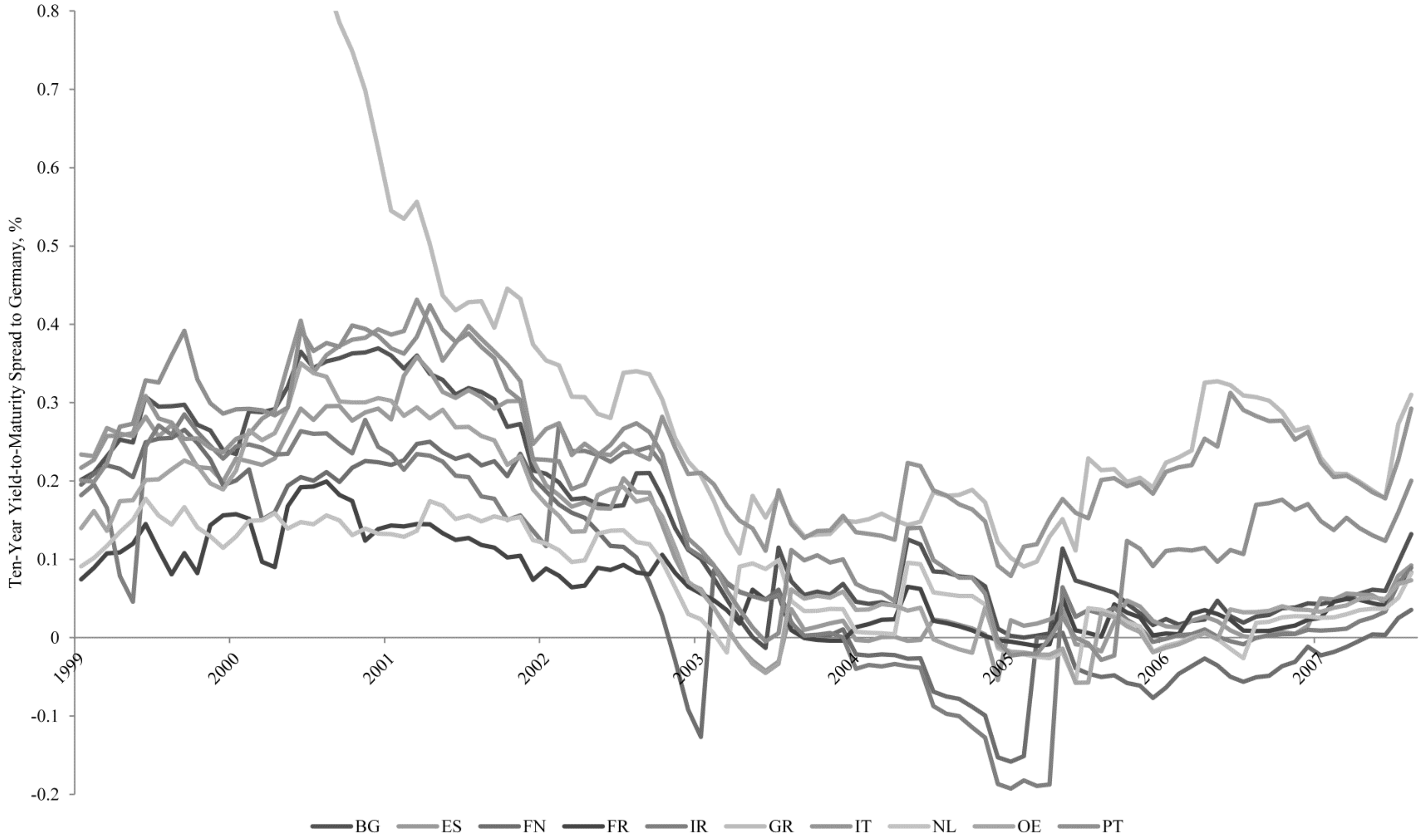
Source: Reuters Datastream

However, despite the scale of observed convergence it became apparent in the following years that the divergences in yields on public debt securities had not been completely eliminated as there remained persistent differences across countries. Figure 3-3 illustrates the difference (or spread) in the YTM on the ten year benchmark debt of member states relative to an equivalent German security. The figure highlights the persistent differences that remained characteristic of long-term government bond markets in the region although the size of such differences were small, at most approximately 40 basis points, or equivalently 0.40%.

In the perceived absence of currency or redenomination risk (owing to the lack of a palpable threat of the EMU's breakup) the empirical literature of this time emphasised the relevance of three remaining categories of risk when attempting to explain such divergences, these were as follows: (i) *Default Risk*: there remained the prospect that a sovereign issuer was either unable or unwilling to fulfil its repayment obligations and therefore default on its debts, (ii) *Liquidity Risk*: it was recognised that investors in sovereign debt valued the importance of being able to realise their investments prior to maturity at a price close to 'fair-value', and (iii) *Changes in Global Risk:* investors were thought to require a risk premium for bearing sovereign default risk above and beyond the product of the losses they expected to incur in the event of a default and a risk-neutral probability of this occurring.

Figure 3-3

Yield-to-Maturity Spread on Ten Year EMU Sovereign Debt: 1999 - 2007



Source: Reuters Datastream and Author's Calculations

A prominent finding of the empirical literature which considered sample periods of 1999 to 2007 was that the main driver of time-variation in spreads was changes in the pricing of global risk, or influences that were common across all countries. These global risk factors were calculated as a corporate bond credit spread, i.e. the spread between the YTM of an index of low-rated corporate bonds and that of an equivalent index for higher rated bonds or government securities, see Codogno et al. (2003), Bernoth et al. (2004) and Manganelli and Wolswijk (2009). In contrast, a comparatively insubstantial link was believed to exist between fiscal variables and these spreads despite the values of such fiscal indicators differing across countries to a substantial degree. For example whilst Codogno et al. (2003) find that global risk factors are significant in explaining developments in YTM spreads for all but two countries in their sample they find that debt ratios are significant for only three of the countries they consider: Austria, Italy and Spain. This literature was also characterised by a lack of consensus relating to the relative importance of liquidity risk, Codogno et al. (2003) demonstrated that a series of liquidity measures (e.g. bid/ask spreads) were statistically insignificant in explaining spreads when included alongside global risk factors, whilst Manganelli and Wolswijk (2009) find a more prominent and time-varying role for liquidity in their analysis.

Overall this pre-crisis literature was divided over to what extent the small, yet perceptible, cross-country spreads on EMU public debt could be attributed to a premium for default risk or whether they reflected differences in other factors, such as liquidity risk. However, there was a broad consensus that what drove the time-variation in yield-spreads was changes in the global risks investors faced and that such risks were linked to credit spreads in other categories of financial asset, e.g. corporate bonds.

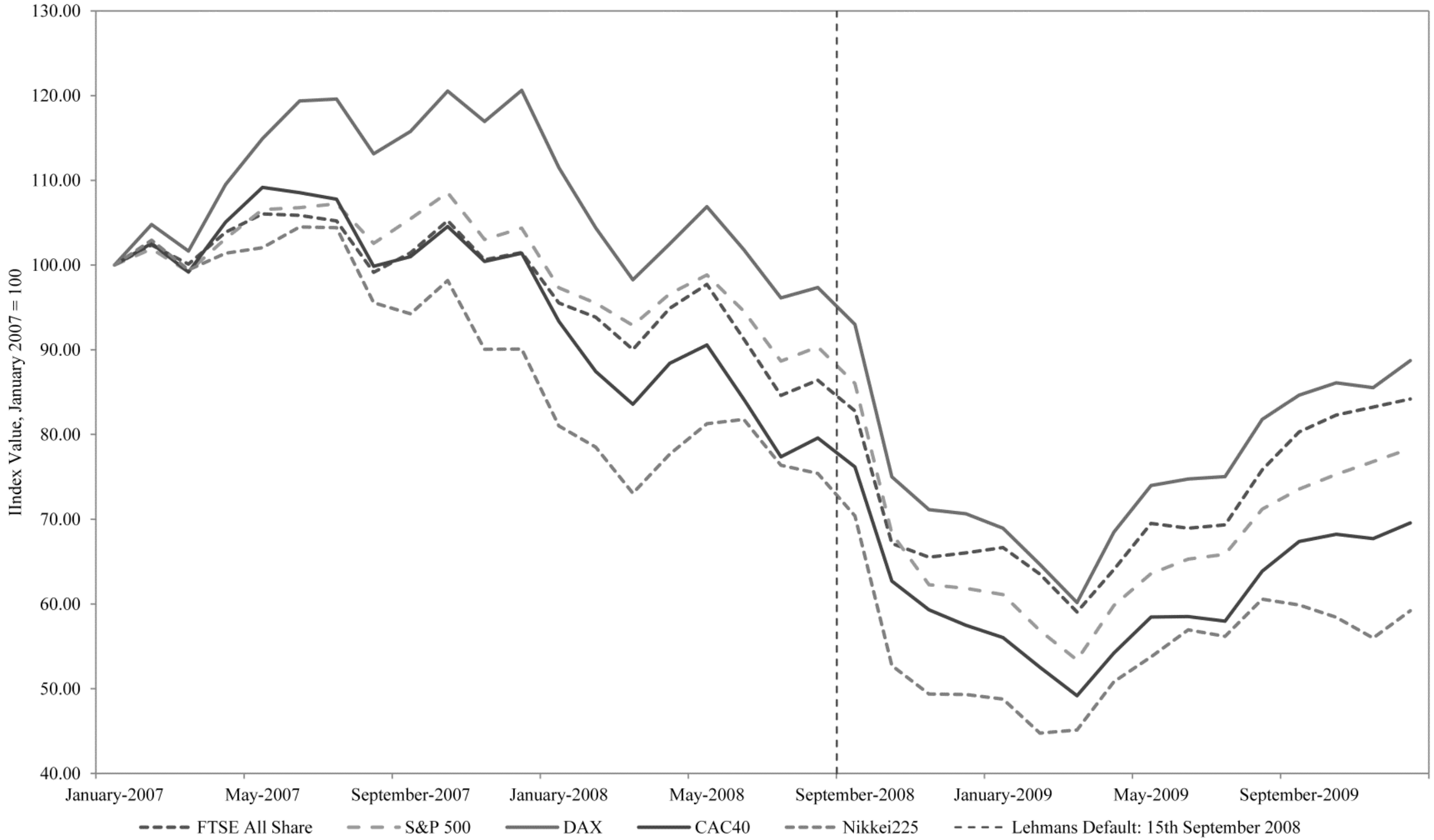
3.2.2. The Early Financial Crisis Period: 2008 – 2009

At the end of 2007 concerns were beginning to mount regarding developments in a relatively small segment of the US financial system: the market for sub-prime residential mortgages. US house prices had been rising over the preceding decade, a trend perceived to have been supported by favourable demographic developments, the accommodative stance of the Federal Reserve and the growth of innovative, and increasingly complex, forms of mortgage financing, see Ackermann (2008). These new forms of mortgage financing facilitated the emergence of a market for sub-prime residential lending which allowed individuals with impaired credit histories and low incomes to purchase residential property. Through securitisation these mortgages could be re-packaged as asset backed securities, thereby allowing their associated risks and return to be distributed beyond the originator of the initial mortgage arrangement. As these securities offered relatively favourable returns they were met with healthy demand from institutional investors across the globe.

From around the middle of 2004 the Federal Reserve began to gradually raise short-terms interest rates in response to the strong performance of the US economy and in an attempt to stave off inflationary pressures. One result of this shift in policy stance was that the interest rates on mortgages began to rise and so too did their default rates, particularly in the sub-prime sector; thereby leading the value of assets linked to the repayment of these mortgages to fall. Concerns began to mount over the exposure of the banking sector to this segment of the US mortgage market and the losses they were likely to incur from holdings in asset backed securities. These concerns spread broadly and globally as the scale of the risks redistribution which had been facilitated by securitisation became clearer and the global financial system entered a phase commonly referred to as the “Credit Crunch”. A crisis of confidence ensued, liquidity in the inter-bank lending market dried up as well as in related segments of the money market, such as that of asset backed commercial paper. Firms particularly reliant upon forms of short-term, wholesale funding came under liquidity pressures and in many cases were unable to continue trading as independent entities e.g. Bear Stearns and Northern Rock.

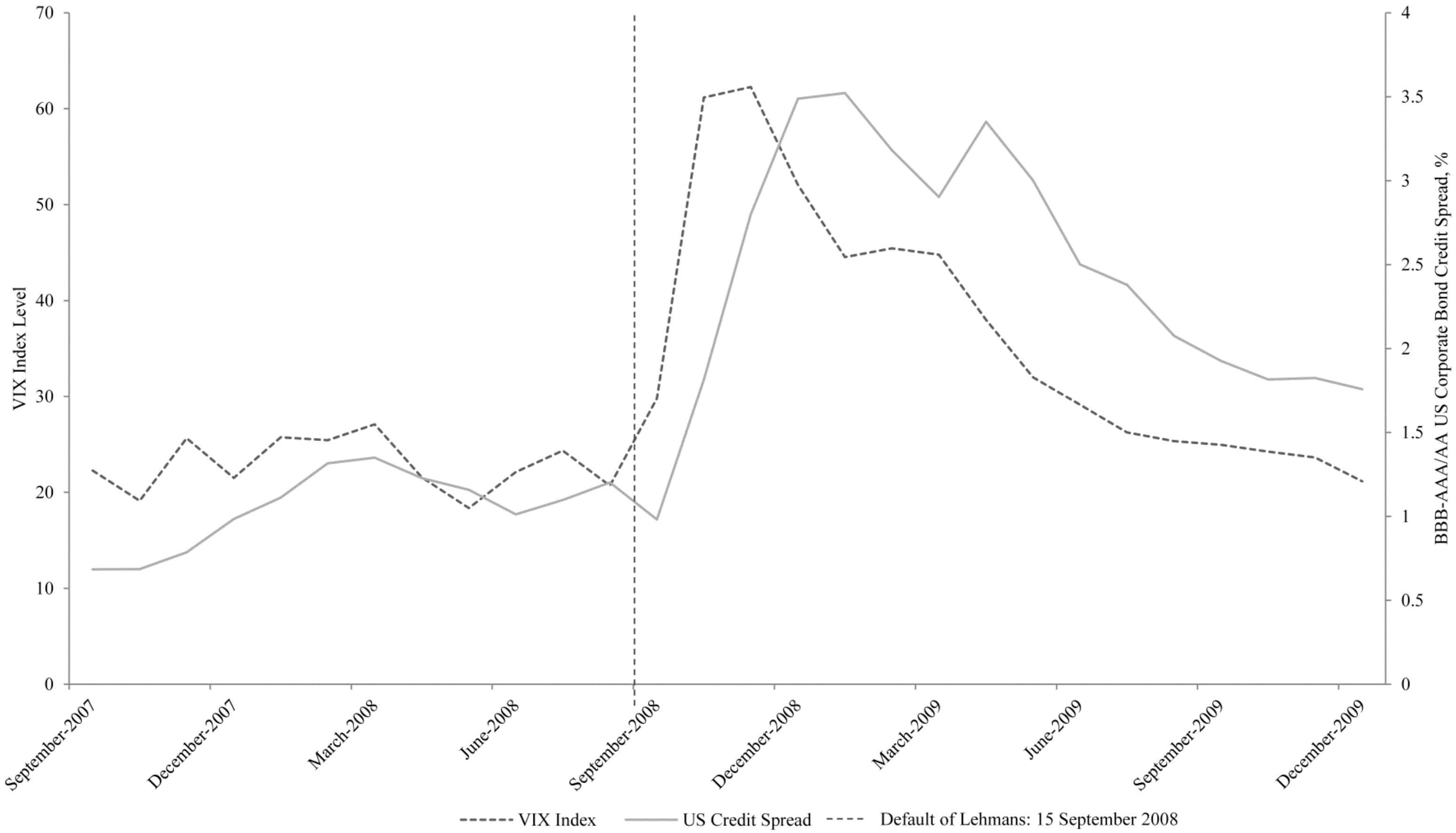
On September 15, 2008 a combination of these events led to the failure of Lehman Brothers and a large shock was unleashed upon the global financial system. At this point Lehman Brothers was the fourth largest US investment bank at this time and was viewed as a key operator in international bond and securitisation markets. The bankruptcy of Lehman Brothers has been held up as the event which led the credit crunch to transform into a global financial crisis, although, as argued by Mishkin (2011), whilst its default may have been a key trigger there were other significant events around this point which also contributed to the crisis entering a new, more pernicious, stage. From this point forward financial markets were characterised by both severe volatility and the expectation that this volatility was to persist. Equity markets across advanced economies dropped in synchrony (Figure 3-4), credit spreads between low rated corporate bonds and their higher rated counterparts widened to reflect concerns over default risk and investors began to project elevated future volatility in equity markets, as indicated by the upsurge in the CBOE VIX index (Figure 3-5).

Figure 3-4
Equity Indices for Major Advanced Economies: 2007 - 2009



Source: Reuters Datastream and Author's Calculations

Figure 3-5
Corporate Bond Credit Spread & CBOE VIX Index: 2007 - 2009

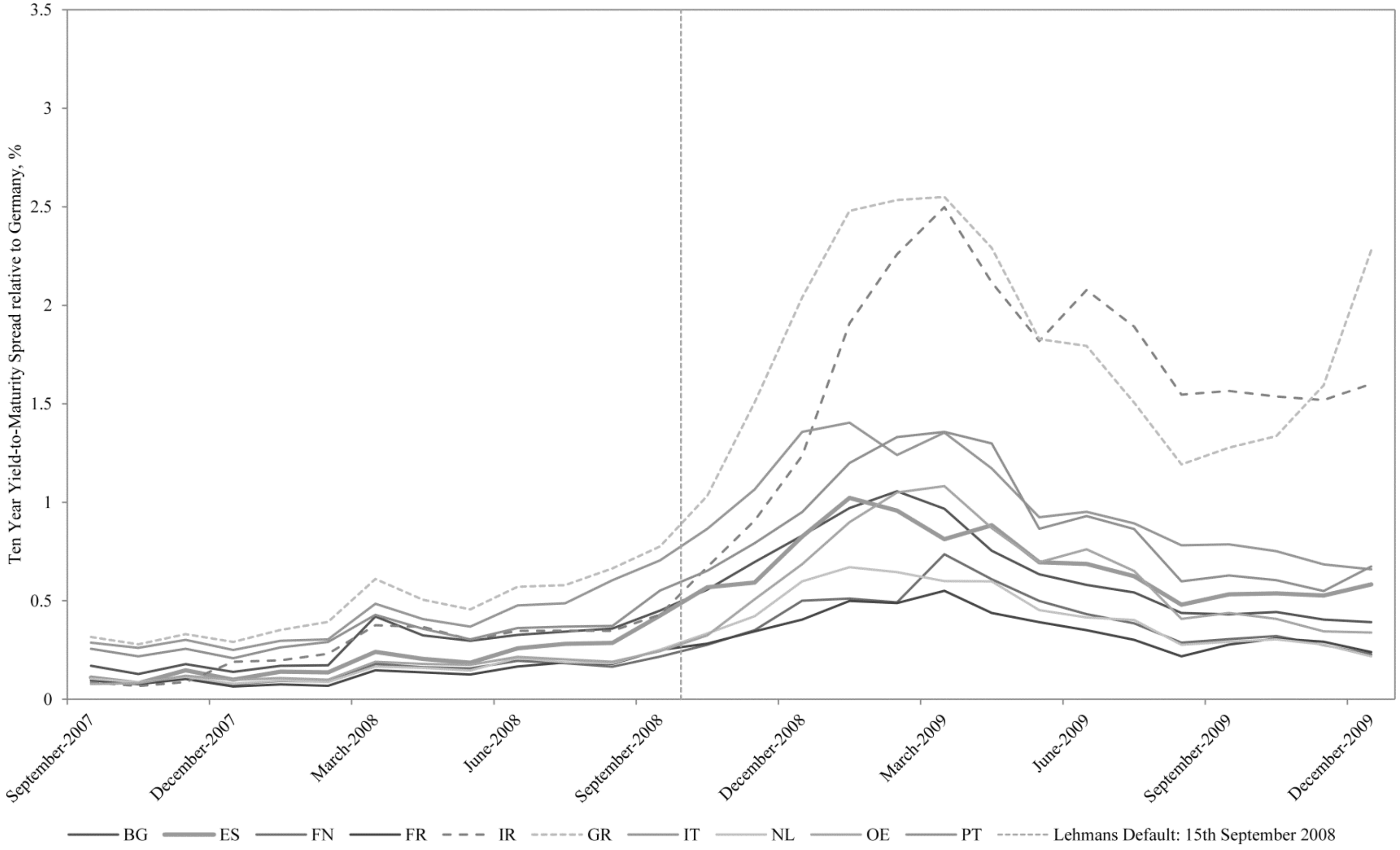


Source: Reuters Datastream and Author's Calculations

Sovereign debt markets were not insulated from the events which were transpiring in global financial markets. As tensions rose and fears over default risk mounted so too did YTM spreads on sovereign debt. There was an increase in both the level and degree of dispersion in these spreads on sovereign which was noticeably larger for Greece and Ireland; this is shown in Figure 3-6.

Policy-makers in advanced economies responded in earnest to the events unfolding in financial markets by implementing a range of emergency measures in an attempt to stem market volatility and cushion the impact of the financial crisis on the real economy. This included the direct recapitalisation or nationalisation of banks, the introduction and extension of public guarantees over a variety of banking liabilities, the authorisation of programmes which allowed the government to purchase illiquid and difficult to value assets, such as mortgage backed securities, and finally fiscal stimulus packages including cuts in indirect taxation and car scrappage schemes. A degree of stability was restored to the global financial system which led markets to upgrade the macroeconomic prospects of the advanced world, which although remaining precariously balanced were not anticipated to be the subject of a 1930s style depression. The macroeconomic context improved, risk premia across asset classes subsequently fell and equity markets regained some of their earlier losses (see Figure 3-4and Figure 3-5)

Figure 3-6
Yield-to-Maturity Spreads on Ten Year EMU Sovereign Debt: 2007 - 2009



The large divergences in relative borrowing costs observed across the EMU from September 2008 rekindled interest in understanding what factors underpin financial market perceptions of sovereign default risk and how these perceptions manifest through asset prices. In line with the pre-crisis literature studies of this period identified a prominent role for global risk factors in capturing the common time-variation in sovereign yield spread, which was measured by corporate bond credit spreads, the VIX index, see Haugh et al. (2009), Attinasi et al. (2009) and Arghyrou and Kontonikas (2010), or as latent factors extracted from the YTM spread series and/or the prices of other financial instruments by employing filtering techniques or principal component methods, see Sgherri and Zoli (2009), Longstaff et al. (2011) and Barrios et al. (2009).

In addition to reconfirming pre-crisis results establishing a prominent role for global risk factors this literature presented new evidence highlighting that the response of financial markets to fiscal imbalances became more forceful following on from the advent of the financial crisis and in particular since the default of Lehman Brothers. von Hagen et al. (2011) presented evidence of a structural break in the relationship between fiscal indicators, such as debt and budget deficit ratios, and sovereign risk premia since this point and found the penalty applied for further deteriorations in these fundamental indicator were also larger in comparison to the pre-crisis period. Similarly a number of studies presented evidence of a significant link between country-specific fiscal developments and measures of sovereign risk, highlighting that the increase in yields differentials could be related to either projected or contemporaneous deteriorations in national fiscal circumstances, see

Attinasi et al (2009) and Sgherri and Zoli (2009). Evidence was also presented which suggested that this relationship was non-linear, as not only the level deterioration in fundamental indicators was priced into these securities but also the rate at which the deterioration occurred as captured by squared versions of fiscal indicators, as demonstrated by Haugh et al. (2009) and Ostry et al. (2010).

Overall the findings of the empirical literature examining yield spreads in the period of financial crisis but preceding the events from the end of 2009 onwards were that the general rise and dispersion of the risks associated with public debt was linked to changes in global risk factors as well as a growing role for country specific developments reflecting both the level and outlook of fiscal fundamentals in both a linear and non-linear manner

3.2.3. Economic & Sovereign Debt Crisis: 2009-Q4 and Onwards

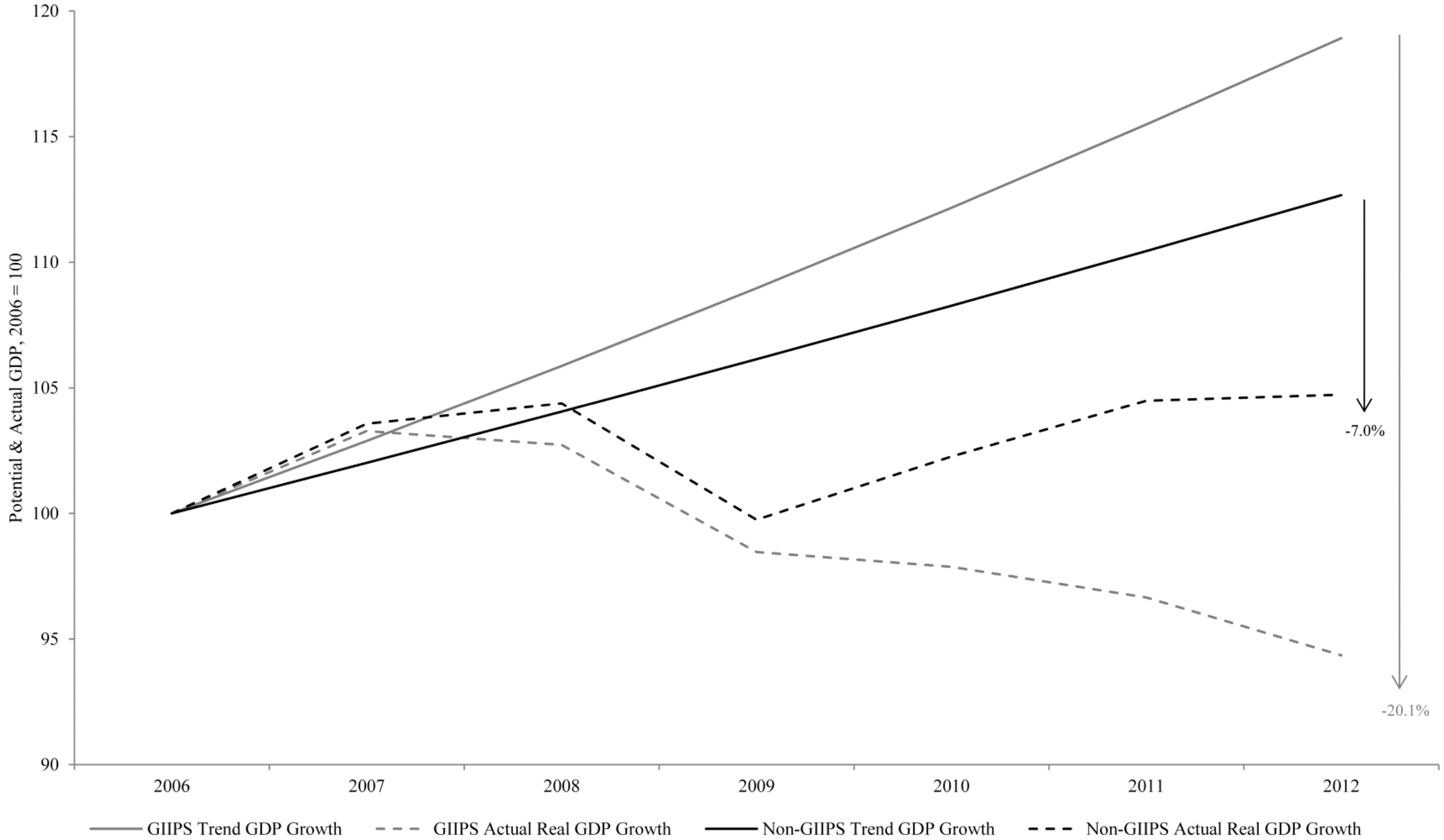
From the end of 2009 onwards the basis of the crisis transformed from financial to economic. During this period economic growth began to resume in many economies and the Eurozone, alongside most of the advanced world, began to emerge from the recession which had been brought about by the financial crisis. However, the overall increases in EMU output masked underlying differences in the growth scenarios countries were experiencing which had become increasingly disparate and uncertain, IMF (2011). Within the EMU the economic recovery was perceived to be taking places at different speeds with comparisons being made between Northern member states, most notably Germany, and those of the periphery, such as Greece, Ireland, Italy, Portugal and Spain.

What is believed to have lain behind such growth disparities was the scale of macroeconomic imbalances that existed within and between member states and their manifestation through a combination of current account deficits, over-valued real-effective exchange rates, high consolidated levels of debt and a lack of international competitiveness. In the years preceding the crisis, Southern EMU nations experienced large capital inflows which were perceived to have pushed up overall prices and unit-labour costs, see Lane (2011). These increases in labour costs were not supported by a corresponding rise in productivity and resultantly led to the generation of large external deficits and debts. The economic growth rates experienced during the pre-crisis period were perceived to be unsustainable given they were underpinned by significant expansions in credit which fuelled similarly unsustainable expansions in non-tradable sectors (such as the construction of commercial property) pushing up wages and prices in both tradable and non-tradable sectors. In order to eliminate these imbalances and regain competitiveness these economies are viewed as required to undertake a period of devaluation, a process which in the absence of a depreciation in the nominal exchange rate is to be pursued internally through a period of relatively low wage and price inflation relative to a nation's major trading partners as well as structural reforms of their public finances, see Wolf (2011) and Sinn (2013).

It became recognised that the correction of macroeconomic imbalances and deleveraging of debts built up prior to crisis would likely weigh on national growth prospects, particularly where the scale of imbalances were perceived to be the greatest. Figure 3-7 shows the path of potential output for Greece, Ireland, Italy, Portugal and Spain (GIIPS) and non-GIIPS nations as outlined in 2006 as well as observed development in economic growth over this same period. By 2012 the economic output of the GIIPS economies was approximately 20.1% below what would have been the case if the economy had grown on the basis of forecasted, pre-crisis (2006) trends, compared to only 7.0% in the case of non-GIIPS nations.

Figure 3-7

Shortfall in GIIPS and Non-GIIPS Economic Output Relative to Pre-Crisis (2006) Trend Growth



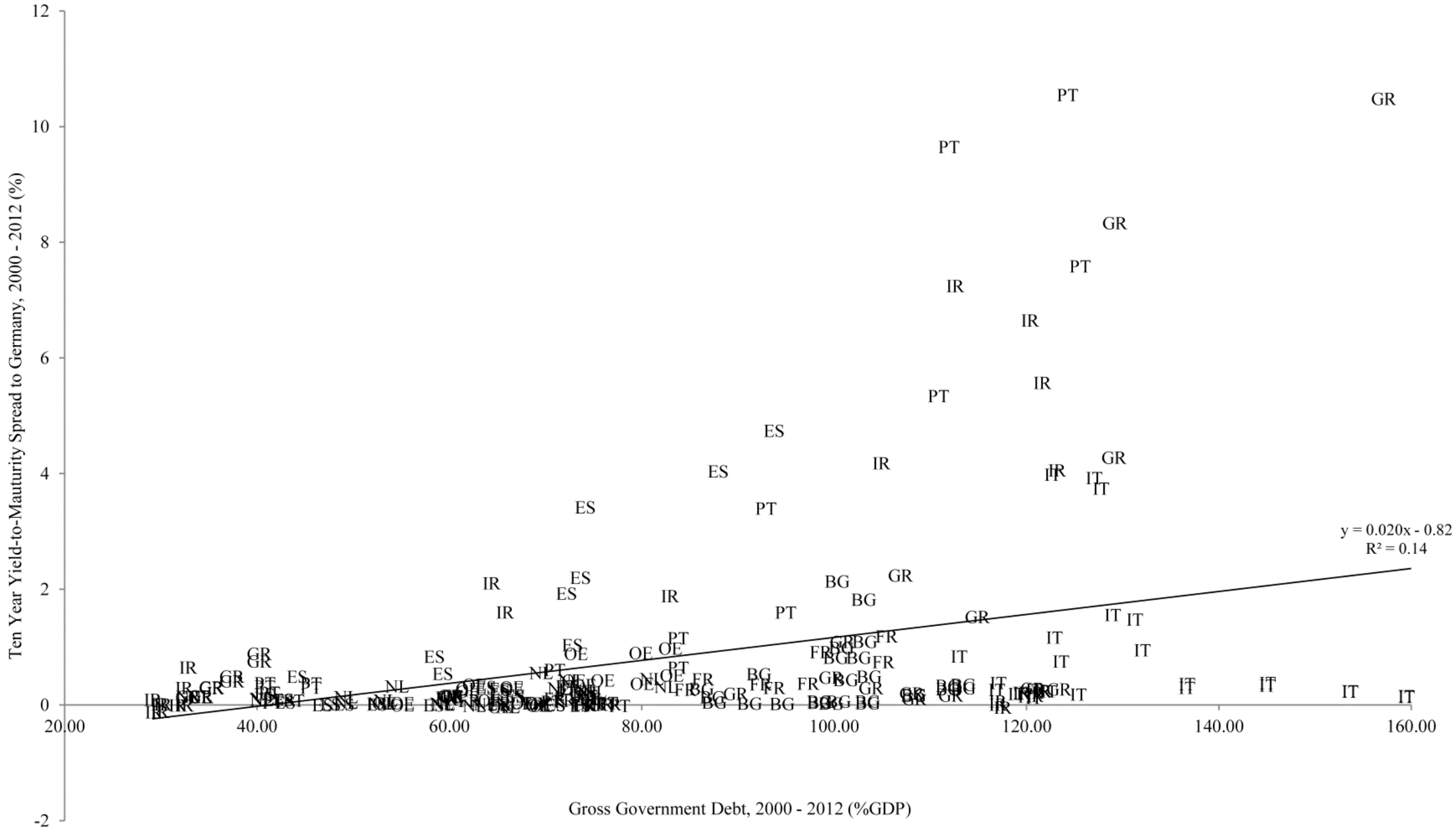
Source: OECD Economic Outlook 80 and 92, and Author's Calculations

Over this period one manifestation of these economic problems was an intensification of pressures from bond markets on certain EMU sovereign issuers. From the end of 2009 concerns became elevated regarding the sustainability of sovereign fiscal positions across advanced economies particularly within the periphery of Europe. After a general election in October 2009 the Greek government presented a revised 2009 deficit forecast of 12.7% which was more than double the preceding estimates and similarly revised upwards its national budget deficit for other years. These large revisions precipitated a dramatic rise in yield spreads for Greek sovereign debt and other countries followed suit with Irish and Portugal spreads hitting unprecedented levels since the launch of the EMU. Several countries were eventually shut out of international bond markets and required to accept funding support through joint EU and IMF programmes on the condition that fiscal austerity packages and structural reforms measures were implemented; in particular Greece was shut out of international bond markets on May 2010 followed by Ireland in November 2010 and Portugal in April 2011, Lane (2012). Over this period perception of sovereign default risk diverged dramatically across member states, particularly between peripheral EMU states and the other advanced economies of Europe.

Attempts to reconcile these dramatic divergences with changes in country-specific budgetary fundamentals and in-line with estimated historical empirical relationships have proven somewhat elusive for more recent contributions to the empirical literature. De Grauwe and Ji (2012) relate EMU yield spreads to debt-to-GDP ratios (in both a linear and non-linear fashion) as well as to national current account positions. To replicate a portion of their work, I plot debt-to-GDP ratios against EMU yield spreads over the period of 2000 to 2012 (Figure 3-8), although the data presented is semi-annual whilst theirs is quarterly. The data points above the simple bivariate regression line are taken to illustrate the inconsistency of market pricing of sovereign debt with fundamental indicators which approximate an issuer's default risk. Analysis of this nature is accompanied by additional econometric work and further cross-country (non-EMU) comparisons to form the basis of an argument that markets have penalised fiscal imbalances in an manner inconsistent with fiscal fundamentals, making a case for additional liquidity support for distressed sovereigns which although illiquid are believed to be fundamentally solvent.

Figure 3-8

Fundamentals Line: Gross Government Debt-to-GDP and EMU Yield Spreads: 2000 - 2012



Source: OECD Economic Outlook Publication, Reuters Datastream and Author's Calculations

Favero and Missale (2012) similarly study YTM spreads on EMU sovereign in sample period which includes 2009 – 2012 and in keeping with the existing empirical literature relate the time-variation in spreads to variables which capture global or aggregate risks, both independently and as a function of fiscal variables. Their contribution rests on allowing spreads of other nations to influence country-specific yield developments in a non-linear manner which is determined by the proximity of other nation's budgetary fundamentals to its own. They argue that instability in the parameter estimates for this global variable is evidence that markets price default risk amongst advanced economies in a discontinuous fashion and in this sense it is regarded as possible that markets can push sovereigns away from a fundamental driven equilibrium for a prolonged period.

A recent study conducted by Alessandrini et al. (2013) examines the relationship between of external imbalance amongst EMU member states and YTM spreads in a sample period which includes the recent sovereign debt crisis. They argue that the large increase in spreads observed since this point reflects the growing importance of external imbalances at the onset of the global financial crisis. The approach taken here differs to their study in several ways. First, they elect to not incorporate the current account-to-GDP ratio in their empirical analysis, as will be shown I find that markets systematically discriminated between sovereign issuers on the basis of the magnitude of pre-crisis (2006) current account ratios as well as subsequent developments in this measure. They also do not consider the role of potential non-linearity in the fiscal variables; my results provide evidence that this non-linearity improves our understanding of developments in yield spreads. In consideration of the role of economic growth in sovereign bond pricing, the authors utilise the rate of GDP growth whereas I employ a real-time forecast error in this variable based upon economic projections produced by the OECD. Finally, the sample period I employ includes a longer portion of the EMU sovereign debt crisis (ending in 2012-Q2 as opposed to 2011-Q2).

Overall, recent contributions to the empirical literature have struggled to rationalise the increase and dispersion in sovereign borrowing costs on the basis of any fundamental indicators of fiscal sustainability. These findings have led such studies to label bond markets as irrational, or characterised by panic, which has pushed sovereign bond pricing away from a fundamental basis. Although further studies have found support for the conception that external imbalance in existence between member states may be one reason for this identified incongruence.

3.3. Data and Methodology

The empirical portion of this chapter employs a benchmark empirical specification which includes the fundamental determinants of sovereign default risk to explain developments in EMU sovereign yield spreads over three sub-periods: (i) the p*re-crisis* period which runs from 2005 to 2007 when yields on sovereign debt were notable for small, yet persistent differences, across countries (ii) a *global financial crisis* period of 2007 to 2009 when the global financial system became unseated by developments in securitisation and wholesale funding markets and investors began to reappraise the risks associated with a wide variety of asset classes (corporate bonds, equities and sovereign debt), and finally (iii) an *economic and sovereign debt crisis* from the end of 2009 to 2012 during which sovereign debt markets took centre stage with investors distinguished strongly across issuers of sovereign debt and yield spreads spiked to unprecedented highs.

3.3.1. Benchmark Specification and Sample Details

I estimate a benchmark empirical specification motivated by the existing literature whereby spreads reflect: (i) the relative default risks which issuers represent, as approximated by difference in debt-to-GDP and projected budget deficit-to-GDP ratios and their squared values to capture potential non-linearity, (ii) differences in the general level of liquidity across secondary markets for EMU public debt of alternate issuers and (iii) time-variation in the general pricing of risk, or global risk factors. The fitted values of this benchmark specification are then compared to yield spreads which are observed in practice, the difference between these two measures is taken to approximate their non-fundamental component.

The general form of the benchmark specification estimated is as follows:

$$EMU\_Spread_{it} = \alpha + \beta_1 Debt_{i,t-1} + \beta_2 Deficit_{i,t+1} + \beta_3 Liquidity_{i,t} + \beta_5 Current\_Account_{i,t} + \beta_5 Global\_Risk_{i,t} + \varepsilon_{it} \quad (3\text{-}1)$$

where i and t denote country and time indices respectively, EMU_Spread_{it}, is the difference in yield-to-maturity on ten year benchmark government debt of each issuer relative to Germany, $Debt_{i,t-1}$ signifies the lagged value of a nations gross government debt as a ratio of GDP, $Deficit_{i,t+1}$ is the one year ahead projection of a nation's general government primary balance as a ratio of GDP[26], $Liquidity_{i,t}$ the total outstanding nominal public debt as a proportion of total debt issued by EMU member states, as outlined by Bernoth et al. (2004) as an alternative and more readily available approximation for secondary market liquidity, $Current\_Account_{i,t}$ is the (balance-of-payments) current account balance as a ratio of GDP for each nation and finally,$Global\_Risk_{i,t}$ is the difference in yield-to-maturity on an index of BBB rated corporate bonds and a comparable index of AAA-AA bonds. All country-specific variables are calculated relative to Germany, which taken to be the reference issuer and is therefore excluded from the estimations.

Data for the fiscal variables and a nation's current account position are taken from subsequent editions, or vintages, of the OECD's economic outlook publication produced semi-annually in January and July. This means that the fiscal variables are calculated in real-time and therefore reflect, at each date, the data in a form which would have been available to economic agents at that point in time, e.g. financial markets. The fiscal data is updated on a semi-annual basis; this is the highest

[26] To avoid problems with collinearity the baseline specification includes Gross Government Debt ratio on a lagged basis and real-time forecasts of the Primary Balance-to-GDP ratio.

frequency available when using real-time data contained in the OECD's Economic Outlook publication. The yield-to-maturity data used in constructing EMU_Spread_{it} and $Global\_Risk_{i,t}$, are taken from Reuters Datastream with the data for the corporate bond indices being calculated on the basis of indices generated by Bank of America Merrill Lynch, and finally $Liquidity_{i,t}$ is calculated using the nominal value of outstanding debt for each member state for which data is taken from subsequent edition of the OECD's Economic Outlook publication. Details of the dataset used are outlined in Table 3-4 of Appendix A.

I estimate equation (3-1) using data for 9 EMU member states, on a quarterly basis over the period of 2005Q3 to 2012Q2. I remove Greece from my sample from Q2 2011 onwards given that its yield spreads reached up to 28.8% following on from this point and hence would dominate the reported empirical results. The end of the sample period is Q2 2012 which coincides with a speech given by ECB chairman Mario Draghi on July 26 2012 during which large scale liquidity interventions in EMU sovereign debt markets were pledged in the form of Outright Monetary Transactions (OMT), this led to large decreases in the yield-to-maturity spreads on peripheral EMU sovereign debt.

Equation (3-1) is estimated over the three sub-periods discussed to give the fundamentals specification the best possible chance of characterising actual developments in sovereign risk during each period, this methodological choice and the associated relaxation of assuming a constant response to each independent variable over time is found to be important as the magnitude and sign of parameter estimates vary over the sub-periods considered[27]. Equation (3-1) is also estimated in the absence of country-specific fixed effects which when included are found to absorb much of the explanatory power associated with the government debt and liquidity indicators as they exhibit little variation over time. Additionally, by including these effects consideration would be limited to understanding the within-groups determinants of YTM spreads and thereby ignoring variation across countries. As has been demonstrated one of the pertinent characteristics of YTM spreads in the recent debt crisis period has been cross-country disparities in their values. The omission of fixed effects also mirrors the approach adopted by von Hagen et al. (2009, 2011).

[27] An alternative would be to interact time-dummy variables with the explanatory variable for each sub-periods, see for example Afonso et al. (2014),

3.4. Empirical Results

3.4.1. Baseline Specification

The results of estimating equation (3-1) for three sub-periods and the full sample are reported in Table 3-1. In all specifications the fiscal indicators are significant at the 1% level and are signed in a manner consistent with economic intuition, i.e. marginal increases in a nation's debt-to-GDP ratio and falls in the magnitude of its projected primary balance-to-GDP ratio (both relative to the German benchmark) coincide with an increase in YTM spreads. There is also an increase in the magnitude of the point estimates for the fiscal variables across the sub-periods considered, which confirms the findings of existing studies which describe markets as penalising fiscal imbalances more vigorously from the onset of this crisis and since its transition into a sovereign debt crisis.

In terms of the other explanatory variables the coefficient on the current account balance ratio is also significant at conventional levels for all three sub-periods and its negative sign indicates that countries with current account positions in deficit (surplus) relative to Germany and/or those which experienced deteriorations in these positions were characterised by higher (lower) yield spreads Although this coefficient is not significant when the specification is estimated over the full sample period and only at the 10% level during the sovereign debt crisis.

Table 3-1

EMU Yield Spreads: Fundamentals Specification

Dependent Variable: 10 Year YTM Spread (%) **Data Frequency**: Quarterly	(1) **Pre-Crisis** 2005Q3 - 2007Q4		(2) **Financial Crisis** 2008Q1 - 2009Q3		(3) **Sovereign Debt Crisis** 2009Q4 - 2012Q2		(5) **Full Sample Period** 2005Q3 - 2009Q3	
Explanatory Variables:								
Gross Debt-to-GDP (lagged)	0.00264***	(14.03)	0.0111***	(4.05)	0.0796**	(5.83)	0.0308***	(5.02)
Primary Balance-to-GDP (forecast)	- 0.0172***	(5.14)	- 0.111***	(4.60)	- 0.456***	(4.14)	- 0.297***	(5.64)
Current Account Balance-to-GDP	- 0.00587***	(11.24)	- 0.0127**	(2.36)	- 0.128*	(1.93)	- 0.00914	(0.34)
Liquidity	- 0.00107***	(3.14)	- 0.0195***	(4.15)	- 0.152***	(5.90)	- 0.0620***	(5.98)
Global Risk	0.154*	(1.83)	0.375***	(8.91)	- 1.59	(0.53)	0.359	(1.39)
Constant	- 0.0768	(1.39)	- 0.753***	(4.74)	0.0927	(0.02)	- 0.940	(2.38)
Estimation Methodology	Pooled-PCSE		Pooled-PCSE		Pooled-PCSE		Pooled-PCSE	
R^2	0.75		0.69		0.40		0.22	
NT	90		63		92		245	

*Notes: t-statistics are reported alongside coefficient estimates in parentheses, these statistics are calculated using panel-corrected standard errors which assume that the disturbances are heteroskedastic and contemporaneouly correlated across panels, i.e. Panel Corrected Standard Errors (PCSE). * Significant at 10% level, ** Significant at 5% level and *** Significant at the 1% level.*

The liquidity indicator is statistically significant in all specifications and signed such that issuers of greater liquidity benefitted from lower yield spreads. Again the magnitude of the estimated point estimates are increasing over the sub-periods suggesting that markets placed a greater premium on an issuer's liquidity during the crisis. Finally, in line with existing studies I find a significant role for global risk in explaining time-variation in spreads during the pre-crisis and financial crisis periods; however during the sovereign debt crisis and in the full sample period this variable does not appears to be systematically related to spreads.

The benchmark model explains 75%, 69% and 40% of the variation in yield spreads during the pre-crisis, financial and sovereign debt crisis periods, respectively. These results therefore indicate the significant magnitude of disparities between developments in yield spreads and the perceived fundamental determinants of these spreads during the sovereign debt crisis. I examine whether the fit of this benchmark model can be improved by incorporating additional variables which capture a non-linear relationship between fiscal fundamental indicators and yield spreads, as highlighted by De Grauwe and Ji (2012) and Haugh et al. (2009). This non-linearity is motivated on the basis that markets might penalise extreme movements in the fundamentals indicators more vigorously. I therefore re-estimate the specification outlined in column (1) of Table 3-1 but include squared values of the fiscal indicators, the results for the alternative sample periods are shown in columns (1) to (5) of .

Table 3-2

EMU Yield Spreads: Non-Linear Fundamentals Specification

Dependent Variable:10 Year YTM Spread (%) **Data Frequency**: Quarterly	(1) **Pre-Crisis** 2005Q3 - 2007Q4		(2) **Early Crisis Period** 2008Q1 - 2009Q3		(3) **Sovereign Debt Crisis** 2009Q4 - 2012Q2		(5) **Full Sample Period** 2005Q3 - 2009Q3	
Explanatory Variables:								
Gross Debt-to-GDP (lagged)	0.00234***	(12.17)	0.00760***	(4.49)	0.0818***	(5.21)	0.0325***	(4.79)
Squared Gross Debt-to-GDP (lagged)	0.0000232***	(5.09)	0.000182***	(4.38)	0.000407*	(1.66)	- 0.000166	(1.27)
Primary Balance-to-GDP (forecast)	- 0.0154***	(3.10)	- 0.00235	(0.08)	- 0.689***	(3.75)	- 0.264***	(3.93)
Squared Primary Balance-to-GDP (forecast)	- 0.0017	(1.22)	0.0158***	(4.33)	- 0.0409*	(1.79)	0.00816	(0.63)
Current Account Balance-to-GDP	- 0.00485***	(7.44)	- 0.0131***	(3.17)	- 0.118*	(1.70)	- 0.0158	(0.63)
Liquidity	- 0.00163***	(3.32)	- 0.0211***	(4.13)	- 0.161***	(5.95)	- 0.0573***	(5.37)
Global Risk	0.167*	(1.90)	0.364***	(10.07)	- 0.700	(0.25)	0.345	(1.35)
Constant	- 0.100*	(1.72)	- 0.834***	(4.79)	- 1.60	(0.36)	- 0.822**	(2.05)
Estimation	Pooled-PCSE		Pooled-PCSE		Pooled-PCSE		Pooled-PCSE	
R^2	0.80		0.84		0.40		0.22	
NT	90		63		92		237	

*Notes: t-statistics are reported alongside coefficient estimates in parentheses, these statistics are calculated using panel-corrected standard errors which assume that the disturbances are heteroskedastic and contemporaneouly correlated across panels, i.e. Panel Corrected Standard Errors (PCSE). * Significant at 10% level, ** Significant at 5% level and *** Significant at the 1% level.*

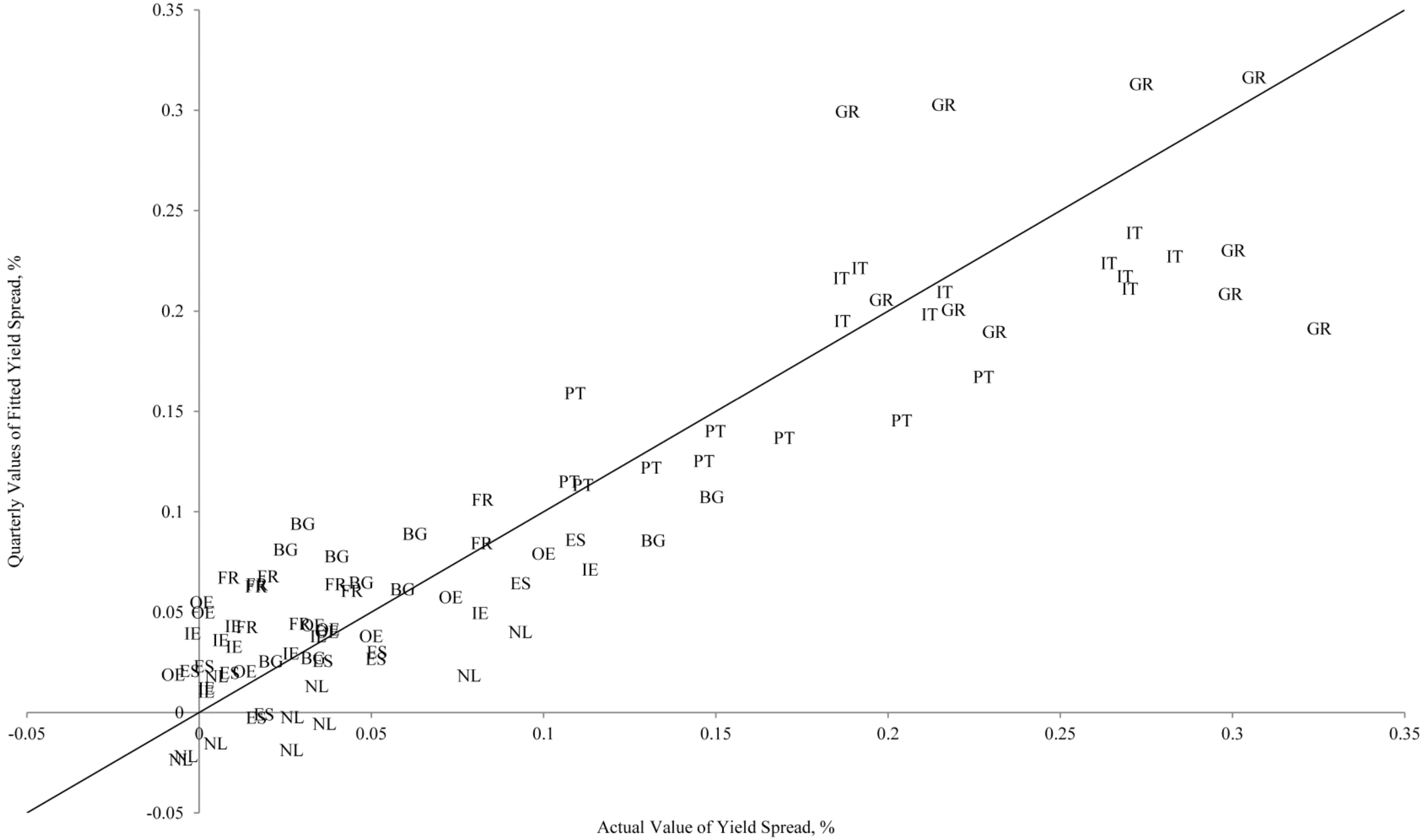
The estimated coefficient on squared gross debt is significant at conventional levels across all three sub-periods whilst the squared primary balance is significant for the early crisis and sovereign debt crisis periods although in the latter case it has the opposite sign to what would be anticipated, this is similar to the results presented by Alessandrini et al. (2013). The R^2 increases across the sample periods considered and in particular 84% of the variation in spreads for the financial crisis period is now captured by the model. The coefficient estimates for the remaining determinants remain qualitatively the same.

3.4.2. Benchmark Specification: Fitted and Actual EMU Yield Spreads

Following Blanchard and Wolfers (2000) I examine the fit of the model for each sub-period in a visual sense. This is carried out by plotting the fitted values of the estimated specification against actual yield spreads as well as the average of the actual and fitted spreads of the model for each country and sub-period. The latter exercise is conducted so to examine how the model performs in explaining the observed differences in yield spreads across countries. Figure 3-9 and Figure 3-10 outline the fitted values from the specification estimated in column (1) of Table 3-2, as can be seen the specification does a respectable job at capturing the salient features of yield spreads over the period as the observations are located in proximity to the 45 degree line. In terms of cross-country differences, during this period financial markets differentiated between issuers, with Greece and Italy exhibiting the highest spreads and France, Spain, Austria and the Netherlands lower values, whilst Portugal is located between these two groups.

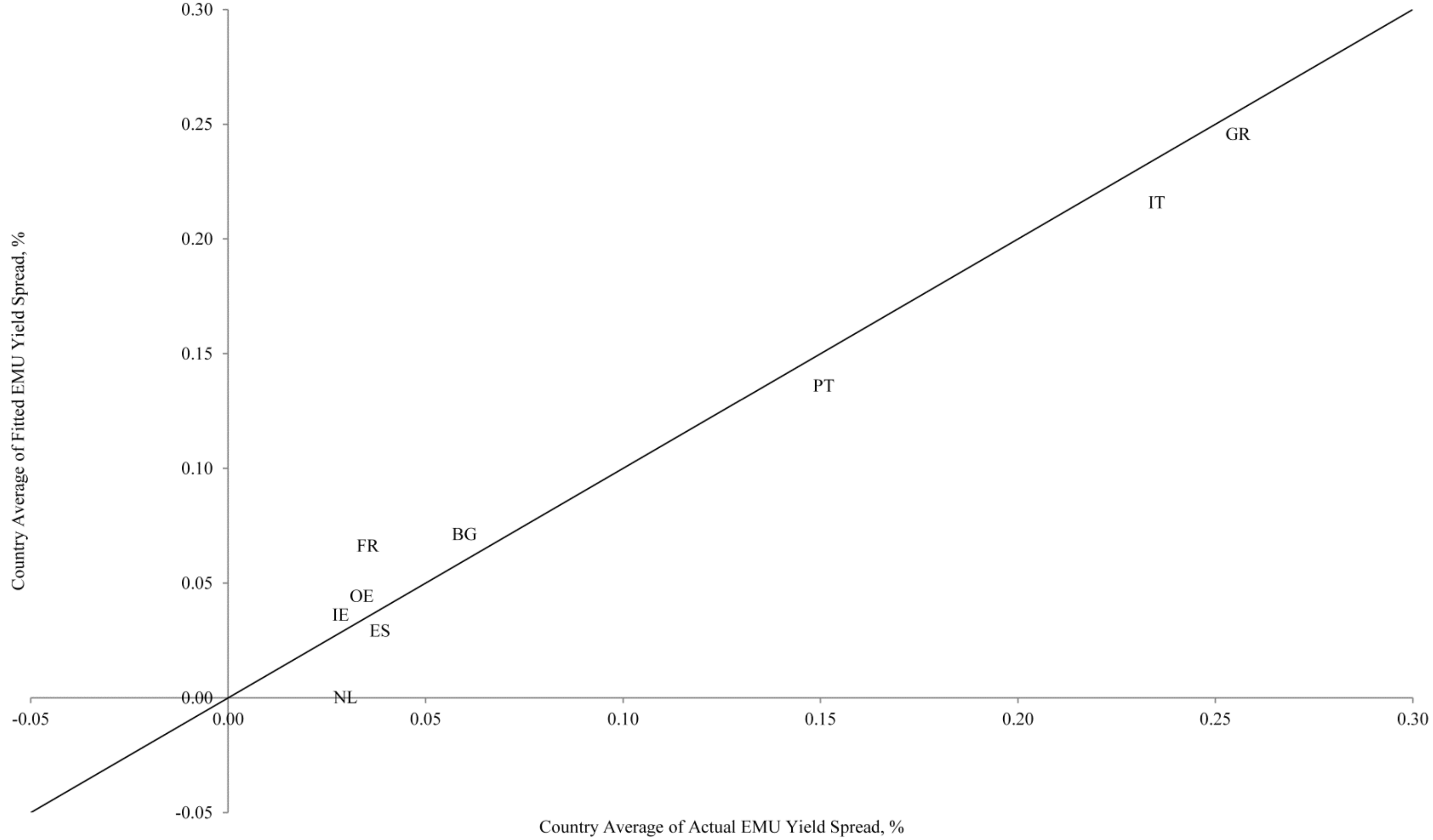
Figure 3-9

Actual and Fitted EMU Yield Spreads, Non-linear Specification: 2005Q3 - 2007Q4



Source: Author's Calculations based upon Table 3-2

Figure 3-10
Actual and Fitted EMU Yield Spreads, Non-linear Specifcation, by Country: 2005Q3 - 2007Q4



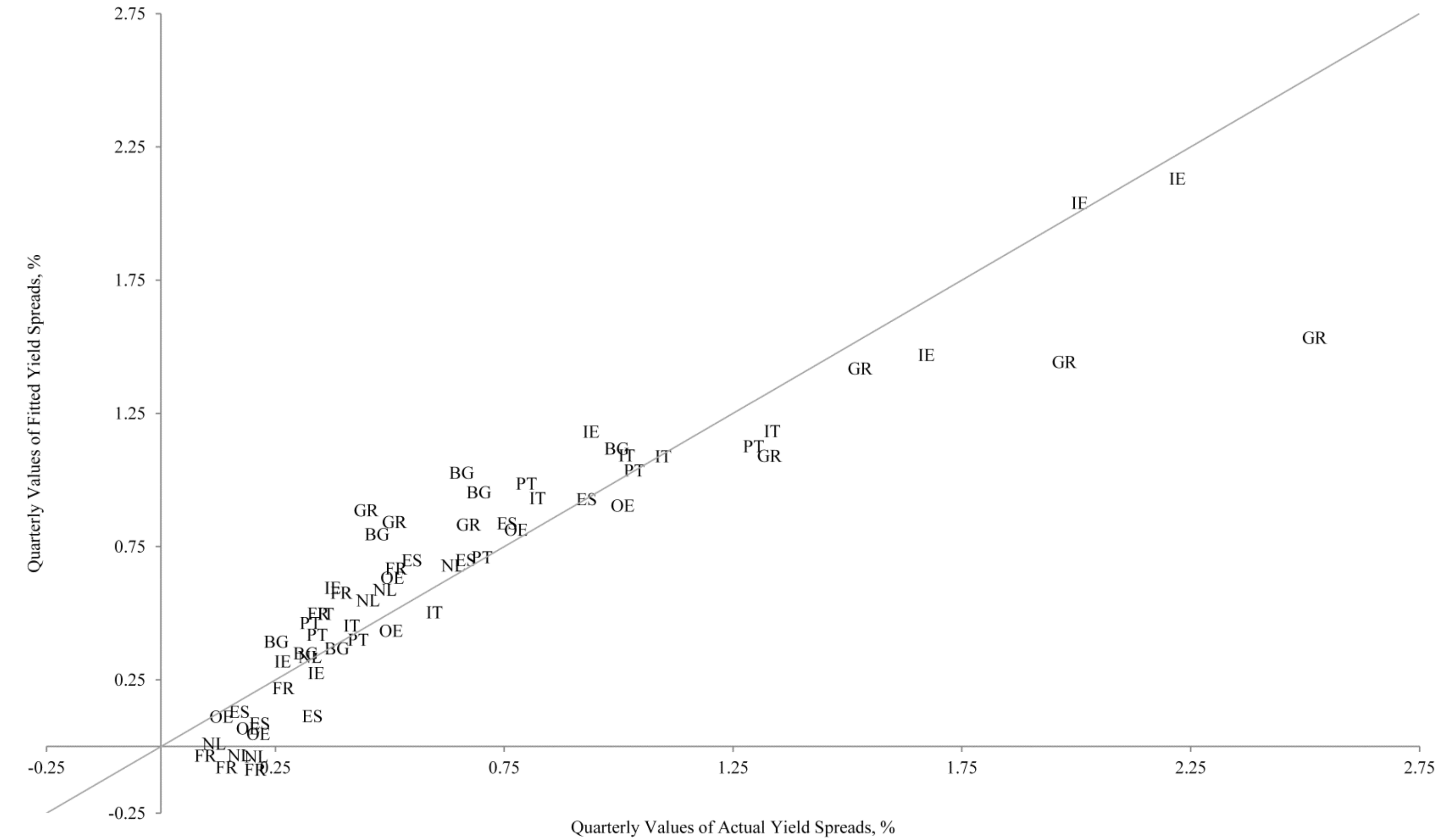
Source: Author's Calculations based upon Table 3-2

The specification appears to capture the pertinent cross-country features of EMU yield spreads in the financial crisis sample period, Figure 3-11and Figure 3-12, but at times struggles to capture developments in the spreads of Ireland and Greece which became detached from the rest of the sample in a manner, which can only partially be accounted for on the basis of relative disparities in the selected fundamental indicators. The results for the sovereign debt crisis period (Figure 3-13and Figure 3-14) demonstrate that there are at times substantial divergences between observed and fitted values of EMU yield spreads implied by the benchmark model.

Overall these figures highlight the general inability of the benchmark model to capture observed developments in EMU yield spreads during the sovereign debt crisis, most notably in the case of Portugal, Ireland, Greece, Italy and Spain. In these cases spreads appear to have become increasingly disconnected from their assumed fundamental determinants. These results corroborate the findings of the existing literature which has argued that the pricing of sovereign risk in the EMU became detached from its fundamental basis during the sovereign debt crisis, e.g. De Grauwe and Ji (2012). These results also represent an extension to such work as a wider number of potential determinants have been considered; although despite the inclusion of these further variables it remains true that much of the variation in EMU bond spreads since the advent of the sovereign debt crisis at the end of 2009 remains unaccounted for. However, it is also apparent that up to this point, i.e. for the pre-crisis and financial crisis periods, the benchmark specification which incorporates non-linearity in the fiscal indicators is able to characterise differences in yield spreads amongst EMU member states on the basis of fundamentals.

Figure 3-11

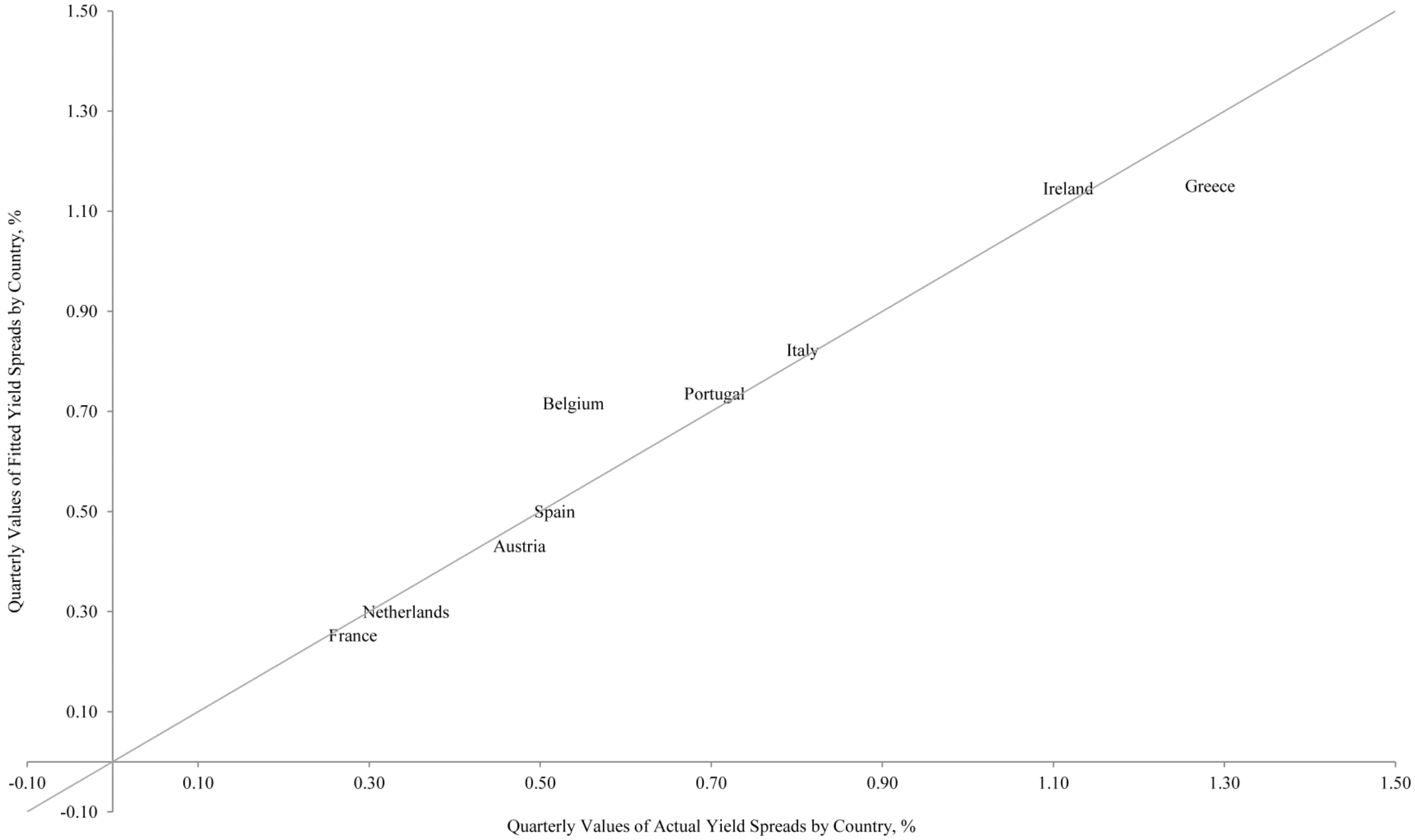
Actual and Fitted EMU Yield Spreads, Non-Linear Specification: 2008Q1 - 2009Q3



Source: Author's Calculations based upon Table 3-2

Figure 3-12

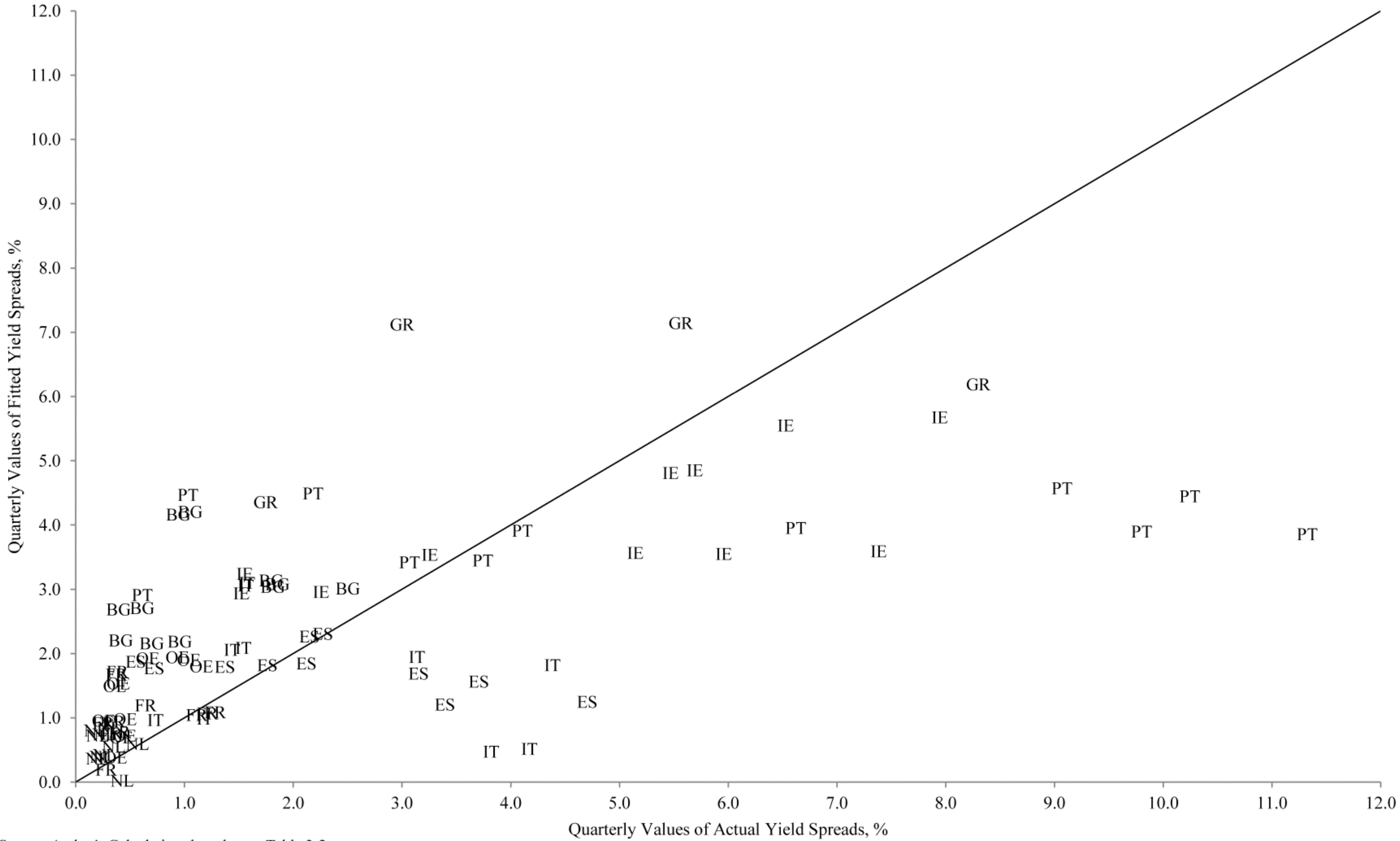
Actual and Fitted EMU Yield Spreads by Country, Non-Linear Specification: 2008Q1 - 2009Q3



Source: Author's Calculations based upon Table 3-2

Figure 3-13

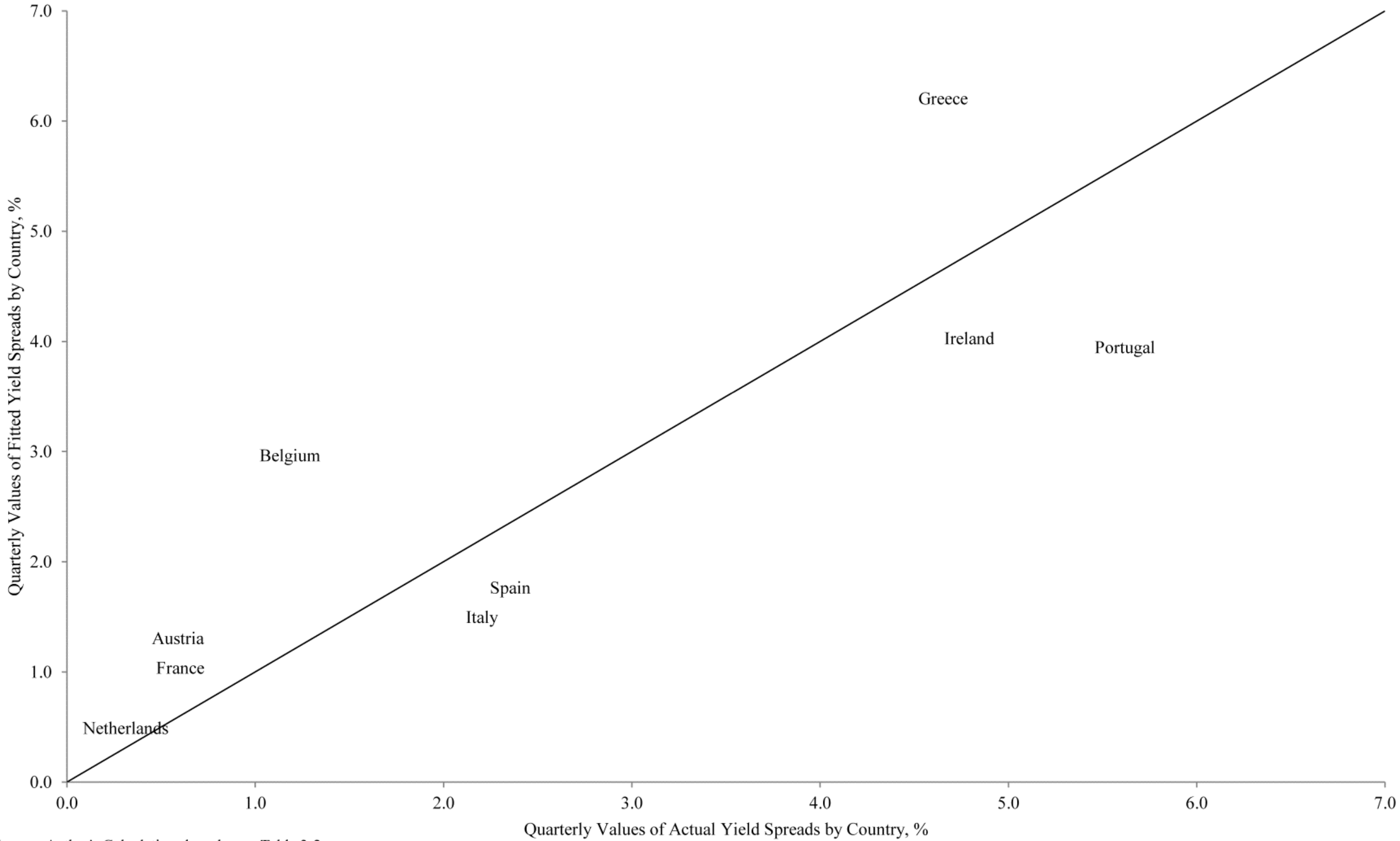
Actual and Fitted EMU Yield Spreads, Non-linear Specification: 2009Q4 - 2012Q2



Source: Author's Calculations based upon Table 3-2

Figure 3-14

Actual and Fitted EMU Yield Spreads by Country, Non-linear Specification: 2009Q4 - 2012Q2



Source: Author's Calculations based upon Table 3-2

3.4.3. Macroeconomic Imbalances Specification

In this section I examine whether the inability of the benchmark empirical model to capture observed developments in spreads during the debt crisis period is due to the omissions of variables which capture broader macroeconomic imbalances. In recognition of this I augment the benchmark specification by including a (time-invariant) approximation for these imbalances as well as its interaction with existing fundamental determinants of sovereign yield spreads. The scale of these imbalances is measured as the size of the country-specific current account balance-to-GDP ratio in 2006.

This examination of whether pre-crisis factors have a significant role in understanding the differing impact of the financial crisis across countries is motivated by the work of Claessens et al. (2010) and Rose and Spiegel (2009, 2010). These studies examine the ability of alternative pre-crisis indicators of macroeconomic imbalances to explain cross-country differences in the severity of real economic impacts stemming from the crisis, presenting evidence that countries with larger current account deficits suffered more during the recent economic crisis than countries with surplus positions. Whilst these studies limit themselves to consider only cross-country differences in the impact of the crisis the analysis presented here attempts to explain both cross-country and across time variation in EMU yield spreads.

Also included in this specification is a direct measure of the uncertainty of growth circumstances amongst EMU member states which markets may have perceived as relevant in determining the sustainability of national fiscal positions. I capture such effects through the inclusion of the forecast error real-GDP growth for each nation which is calculated on the basis of economic forecasts contained within the OECD's economic outlook publication released in June and December of each year.

The estimated specification which incorporates macroeconomic imbalances and unanticipated developments in real-GDP is as follows:

$$EMU\_Spread_{it} = \alpha + \sum_{k=1}^{K} \left(\beta_k Fdmtl_{i,t}^{k} + \theta_k \left(Fdmtl_{i,t}^{k} \cdot CA\_2006_i\right)\right) + \gamma CA\_2006_i + \beta_{k+1} GDP\_Error_{i,t} + \beta_{k+2} Liquidity_{i,t} + \beta_{k+3} Global\_Risk_{i,t} + \varepsilon_{it} \quad (3\text{-}2)$$

where $Fdmtl_{i,t}^{k}$ denotes alternative fundamental indicators reflecting a nation's fiscal and current account position, CA_2006_i is the (time-invariant) current account balance-to-GDP ratio for each country in 2006 (multiplied by -1), $GDP\_Error_{i,t}$ is the difference between the projected rate of real GDP growth and its observed value and all other variable remain as previously defined for equation **(**3-2**)**. The interaction terms in this specification allow for the effects of the fundamental indicators to be shaped in a manner proportionate to the scale of macroeconomic imbalances in each country just prior to the onset of the financial crisis, as captured by the parameter θ_k.

Estimations based upon equation (3-2) are carried out for the period of economic and sovereign debt crisis where the shortfall between observed and implied EMU yield spreads has been demonstrated to be the largest.

3.4.4. Macroeconomic Imbalances Specification: Results

Results based upon the estimation of equation (3-2) are presented in Table 3-3 where column (1) replicates the benchmark specification from column (3) of Table 3-2. Allowing the marginal responses of the fundamental determinants of spreads to be shaped by pre-crisis current account positions now means that the specification is able to account for up to 83% of the total variation in yield spreads over the sovereign debt crisis period, this figure is more than double that of the (non-interactive) benchmark specification of column (1). In order to ascertain where this explanatory power is drawn from I sequentially drop insignificant variables one-by-one, a process which results in the specification displayed in column (3), and for which I cannot reject the null that the omitted variables are jointly equal to zero based upon an F-test.

The results of column (3) indicate that yield spreads were on average higher for countries with larger pre-crisis current account deficits and that markets responded to developments in the lagged debt-to-GDP ratio and current account ratios although distinguishing across issuers in a manner proportionate to the magnitude of pre-crisis current account positions. They also indicate that the pricing of sovereign debt reflective unanticipated changes in real-GDP growth across nations, as this coefficient is signed in line with intuition and significant at the 1% level.

In terms of the other control variables, the non-linearity which was identified in the case of debt-to-GDP ratios is found to be no longer significant whilst the estimated coefficient on the non-linear forecasted primary balance-to-GDP ratio is significant but of the opposite sign as to what was anticipated, there remains a significant role for liquidity in explaining yield spreads amongst EMU member states and the measures of global risk is now found to be significant at the 10% level.

Table 3-3

EMU Yield Spreads: Interactive, Imbalances Specifications: 2009Q4 - 2012Q2

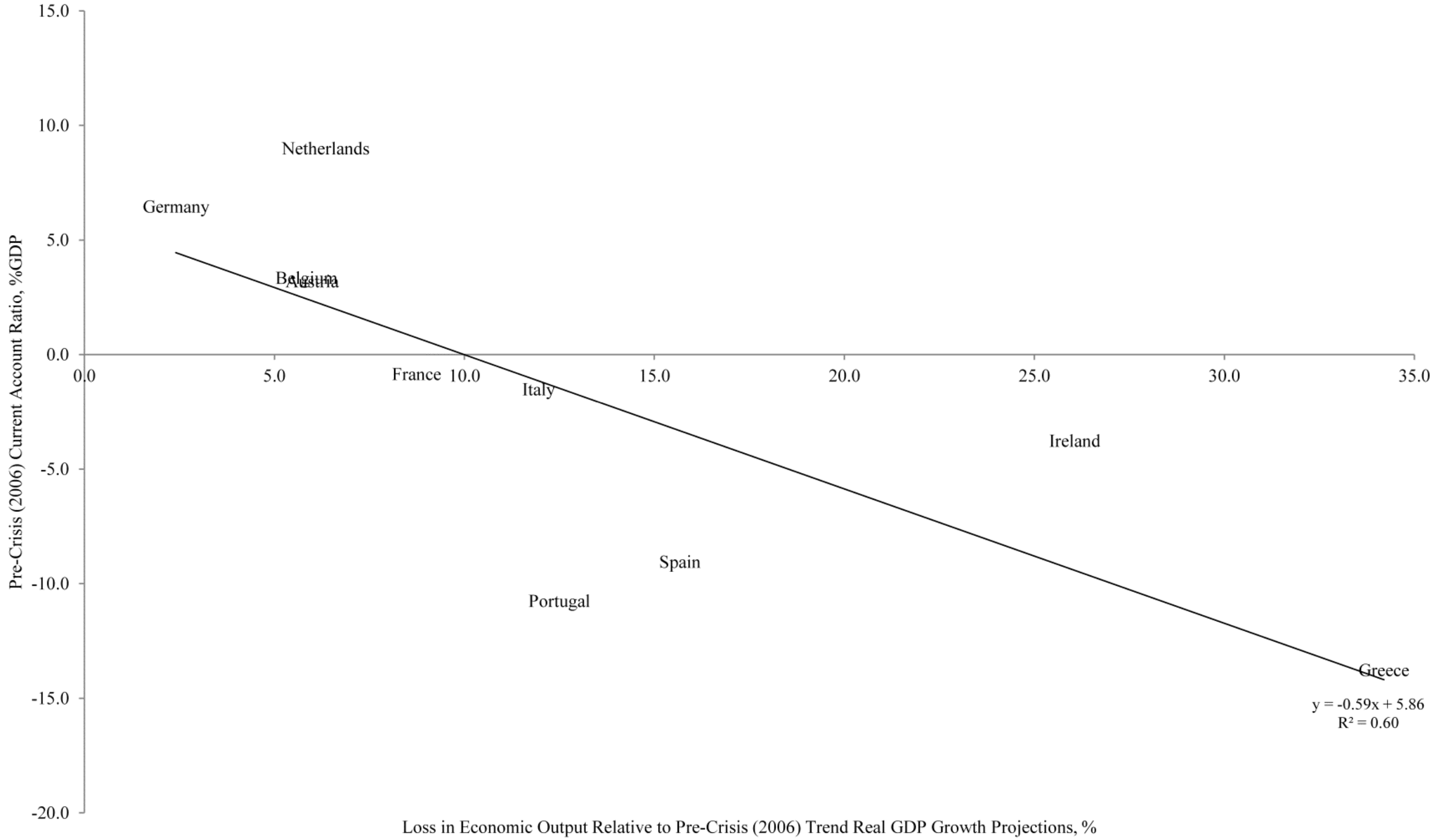
Dependent Variable:10 Year YTM Spread (%) **Data Frequency**: Quarterly	(1)		(2)		(3)	
Explanatory Variables:						
Gross Debt-to-GDP (lagged)	0.0818***	(5.21)	0.0382	(1.36)	0.00292	(0.11)
Squared Gross Debt-to-GDP (lagged)	0.000407*	(1.66)	- 0.000639	(0.96)	-	
Primary Balance-to-GDP (forecast)	- 0.689***	(3.75)	- 0.544*	(1.69)	- 0.287***	(2.70)
Squared Primary Balance-to-GDP (forecast)	- 0.0409*	(1.79)	0.011	(0.12)	- 0.0537***	(3.76)
Current Account Balance-to-GDP	- 0.118*	(1.70)	0.485***	(5.60)	0.445***	(5.31)
Liquidity	- 0.161***	(5.95)	- 0.0859***	(5.10)	- 0.0757***	(5.32)
Global Risk	- 0.700	(0.25)	3.016*	(1.78)	3.25*	(1.89)
2006 Current Account-to-GDP	-		0.945***	(10.53)	0.889***	(13.53)
Real-GDP Growth Projection Error	-		0.472***	(3.11)	0.497***	(3.23)
Interaction Terms:						
Lagged Gross Debt-to-GDP ratio * 2006 Current Account	-		0.00437	(1.33)	0.00982***	(4.35)
Lagged Debt ratio squared * 2006 Current Account	-		0.000117	(1.27)	-	
Primary Balance ratio * 2006 Current Account	-		0.0344	(0.77)	-	
Primary Balance ratio squared * 2006 Current Account	-		- 0.00886	(0.74)	-	
Current Account Balance ratio * 2006 Current Account	-		0.0232***	(3.32)	0.0256***	(3.71)
Estimation	Pooled-PCSE		Pooled-PCSE		Pooled-PCSE	
R^2	0.40		0.83		0.82	
NT	92		92		92	

*Notes: t-statistics are reported alongside coefficient estimates in parentheses, these statistics are calculated using panel-corrected standard errors which assume that the disturbances are heteroskedastic and contemporaneouly correlated across panels, i.e. Panel Corrected Standard Errors (PCSE). * Significant at 10% level, ** Significant at 5% level and *** Significant at the 1% level.*

The results also indicate that whilst the estimated relationship between debt ratios and the primary balance are intuitively signed and significant, the sign on the non-linear component of the primary balance coefficient is the opposite to that anticipated, this is perhaps reflective of the austerity measures implemented by certain member states which may have negatively impacted growth, adversely impacted sovereign debt-dynamics and hence the sustainability of fiscal positions. The results also imply a situation whereby improvements in current account positions since the start of the debt crisis period have coincided with increasing yield spreads, this may be reflective of the fact that the unwinding of pre-crisis imbalances weigh heavily on the growth prospects of such member states as they undergo a period of internal adjustment in the absence of external nominal devaluations within an monetary union. These claims appear at least plausible when observing the (ex-post) correlation between the scale of current account deficits pre-crisis, their subsequent unwinding and the relative shortfall between GDP on a pre-crisis trend basis and the actual path of GDP over this period, in Figure 3-15 and Figure 3-16. These findings also reverberate with the work of Lane and Milesi-Ferretti (2012) who find that amongst countries with fixed exchange rate regimes corrections to excessive current account positions have been achieved primarily through demand compression.

Figure 3-15

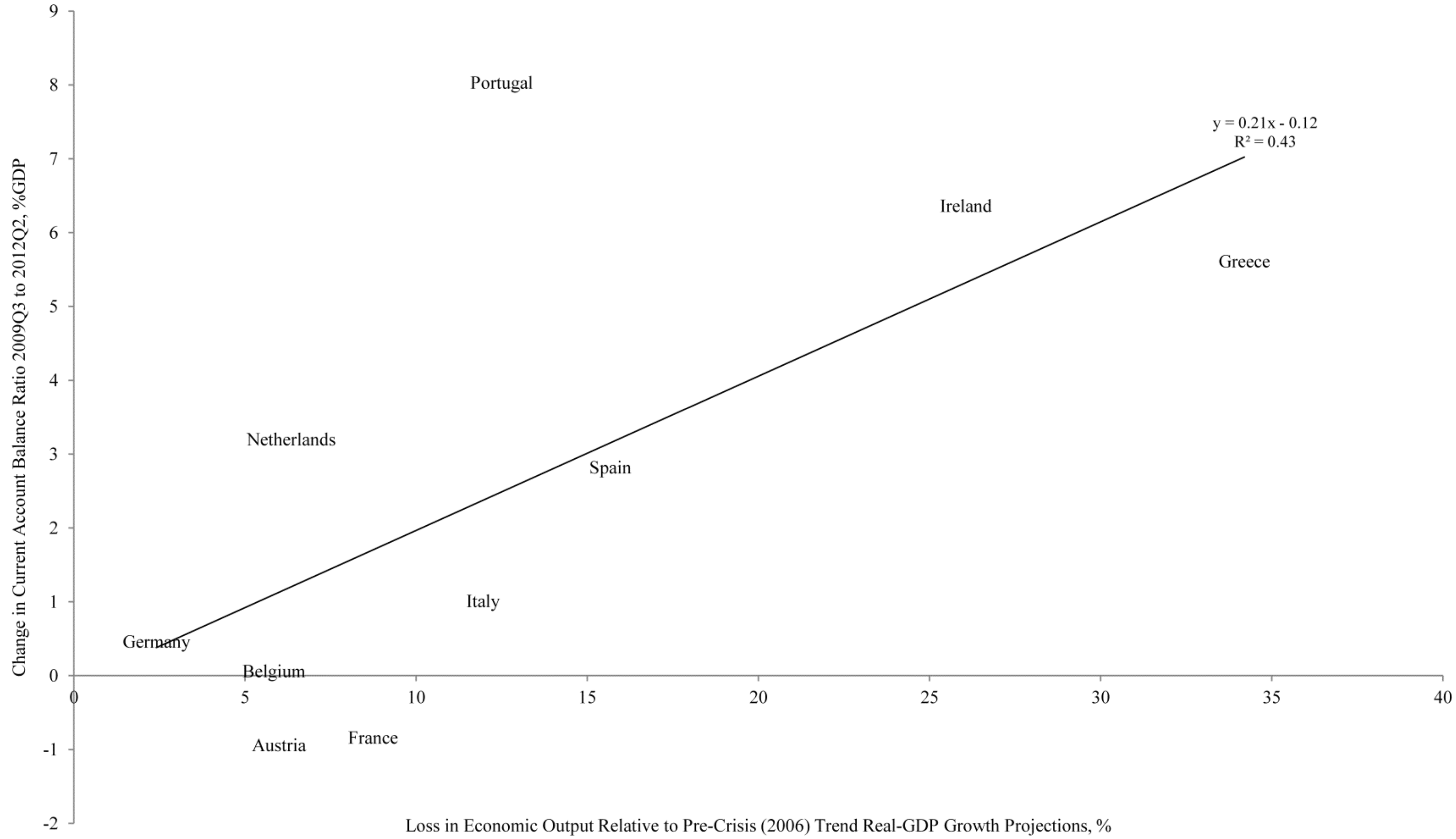
Pre-Crisis Current Account Ratio & Loss in Economic Output Relative to Pre-Crisis Trend Growth Projections



Source: OECD Economic Outlook 80 and 92, and Author's Calculations

Figure 3-16

Change in Current Account Balance during the Crisis and Loss in Output Relative to Pre-Crisis Forecasted Growth



Source: OECD Economic Outlook 82 and 90, and Author's Calculations

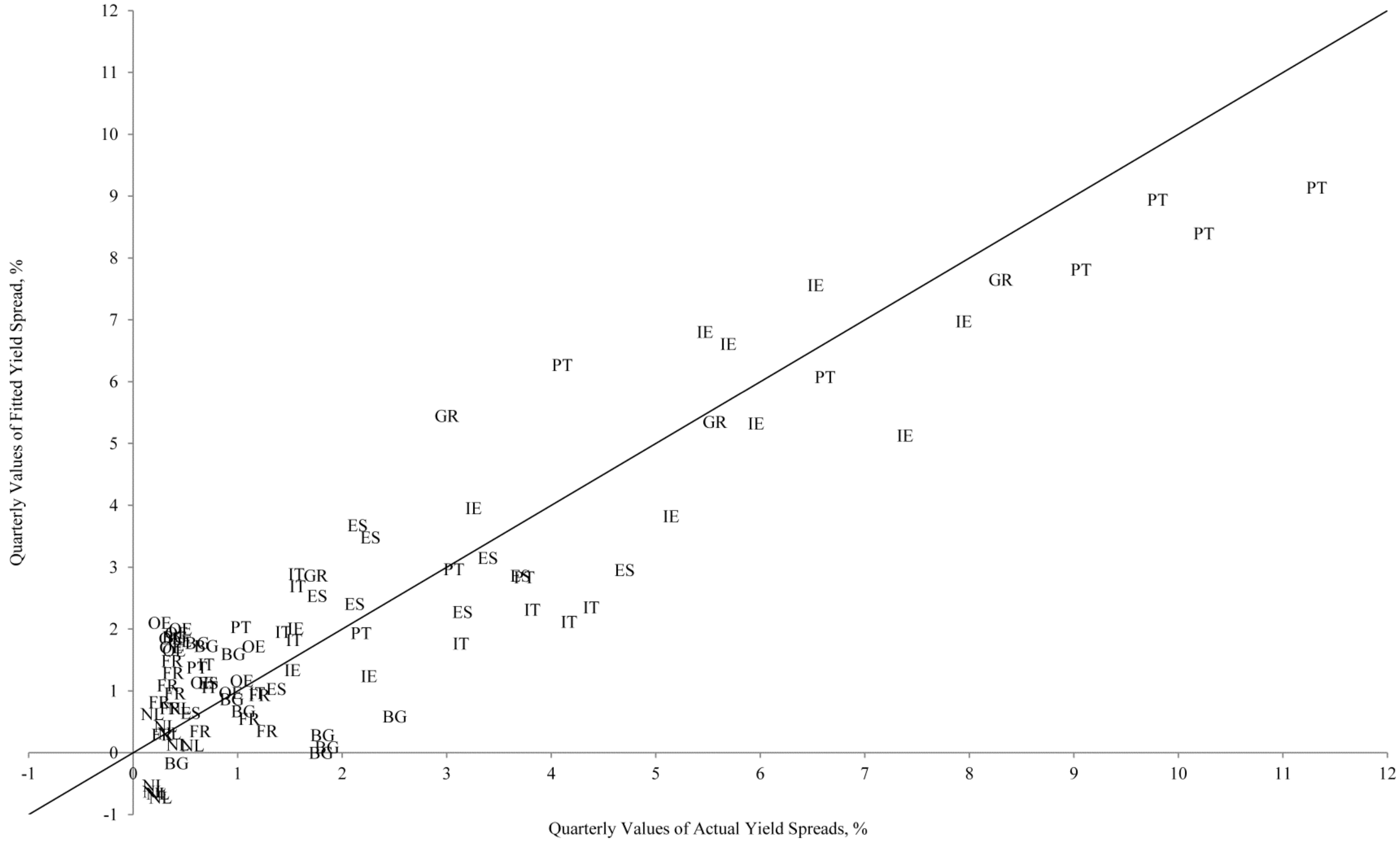
3.4.5. Imbalances Specification: Fitted and Actual EMU Yield Spreads and Estimated Contributions

The overall improved fit of the model is confirmed by a visual comparison of observed spreads and the fitted value of the model, as outlined in Figure 3-17. Whilst there remain discrepancies between these two measures the fitted values are noticeably closer to the 45 degree line than in the specification which excludes macroeconomic imbalances and can thereby account for a higher degree of explanatory power for the yield spread series during the recent economic and financial crisis. Therefore, whilst the benchmark model may have implied a mispricing of sovereign risk during the crisis this is less apparent once the external imbalances which existed amongst EMU member states and began to unwind are taken into account alongside unanticipated developments in real-GDP growth rates.

Finally, in Figure 3-18 I assess the contribution of each explanatory variable to changes in yield spreads over the period of 2009Q4 to 2012Q3, this is a similar exercise to that performed by Attinasi et al. (2009) and Alessandrini et al. (2012) and. The figure highlights that changes in underlying fiscal fundamentals (as captured by debt and budget deficit ratios) contributed to an increase in spreads across all countries considered, they also indicate that countries benefitted from an overall reduction in global risk and changes in liquidity only played a minor role over the period except in the case of Italy where a reduction in its liquidity contributed to a rise in spreads.

Figure 3-17

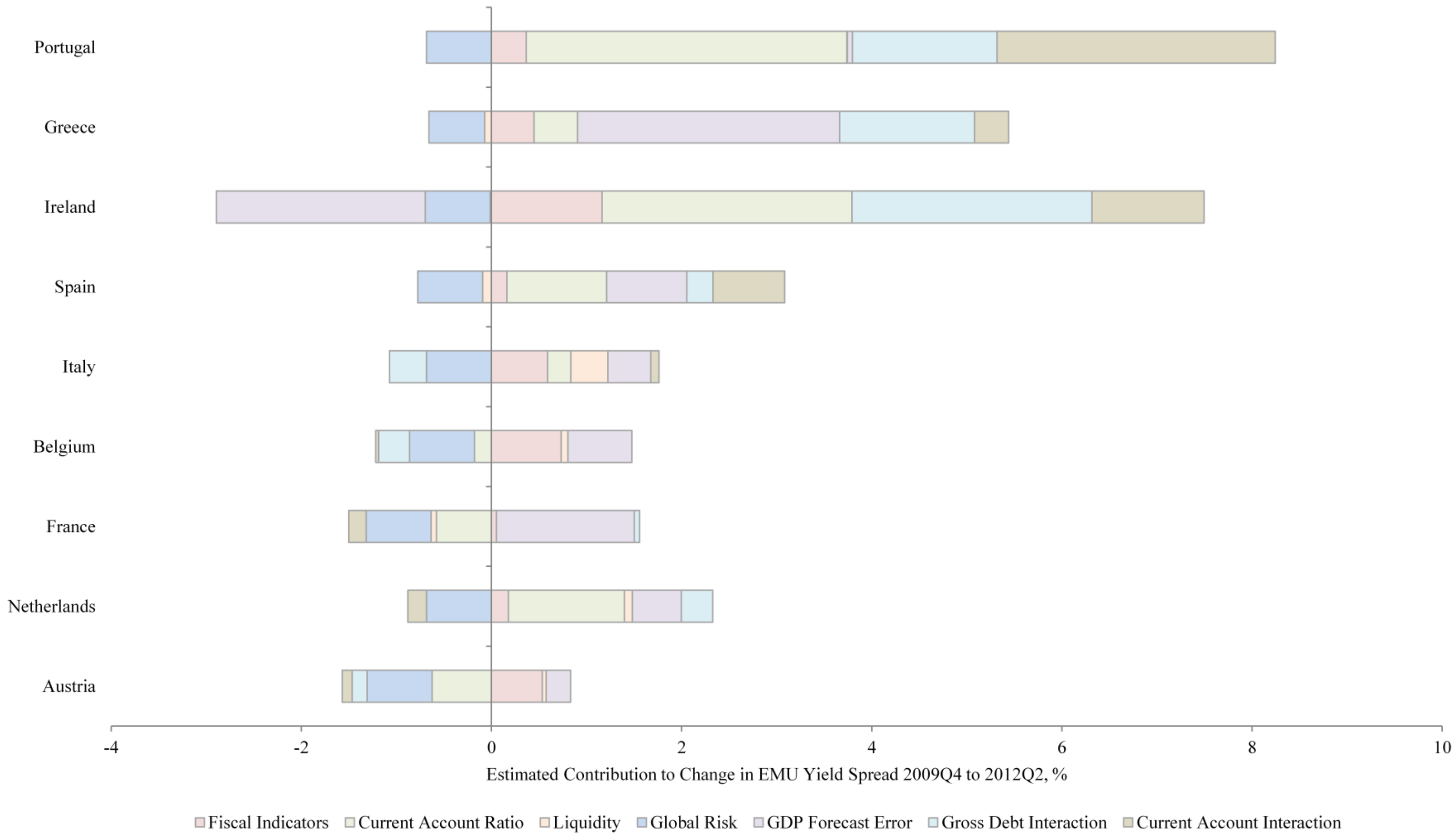
Actual and Fitted EMU Yield Spreads, Imbalances Specification: 2009Q4 - 2012Q2



The estimated contributions also highlight the importance of allowing for the impact of developments in fiscal positions to be conditioned upon the relative scale of external imbalances across countries which contribute to an increase in yield spreads for Portugal, Greece and Ireland, whilst the interaction with developments in current account balances also contributed to increases in the spreads of Portugal, Greece, Ireland and Spain. Finally, relative differences in unanticipated economic growth rates coincided with an increase in spreads for all countries except for Ireland where real-GDP growth rates began to exceed those forecasted by the OECD over towards the end of the sample period and hence led spreads to fall.

Figure 3-18

Estimated Contribution to Change in EMU Yield Spreads, Imbalances Specification: 2009Q4 - 2012Q2



Source: Author's Calculations based upon Column 3 of Table 3-3

3.5. Conclusions

This chapter has examined developments in sovereign risk premia for EMU member states over a period of 2005 to 2012 but with an emphasis on events relating to the recent sovereign debt crisis. Yield spreads on ten-year public debt securities issued by EMU sovereign nations are analysed using a panel data model. Using this model it is examined to what extent observed development in these spreads can be explained by approximations of the fundamental risks associated with these securities and common factors which capture aggregate default risk. These indicators initially include (i) measures of relative default risk, approximated by differences in debt-to-GDP ratios, projected budget deficit-to-GDP ratios and their squared values, (ii) differences in the degree of liquidity risk across issuers, and (iii) time-variation in the general price of risk.

On the basis of a benchmark model which includes these indicators it is shown that 80% and 84% of the total variation in EMU yield spreads can be explained in sample periods running from 2005 to 2007 and covering the global financial crisis of 2008 and 2009, respectively. In contrast, it is demonstrated that this same specification is unable to capture observed developments in yield spreads since the onset of the sovereign debt crisis in late 2009. That is, a substantial incongruence exists between the fitted values derived from this specification and yield spreads observed in practice, with this specification only explaining 40% of their total variation for this period. These findings are consistent with arguments presented by existing studies which have emphasised that financial markets may have mispriced the risks associated with holdings of EMU sovereign debt.

This benchmark specification is then modified to include additional fundamental indicators which capture the scale of macroeconomic imbalances within certain member states and unanticipated developments in real-GDP growth rates. The principal contribution of this chapter is that once these additional indicators are incorporated into the benchmark model that it is possible to explain up to 83% of the observed variation in spreads. The contribution of each explanatory variable to the change in spreads from 2009-Q4 to 2012-Q2 is also estimated. It is demonstrated that reversals in current account deficits significantly contributed to the increase in yield spreads for Portugal, Ireland, and Spain, whilst unanticipated developments in real-GDP pushed up spreads for Greece and Spain. These results demonstrate that during the sovereign debt crisis markets continued to differentiate between EMU issuers on the basis of fundamental risk factors although their pricing behaviour came to reflect previously unconsidered representations of these risks.

Overall, this chapter re-establishes the link between observed yield spreads and their fundamental basis as well as providing empirical support for the notion that the sovereign debt crisis is, at its heart, a balance-of-payments crisis; Wolf (2011) and Sinn (2012). Its resolution therefore hinges upon both the introduction of a permanent adjustment mechanism for imbalances of this nature as well as restoring sustainability to the fiscal positions of member states. These results also resonate with recent attempts to understand sovereign default risk from a theoretical perspective, studies of this nature emphasise that budgetary fundamentals matter in the pricing of sovereign default risk both independently and alongside the economic conditions which influence country-specific debt dynamics, in particular a nation's growth outlook, Bi (2012) and Ghosh et al. (2010).

It should be recognised that in order to provide a realistic characterisation of developments in yield spreads these results rely upon an assumed degree of structural instability in the parameter estimates. Why markets move from one focal point to another in their pricing of sovereign risk remains an important yet outstanding question. I believe further research could examine additional factors which lead financial markets to distinguish between the sovereign debts of different issuers. These could relate to perceptions of credibility, the strength of national fiscal institutions and the perceived strength of the government to implement fiscal consolidations or other types of structural reform. Finally, the sample could be extended to include additional sovereign issuers and thereby allow for a comparison of market perceptions of sovereign default risk between nations who form a monetary union and those who are not.

3.6.Bibliography

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Appendix A. Data Appendix

Table 3-4
Data Appendix

Variable	Units	Description	Time Period	Frequency	Source
EMU Yield Spread	%	Difference in yield-to-maturity on 10 year benchmark government bonds	2005Q3 - 2012Q2	Quarterly	Reuters Datastream
Projected Primary Balance Ratio	% GDP	One period ahead forecast of government primary balance	2005H1 - 2012H1	Semi-annual	OECD Economic Outlook: 76 - 92
Gross Government Financial Liabilities	% GDP	One period lagged gross government financial liabilities	2005H1 - 2012H1	Semi-annual	OECD Economic Outlook: 76 - 92
Global Risk	%	Difference in yield on index of BBB US corporate bonds and AAA index	2005Q3 - 2012Q2	Quarterly	Reuters Datastream
Liquidity	%	Country share of total gross government liabilities in the EMU	2005Q3 - 2012Q2	Quarterly	OECD Economic Outlook: 92
Current Account / GDP Ratio	% GDP	Current account balance	2005H1 - 2012H1	Semi-annual	OECD Economic Outlook: 76 - 92
Equity Market Indices	%	Price indices of FTSE All Share, S&P500, Xetra Dax, CAC40 and Nikkei 225	2005Q3 - 2012Q2	Quarterly	Reuters Datastream
VIX Index	Index Value	Value of CBOE VIX Index	2005Q3 - 2012Q2	Quarterly	Reuters Datastream
Trend Output Growth Rate	% pa.	Projected growth rate in potential output in 2006	2005H1 - 2012H1	Annual	OECD Economic Outlook: 82
Real GDP Growth Rate	% pa.	Growth rate in real GDP	2005H1 - 2012H1	Semi-annual	OECD Economic Outlook: 82 - 92

Table 3-4: *Data Appendix*

Conclusions

This thesis has analysed three different topics relating to fiscal policy and the pricing of sovereign debt instruments.

Chapter 1 considered the nature of the optimism bias demonstrated to be characteristic of official budgetary projections amongst EU member states. It was found that a systematic link exists between the magnitude of this optimism bias and the degree of fragmentation which characterises the government responsible for producing these projections. Numerical fiscal rules were considered as one mechanism for improving the credibility of these projections and it was shown that these forms of budgetary stricture are an effective means of reducing optimism bias which stems from these sources. These results therefore provide qualified support for the introduction of these rules at a national level in so far as they target the sources of political failure which are perceived to give rise to biases in fiscal policy-making and caution against placing excessive reliance on such institutional mechanisms in unsuitable political contexts.

Chapter 2 examined the importance of systematic default risk and fiscal indicators in the pricing of long-term public debt securities issued by EMU member states. Using two distinct methodologies it was demonstrated that measures of systematic default risk and fiscal indicators share important information about the default risks which EMU sovereign issuers represent. New evidence was presented which demonstrated the relevance of this (shared) variation in explaining difference in excess returns across issuers in sample periods which include and exclude the financial and sovereign debt crisis. Overall, this chapter represents a contribution to an existing literature which examines the relevance of systematic risks in the pricing of financial assets by expanding such topics to consider the relative default risks which exist amongst the issuers of sovereign debt in the EMU.

Finally, Chapter 3 analysed developments in yield spreads on ten-year public debt securities issued by EMU sovereign nations, with an emphasis on events relating to the recent sovereign debt crisis. In-line with recent studies it was first shown that substantial discrepancies exist between the spreads observed in practice and those implied by a simple benchmark model which includes the presumed fundamental determinants of these spreads. The principal contribution of this chapter is that once additional indicators are incorporated into this model which reflects the scale of macroeconomic imbalances in member states that it is possible to explain up to 83% of the observed variation in spreads during the sovereign debt crisis. These results therefore re-establish the link between observed yield spreads and their fundamental basis as well as providing empirical support for the notion that the sovereign debt crisis is, at its heart, a balance-of-payments crisis.