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TESTING THE IMPACT OF FISCAL, FINANCIAL, AND POLITICAL VARIABLES ON EUROPEAN BOND SPREADS

Vivien DJIAMBOU

Doctoral Thesis 06 | 2016

Université catholique de Louvain
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Doctoral Thesis

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Cette thèse a pour but d'identifier les facteurs fiscaux, financiers et politiques qui ont contribué à la crise financière et économique dans les pays européens.

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Thèse présentée en vue d'obtention
du grade de Docteur
en sciences économiques et de gestion

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Abstract

The general theme covered in this dissertation is "Testing the impact of fiscal, financial, and political variables on European bond spreads". We argue that deteriorations in fiscal and political variables during bad economic conditions and increased volatility in stock markets have been major drivers of the rise in bond spreads in various European countries. This allows us, to some extent, to apply an innovative approach when analyzing these internal factors. To the best of our knowledge, there are no existing research in the literature on European bond spreads, that apply a non-linear threshold method to explain how the impact of a change in government debt and in political risk on bond spread, depends on the level of government debt, real GDP growth, political risk, stock market volatility, and membership to the euro area. Moreover, in the literature analyzing the drivers of bond spreads, political risk variables usually considered are international political risks rather than country-specific political risks, that capture the deterioration of the domestic political situation.

In the first chapter, we propose a framework that captures the impact of public debt ratios during periods of bad economic conditions. We used a fixed effect panel approach to show that deterioration of public debts are significant during bad economic conditions, in contrast to periods of normal economic conditions in euro area countries. In the second chapter, we extend the analysis by considering the state of financial systems and economic conditions. This allows us to determine endogenously and exogenously the threshold levels of public debt and volatility index. In the third chapter, we further extend our analysis to consider country-specific political risk variables. In particular, we devote much effort to determine the drivers of bond spreads in various European groups using the dynamic panel threshold methodology.

Keywords: Public debt; primary balance, sovereign bond spread; volatility index, stock market return, political risk, lack of trust in the government, lack of trust in parliament, lack of trust in political parties, real GDP growth.

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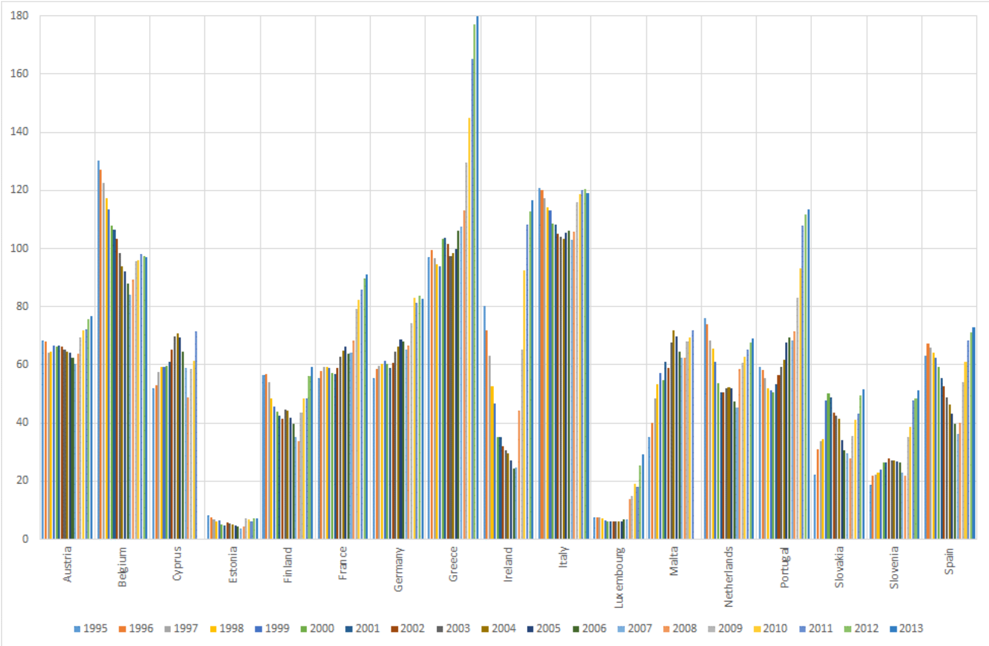
INTRODUCTION

This dissertation is my personal tentative work and view related to the euro crisis. It is a tentative work in the sense that the fundamental causes of the euro crisis are not yet fully agreed upon among economists. On the one side prominent economists, such as Sinn (2014), mostly argue that the crisis was caused by the supply side due to large government indebtedness. As a result, Sinn for instance, advocates for budget discipline and reduction in government risk exposures to help to reduce the rising bond yields in affected European countries. However, on the other side, other leading economists, such as De Grauwe and Ji (2013), believe that the crisis was caused by the demand side due to a fall in demand as the private sector faced with severe risks of default. As a result, the policy responses they advocate involve directly or indirectly government intervention to stimulate the economy. However, the divergences in policy responses to the euro crisis underscore the importance of the current European crisis. Hence, we decided to consider potential non-linearities due to rising concerns over the fiscal exposures, international financial markets, and political uncertainty.

Over the last few years, the sharp rise in sovereign bond yields forced some European economies to request financial assistance from either the International Monetary Fund (IMF) or the troika (European Union, International Monetary Fund, and European Central Bank) with deteriorating fiscal positions being regarded as the root of the turmoil. Figure 1 shows the historical evolution of government debt ratios in some euro area economies. It shows rising levels of government debt ratios in almost all euro area countries. Moreover, as illustrated in Figure 1 before the global financial crisis in 2008, the levels of government debt ratios were mostly decreasing.

Figure 1. General government debt



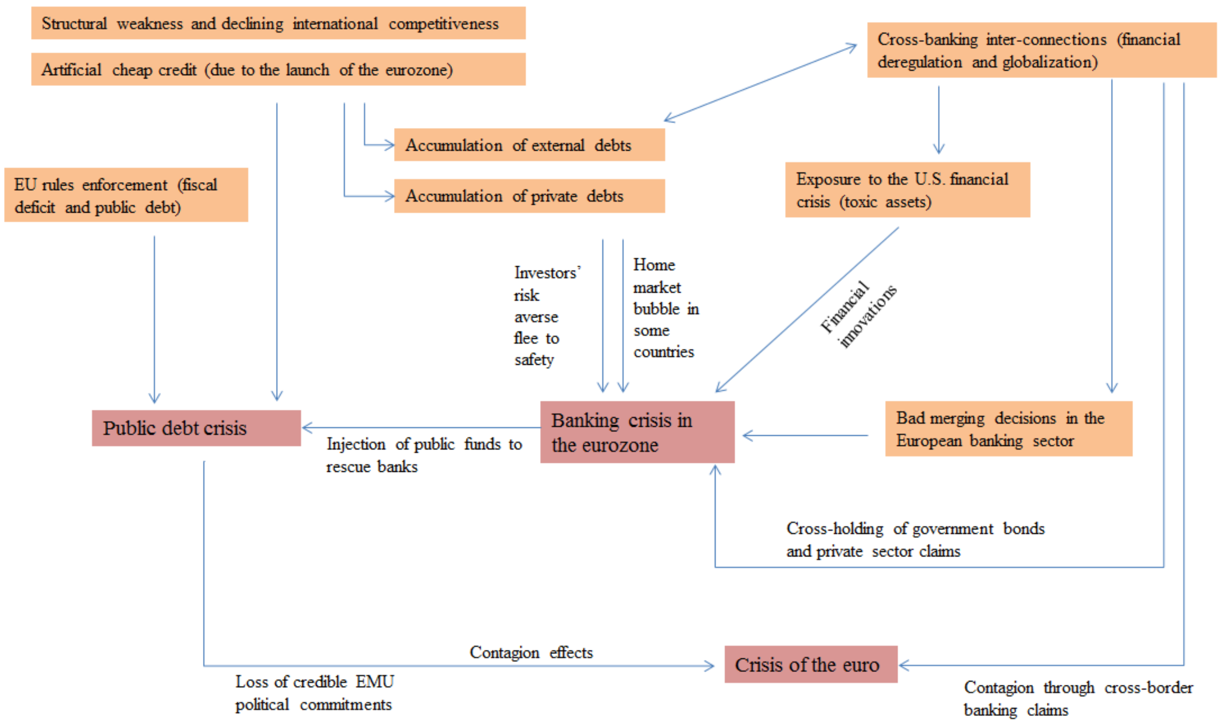
Note: government debt as percentage of GDP
Source: Eurostat and OECD

To tackle the problem of rising fiscal deteriorations, policy responses have focused on the implementation of structural fiscal reforms to reduce both fiscal deficits and public debts to the levels set within the Stability and Growth Pact (SGP). In addition, further European integration has been considered. Particularly, measures that have already been implemented include the creation of the European Stability Mechanism (ESM) to provide urgent financial assistance to indebted euro area governments and to financial institutions to reduce the risks of contagion. Also, the implementation of the European semester ensures that EU-level discussions on all policies (fiscal policy, macroeconomics imbalances, financial sector issues, and growth enhancing structural reforms) are analyzed and assessed together. This helps to improve the coordination between economic and fiscal policies amongst the member states ensuring progress towards targets. In addition, several measures have been taken to further strengthen the European Economic and Monetary Union (EMU) with significant major agreements concerning the establishment of a single banking authority to regulate financial institutions under the supervision of the European Central Bank (ECB). Also, amongst these measures, the proposal to strengthen the protection of bank depositors across the Banking Union with the European Deposit Insurance Scheme (EDIS) marks an important step towards reinforcing financial stability and minimizing potential spillover effects resulting from the highly integrated European financial markets. Once it will be fully operational, this measure should reinforce the financial stability across European countries by further weakening the link between banks and their national governments, and by delivering even greater trust in the safety of retail bank deposits, regardless of a bank's location in the European Union. Further additional measures include for example the adoption of a unified fiscal policy to achieve greater fiscal coordination and budget discipline.

In this thesis, we identified some key areas that could explain why investors' interest in fiscal and political variables during bad economic conditions and highly volatile stock markets have caused the sudden rise in European bond spreads. We argued that the causes of the euro crisis may be due to the deterioration of a combination of various macroeconomic variables (see Figure 2), over the years that are dragging down European economies. As serious deteriorations in the macroeconomic factors reach dangerous critical levels, the importance of fiscal and political variables are even more emphasized, with the financial and economic crisis. Thus, we aim to capture the potential non-linearity factors driving bond spreads to better reflect the current disparities of bond spreads across European countries due to the changes in the state of the economy. Using nonlinear threshold models, we intend to endogenously and exogenously determine appropriate thresholds that could explain higher impact of government debt and political risk on bond spreads during crisis times compared to normal times, especially as government debt levels and political risk levels were rising to unprecedentedly high levels.

In addition, the rise in bond spreads during the euro crisis has been felt differently across European countries. While some peripheral euro area member states have been severely punished by the financial markets with high borrowing costs, core euro area member states still continue to enjoy relatively low borrowing costs. Similarly, euro area countries are generally faced with higher borrowing costs compared to European countries with independent monetary policies. However, we argue that as investors usually focus on the level of public debt and fiscal deficit in each individual country, such considerations maybe misleading and inappropriate when considering countries in a monetary union. Hence, we intend to use an approach that highlights the determinants of bond spreads based on state of the stock markets or on state of the economy.

Figure 2. Various aspects of the origins of the euro crisis



In the following three chapters, we will try to assess the importance of nonlinear effects of government debt, political risk, real GDP growth, and volatility on European bond spreads. Traditionally, non-linear threshold panel approach is used to determine the impact of government debt or inflation on economic growth. However, these non-linear models could give us a better understanding of the current dynamics of bond spreads in European countries. After several years of stable bond spreads in the euro area countries following the creation of the monetary union, government bond spreads suddenly surged. In fact, we observed great divergences in bond spreads following the global financial crisis and the European sovereign debt crisis with rising government debt ratio, political risk, and volatility in stock markets.

Chapter 1 tries to shed light on the non-linear impact of government debt during bad economic conditions. We developed a framework to capture periods of bad economic conditions using the real GDP growth rate. Using this approach, we intended to demonstrate that government debt ratios become significant during bad economic conditions with far greater impact compared to periods of normal economic conditions. We argue that current empirical literature does not fully capture the various negative economic conditions at the country level by defining the periods after 2008 as “crisis period” which captures the impact of government debt on bond spreads. Given that empirical literature about the relationship between government debt ratios and bond spreads does not consider the heterogeneous economic fluctuations among European countries, we built a model that aims to overcome these limitations and identify when bad economic conditions can happen. Hence, we are able to analyze the impact of government debt in normal and bad economic conditions using panel fixed effects.

Chapter 2 presents the dynamic panel approach when determining the impact of government debt on bond spreads based on stock market volatility. In particular, the objectives are to determine endogenously the levels of government debt ratios and/or volatility indices that cause government debts to have significant impact on the bond spreads. This model deals with one of the most controversial issues related to the determination of government debt thresholds. Furthermore, combining government debt ratios and volatility indices allows us to analyze the impact of government debts in four regimes. This framework allows us to determine the various dynamics present in the different panel groups.

Chapter 3 analyzes the impact of political risks and stock market volatility on bond spreads. In this chapter, we analyze the effects of political risks variables when the volatility reaches certain endogenous threshold levels using the dynamic threshold panel. Indeed, we argue that as the economic and financial conditions deteriorate, the impact of country-specific political risk becomes quite important. Hence, this allows us to determine the sensitivity of bond spreads as political risks rise across various European countries given the fragile state of the economy.

Chapter 1: Testing the impact of government debt and primary balance on bond spreads during periods of weak economic growth

1.1. Introduction

During the recent global financial crisis and the subsequent euro area sovereign debt turmoil, long-term euro area government bond yields relative to the German Bond started to rise significantly after a decade of prior convergence, following the creation of the monetary union. Governments in several European countries intervened to rescue various large financial institutions whose failures could have crippled their national economies. However, as concern intensified regarding the solvency of financial institutions or sovereigns, banks stopped lending to even healthy banks, and became reluctant to refinance profitable projects. The uncertainty about the viability of financial institutions and governments caused a major rift that engendered a crisis of confidence in the European project, this lack of confidence could have crippled the entire financial system due to the interconnection of the European financial markets. As a consequence, the governments' rescue programs led to the rapid deterioration of the fiscal positions of several European economies. In some cases, the impacts of the deterioration of the macroeconomic fundamentals were felt differently not only amongst euro area countries, but also between euro area countries and European countries that kept independent monetary policies (the latter are denominated "*standalone*"). In this paper, we focus on the dissimilarities of the macroeconomic fundamentals that exist between euro area countries and standalone countries.

The divergence in long-term government bond spreads between euro area countries and standalone countries have led authors such as De Grauwe and Ji (2013) to argue that bond spreads in euro area countries before the global financial crisis were disconnected from the underlying fundamentals such as public debts. However, their study on standalone countries considers several non-European economies (e.g. Australia, Canada, Japan, and the United States) that could significantly differ from European economies with independent monetary policies. We advocate that a more interesting panel approach should be based on European countries since these countries are closely interrelated on several dimensions such as financially, economically, and politically. In addition, the group of standalone countries shows relatively less deterioration in public debts, than what was observed in the group of euro area countries. Potential causes amongst others that could explain the current development are related to the financial and economic deregulations, labor market rigidities undermining their competitiveness, and difficulties in establishing and enforcing fiscal policies, that started or were accentuated after the creation of the monetary union. This contributed to the modification of the usual transmission between fiscal positions and government bond spreads in euro area countries. As a consequence, persistent and excessive foreign indebtedness exposed peripheral euro area countries to the risk of sudden stops and reversals in capital inflows, while during normal economic periods, large capital inflows generally contributed to the rise in government indebtedness in some European economies. Consequently, this may have generated significant financial instability during bad economic conditions and may have led to the current painful and prolonged macroeconomic adjustments. For all these reasons, we argue that it is important to assess potential non-linear effects of fiscal variables (public debt and primary balance) to explain the sudden surge in bond spreads during periods of bad economic conditions. Hence, this chapter mainly focuses on this issue.

We would like to contribute to the current literature in studying the non-linear impact of public debt and primary balance on long-term government bond spreads during normal and bad economic conditions. In particular, our modeling approach is designed to analyze the fiscal variables in normal and bad economic conditions. We created a dummy stress variable that turn values of an underlying macroeconomic variable such as public debt and primary balance into zero during normal economic periods, such that we only capture their values during stressful economic periods. Similarly, we also perform the same procedure to only capture their values during normal economic conditions. In particular, our analysis extends previous studies on sovereign bond spreads on fiscal positions (see De Grauwe (2010), De Grauwe and Ji (2013), Gros (2011)) and those using additional macroeconomic variables (see. Gómez-Puig, Sosvilla Rivero et al. (2014), Mody (2009)) by capturing the fiscal variables during normal and bad economic conditions. Therefore, we analyze the impact of public debt and primary balance on bond spreads related to the state of the economy. We argue that the non-separation of the effects of fiscal variables during normal and bad economic growth periods dilutes the non-linear effects present in them. Moreover, this approach will allow us to disentangle possible differences between euro area and standalone countries, when such contrasts are high during periods of tough economic conditions.

Our analysis reveals important results: (i) the use of a nonlinear framework clearly highlights the magnitude and significance of public debt when comparing periods of economic crisis with normal periods; (ii) the magnitude of public debt after the global financial crisis is relatively more important and greatly contributed to the rise in bond spreads in all panel groups; (iii) the non-linear effects caused by the accumulations of public debt are greater during crisis times (or bad economic conditions) compared to normal times in the initial euro area group, in contrast with the results obtained in the standalone group; (iv) however, the accumulations of public debt during normal or crisis times' have relatively the same impact in the European group and in the new euro area group.

The remainder of this paper is structured as follows. Section two discusses the literature review of the impact of macroeconomic fundamentals on sovereign bond spreads through linear and non-linear effects. Section three presents the macroeconomic variables and discusses the relationships amongst them. Section four presents our panel estimation results and some robustness tests. Section five provides some theoretical explanations about the results in explaining long-term government bond spreads. Finally, section six concludes with some policy recommendations.

1.2 Related literature

In the literature, researchers analyzing the drivers of government bond spreads generally consider fiscal variables such as fiscal deficit, public debt, and external public debt. In addition, other researchers in the literature focus on additional macroeconomic fundamentals and financial variables such as private debt, ratings, private savings, and volatility for long-term determinants of government bond spreads. In both approaches, researchers do not generally try to disentangle the effects of these macroeconomic variables during normal and bad economic conditions, despite the fact that their impact could be less important or even negligible during normal economic periods. In this chapter, we focus on the effects of fiscal policy on government bond spreads, it is generally argued that fiscal variables are the main determinants to explain long-term government bond yields. In this context, the main differences in the literature about bond spreads come from considering the following variables: fiscal variables, financial variables, and other additional macroeconomic variables. Also, the techniques used in the analysis of sovereign bond spreads are generally based on standard VAR, fixed effect panel regression, and time varying VAR models.

In the fiscal approach, De Grauwe and Ji (2013) argue that there was a disconnection between long-term government bond spreads and the fiscal positions in the selected euro area countries (Belgium, France, Greece, Ireland, Italy, Portugal, Netherlands) prior to the periods before the global financial crisis. Their results show that before 2008, investors did not focus on the level of public debt in euro area countries, which was in contrast with standalone countries. However, after the global financial crisis in 2008, investors started to exclusively focus on the fiscal positions (government debt and fiscal deficit) in euro area countries. Therefore, the sudden focus of investors left some euro area economies highly vulnerable to shocks, due to the resurgence of government debts after investors stopped relying on them. In contrast, governments in standalone countries were less vulnerable to the sudden shift of investors because they did not experience the disconnection between fiscal variables and bond spreads.

In the approaches representing a combination of several factors such as fiscal, financial, and other macroeconomic variables, Gómez-Puig, Sosvilla Rivero et al. (2014) investigate the drivers of euro area sovereign bond yields with respect to the German bond, using a panel data technique with a wide range of variables including variables that capture changes in market sentiment. Haugh, Ollivaud et al. (2009) analyze the non-linear effects that have characterized the financial crisis due to deteriorations in fiscal performance. They argued that incremental deterioration of the fiscal position led to larger increase in bond spreads with financial factors such as risk and illiquidity acting as magnifiers. As the increase in risk aversion became a significant factor, euro area countries became highly exposed to financial markets particularly those with deteriorating fiscal positions with major bank bailouts. Codogno, Favero et al. (2003) provide evidence that yield differentials of government bonds in euro area countries, which are mostly explained through vulnerability of fiscal policies and international risk factors. Aßmann and Boysen-Hogrefe (2012) explain that the yield differentials between euro area countries are based on differences in default and liquidity risks. In their analysis, default risk is modelled based on forecasted debt to GDP ratio, budget balance in percentage of GDP, and current account in percentage of GDP. Meanwhile, liquidity risk is approximated using the outstanding amount of domestic debt securities of the public sector. De Santis (2012) analyzes the change that occurred in the euro area with long-term government bond yields relative to the German bond based on three factors: weak fiscal fundamentals, regional higher risk aversion, and Greek contagion risk. The literature on the drivers of the euro area sovereign bond spreads mostly focuses on the importance of fiscal variables.

Adverse market sentiment conditions, after the global crisis has increased the relevance of the credit risk component in the determination of the sovereign bond spreads. This credit risk component of the bond yields accounts for the risk exposures; this will be materialized when borrowers cannot fully recover the amount lent on time, to completely meet the initially agreed conditions. Each euro area country has a non-zero probability of default and/or credit downgrades that should be taken into account. The extra yields investors require to compensate for the additional exposures to higher potential losses will vary based on the countries' abilities to generate revenues to meet liabilities, Ardagna, Caselli et al. (2004). However, the deteriorations in fiscal positions that led investors to require extra yields can be reduced or even nullified when the country can count on high residents' private savings to continue to purchase the government bonds. International capital inflows can also help to fund the governments, if foreign investors are willing to buy up government debts despite the already high level of debts (Faini (2006)). For example, during the debt crisis, as investors were seeking safety, the German government was able to issue bonds at very low yields. However, the rise in foreign borrowing in most of the euro area countries either through public and/or private sector activities is a major source of concern. This illustrates the importance of foreign indebtedness, as euro area countries became highly dependent on the international financial markets to meet their obligations and to be able to keep funding basic activities. In some European countries, investors looking for safe, cheap source of external financing suddenly stopped during the global crisis, and this led to rapid deteriorations in fiscal positions due to large increase in borrowing costs. This was particularly devastating for countries that rely on short-term bonds for refinancing. To assess government bond yield differentials in the financial perspective, Gómez-Puig (2006) discusses the importance of default and liquidity risks. As liquidity risk varies inversely to the size of the bond markets, large bond markets in Italy, United Kingdom, Germany, and France assist these countries to relatively lower their risk exposures. Large bond markets are very liquid with depth so profound that individual transactions are unable to cause changes in prices. Therefore, the liquidity risk component are significantly reduced due to depth of the bond markets. However, countries with large amount of debts might increase the perception of an increasing risk of default, which will cause a surge in the yields that investors accept to purchase the bonds.

In recent studies, another aspect covered in the literature about the drivers of bond spreads includes other additional macroeconomic variables besides the country's fiscal policy effects that are so predominant. For instance, Bernoth, von Hagen et al. (2012) argue that long-term government bond spreads are better captured with deficit and debt service measures rather than relying on government debt ratios due to the creation of the European Monetary Union. In this paper, the effects of debt service on government bond spreads are non-linear as they measure the ability of countries to raise revenues to meet their obligations on time. Also, Corsetti, Kuester et al. (2012) analyze the complex interactions related to the stability of macroeconomic variables with sovereign risks, that are exacerbated through the transmission links between strained government finances and accumulation of private sector debts. As euro area countries have a monetary policy that is constrained to fit the entire region despite diverse fiscal policies, the result of macroeconomic instability effects are amplified, resulting with negative shocks that affect the economy through self-fulfilling higher costs for both private and government sectors. In addition, Alexopoulou, Bunda et al. (2009) analyze the drivers of long-term sovereign bond spreads for new EU countries based on macroeconomic indicators such as external debts, fiscal balances, current account balances, exchange and inflation rates, short-term interest rate spreads, and trade openness. While the fiscal policies remained the most important drivers of long-term sovereign bond spreads, the increasing reliance on external debts raised new importance due to the risk of potential spill-over effects. (Caporale, Ciferri et al. 2011) analyze the dynamic effects of fiscal imbalance in euro area countries based on investors discrimination among sovereign bond issuers. With long-term government bond yields based on a linear Global VAR approach using both fiscal variables and additional macroeconomic variables such as real estate rates, inflation, and real output.

In this framework, we contribute to the existing literature on the drivers of sovereign bond spreads by empirically assessing the relevance of non-linear effects of fiscal variables during tough economic conditions. This paper aims to further extend the research done by De Grauwe and Ji (2013) and Haugh, Ollivaud et al. (2009) by capturing the potential non-linear effects of fiscal variables during normal and stressful economic periods. Following the crises, we consider potential alternative links that could affect a country's fiscal position due to the deteriorations of various macroeconomic fundamentals. Gros (2011) argues that the impact of external debt on the affected European countries during the turmoil should be the focus and that the current focus on public debt is misleading. Meanwhile, Afonso, Baxa et al. (2011) argue that the sustainability of public debts mostly depend on the state of the financial markets and its ability to harm economic growth rather than the extent of public indebtedness. Based on these papers, we develop a new approach that considers two states (normal and bad economic conditions). Our objective is to determine the states where the impact of these fiscal variables on bond spreads are significant or not. We believe that the deterioration of fiscal variables are further exacerbated during bad economic conditions when their effects are maximized contrary to periods of normal economic conditions. This approach differs from Afonso, Baxa et al. (2011) that analyze the effects of the financial stress index (dummy variable) on bond spreads. In our approach, dummy stress variables are directly multiplied with the underlying fiscal variables (e.g. public debt and primary balance) to help to capture the non-linear effects. Alternatively, we could use the financial stress index (FSI) designed by the IMF in the analysis, because it captures broad underlying factors related to the deterioration of the global economic condition. However, it presents some limitations in the control of this kind of analysis because one of the factors used to build this index is the 10-year government bond yields. In order to avoid to trivially explain a variable by itself, we designed a stress dummy variable that captures periods of bad economic growth. Due to the limited dataset available for each European country, we have decided to use a panel approach to improve the robustness of the analysis since we can obtain more data points. In addition, a potential advantage of the limited dataset starting from 2000Q1 to 2015Q3 is that our analysis fully captures the various fiscal policies that have been implemented since the introduction of the euro in 1999. Moreover, the panel approach allows to avoid potential overparameterization issues that can arise in a standard VAR with several lags in a short dataset. The results obtained from this analysis leads us to believe that the accumulation of imbalances in fiscal variables during several years in euro area economies played a significant role in the surge of sovereign bond spreads.

1.3 Data descriptions and variables

In this section, we present the variables that are used to study the determinants of bond spreads as follow.

Table 1. Description of the macroeconomic variables

Variable	Description	Source
SPRDDE	$\text{Spread}_{Q1} = \text{average}[(\text{yield}_{M1} + \text{yield}_{M2} + \text{yield}_{M3})_i - (\text{yield}_{M1} + \text{yield}_{M2} + \text{yield}_{M3})_{DE}]$, we average the monthly bond yields over three months of a country i, then subtract the German bond (DE) yield that is also expressed as an average over three months in percentage points. Long term government bond yields represent non-seasonally adjusted data with a residual maturity of around 10 years.[1]	OECD ECB Macrobond
PRIM	Primary balance is expressed in GDP percentage points.	Macrobond
GDBT	Government debt is expressed in GDP percentage points (Maastricht debt definition). Government debt is defined as the consolidated gross debt of the whole general government sector outstanding debt at the end of the quarter.	Eurostat Macrobond
D	D is a dummy variable which takes the value of 1 if the real GDP growth of that year is less than the yearly average from 2000 to 2007. Otherwise, this dummy takes the value of 0. Using annual real GDP growth rate in percentage, the objective of the dummy is to capture periods of bad economic conditions. We assume that taking the average of the period from 2000 to 2007 represents the adequate cut-off point between normal and bad economic periods. If the value of real GDP growth in a year is lower than this average value, then we assume that all the four quarters within that year would have experienced a bad economic condition.	OECD IMF World Economic Outlook Macrobond

Note: To test the robustness of the dummy stress variable, we create an alternative dummy stress variable (DD) that average the yearly real GDP from 2000 to 2015.

The dataset consists of quarterly data on sovereign bond yields and their fundamental macroeconomic determinants for the period 2000Q1 – 2015Q3 for 26 European economies. Following the literature, we use the 10-year government bond yields as a measure of sovereign borrowing costs. Quarterly data are normally averages of monthly figures for each country. To obtain the 10-year government bond spreads, we subtracted the German bond yield from the respective country bond yield. We obtained the variables from sources such as Eurostat, Organization for Economic Co-operation and Development (OECD), Macrobond, and the European Central Bank (ECB). Table 1 provides detailed explanations about the construction and

[1] We approximated the 10-year government bond yield in Estonia with the estimate of the long-term interest rate on government bonds, OECD Economic Outlook, Calendar Adjusted, SA taken from the Macrobond database.

description of these macroeconomic variables. Below, we refer to these variables by using the abbreviations proposed in the respective brackets as follows: 10-year government bond spread (sprdde), public debt (gdbt), primary balance (prim), and dummy economic stress (d).

The expected signs for the drivers of bond spreads are as follows:

- *Public debt ratio*: It assesses the size of the risk associated with the build-up over the years of government fiscal policies on long-term government bond yields. Intuitively, the evolution of public debt represents an aggregate fiscal measure that captures current and past fiscal policies, which provide a broad overview of the financial performance of a country. Hence, we would expect a positive relationship between a rise in public debt ratio and long-term government bond spreads.

- *Primary balance ratio*: It measures the influence of fiscal policy developments on long-term government bond yields. A positive change in the primary balance ratio may lead to a reduction in government borrowing costs because the improvement in the fiscal balance has lowered the sovereign risk in the short run. Hence, we would expect a negative relationship between a rise in primary balance ratio and long-term government bond spreads.

We started the sample period from 2000Q1 to 2015Q3 for the euro area group and from 2002Q2 to 2015Q3 for the remaining three groups (European, new euro area, and standalone) due to the difficulties of obtaining older quarterly observations. In addition, as explained in Table 1, we decided to capture periods of bad economic conditions using real GDP growth rate. We argue that as the economic conditions worsened, governments were faced with some hard choices due to lower tax revenues and higher entitlement spending costs (e.g. unemployment benefits), which may significantly raise sovereign risks due to greater risk of default. Figure 3 to Figure 6 present the graphical representations of the various variables (bond spread, public debt, and primary balance) that are used in analysis (see Appendix).

Table 2 shows the various panel groups made up from 26 European countries that are included in our analysis. Our panel groups include countries with similar characteristics in term of monetary union adhesion or not, or even the date of their entry in the Eurozone. We denoted the first group "*European*". It contains all the available dataset of the 26 European countries that we could obtain. The second group is denoted "*initial euro area*" based on the initial euro area countries that adopted the euro in 1999 in addition to Greece[2] that joined a year later. The third group is denoted "*new euro area*" and refers to new member states that later joined the euro area starting from 2007 to 2015. We believe that it is important to differentiate between these two groups since their economies significantly diverge. Consequently, new euro area countries have not experienced similar fiscal policy developments. Finally, we denoted the last group "*standalone*". It includes European countries characterized with independent monetary policies. Note that, all these three groups contain countries that have been severely affected with the turmoil and countries that have weathered relatively well the bad economic environment.

Table 2. List of countries in the various panel groups

Groups	Countries	Nr.
European	Austria (AUT), Belgium (BEL), Bulgaria (BGR), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), the Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), and United kingdom (GBR)	26
Initial euro area	Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Greece (GRC), Ireland (IRL), Italy (ITA), Luxembourg (LUX), the Netherlands (NLD), Portugal (PRT), and Spain (ESP)	11
New euro area	Cyprus (CYP), Estonia (EST), Latvia (LVA), Lithuania (LTU), Malta (MLT), Slovakia (SVK), and Slovenia (SVN)	8
Standalone	Bulgaria (BGR), Czech Republic (CZE), Denmark (DNK), Hungary (HUN), Norway (NOR), Poland (POL), Sweden (SWE), and United kingdom (GBR)	8

Note: We excluded Croatia, Romania, and Switzerland from the analysis due to insufficient sample sizes or lack of available dataset.

[2] While Greece was qualified to join the Eurozone in 2000 and later admitted on January 2001, we assume the 1 year difference in the dataset with other earlier admitted Eurozone countries does not significantly change the underlying fundamentals.

To investigate the presence of potential unit root in the dataset, we apply the panel unit root tests on bond spread, public debt ratio, primary balance ratio, and change in public debt ratio. We use four-unit root testing methods such as Im, Pesaran and Shin (denoted IPS), Levin, Lin & Chu (denoted LLC), Breitung, and ADF-Fisher (denoted Fisher). However, we pay special focus on the IPS test given that it seems more appropriate, since it checks for individual unit root in the panel. Also, the IPS test requires fewer number of observations for the test to have sufficient power for the analysis. In addition, the requirement for the Levin, Lin & Chu and Breitung tests are satisfied given that we are working with a balanced panel of variables. Table 3 presents the results of the panel unit root tests for the various groups. In the European panel group, the tests generally reject the null hypothesis with p-values less than 5% confidence level. Hence, all eight variables are stationary. In the initial euro area panel group, we obtain similar results with the exception of bond spread whose results are mixed. In the new euro area panel group, the four tests support the unit root hypothesis (non-stationarity) for the bond spreads and dummy stress government debt ratio. However, the tests for the remaining variables generally reject the null hypothesis (stationarity). In the standalone panel group, we observe that the tests reject the null hypothesis (stationarity) for all variables, with the exception of dummy stress government debt ratio. To conclude, with few exceptions, the variables (sprdde, d*gdbt, (1-d)*gdbt, d*prim, (1-d)*prim, d*cgdbt, (1-d)*cgdbt, cexr) are stationary according to the IPS test.

Table 3. Panel unit root test

	Test	sprdde	d*gdbt	(1-d)*gdbt	d*prim	(1-d)*prim	d*cgdbt	(1-d)*cgdbt
European	IPS	0.0012	0.0269	0.0000	0.0000	0.0000	0.0000	0.0000
	LLC	0.0606	0.6325	0.0041	0.0000	0.0000	0.0000	0.0000
	Breitung	0.0012	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000
	Fisher	0.0238	0.0093	0.0000	0.0000	0.0000	0.0000	0.0000
Initial euro area	IPS	0.0791	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
	LLC	0.1852	0.1697	0.0000	0.0823	0.0000	0.0000	0.0000
	Breitung	0.0159	0.0000	0.0000	0.0000	0.0007	0.0000	0.0000
	Fisher	0.3104	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000
New euro area	IPS	0.1679	0.4894	0.0011	0.0000	0.0000	0.0000	0.0000
	LLC	0.5436	0.7330	0.2593	0.0000	0.0000	0.0121	0.0000
	Fisher	0.2874	0.1444	0.0011	0.0000	0.0000	0.0000	0.0000
	Breitung	0.0279	0.2144	0.0010	0.0065	0.0000	0.0000	0.0000
Standalone	IPS	0.0007	0.1498	0.0002	0.0000	0.0000	0.0000	0.0000
	LLC	0.0333	0.7801	0.0044	0.0024	0.0019	0.0000	0.0000
	Breitung	0.0725	0.0030	0.3772	0.0102	0.0000	0.0029	0.0000
	Fisher	0.0039	0.0735	0.0005	0.0000	0.0000	0.0000	0.0000

Note: In all panels, the null hypothesis indicates that the variables contain unit roots (non-stationarity). In the Alternate hypothesis, in Im, Pesaran and Shin (IPS) indicates that the series used in some panels are stationary. Levin, Lin & Chu (LLC) and Breitung indicates that all panels are stationary. ADF-Fisher (Fisher) indicates that at least one panel is stationary. The results provided in the table indicate p-values. Results with p-values less than 5% fail to reject the alternate hypothesis that the panels are stationary. Estimations with non-stionary panel variables may lead to spurious regression results. All panel groups cover the period 2002Q2 - 2015Q3 with the exception of initial euro area that covers the period 2000Q1 – 2015Q3. In addition, all groups are balanced panels.

Furthermore, we performed a panel cointegration test using (Pedroni (1999), Pedroni (2004)) approach to test for the existence of a long-term relationship between bond spreads and the set of independent variables as two tests supported the unit root hypothesis in the new euro area group. The results of the Pedroni residual cointegration test (see Table 16, Appendix) show that the cointegration equations do not results in stationarity error terms since all p-values are generally higher than 1% level (we have to accept the null that there is no cointegration from all these equations). Thus, there is no need for a further test after we found that the relations between variables are not cointegrated given that we ran the regressions with generally stationary variables.

1.4 Modeling of bond spreads through panel approach

In this section, we apply a fixed effect (FE) panel model[3] to analyze the impact of the development of fiscal variables on long-term government bond spreads during bad economic growth:

To analyze the non-linear impact of government debt on bond spread, we specify six econometric equations that capture the non-linear effects such as:

$$sprdde_{it} = \alpha + \eta * d_{it} + \psi * d_{it} * gdbt_{it} + \rho * (1-d_{it}) * gdbt_{it} + \alpha_i + u_{it} \quad (1.1)$$

$$sprdde_{it} = \alpha + \eta * d_{it} + \psi * d_{it} * gdbt_{it} + \rho * (1-d_{it}) * gdbt_{it} + \varphi * d_{it} * gdbt_{it}^2 + \gamma * (1-d_{it}) * gdbt_{it}^2 + \alpha_i + u_{it} \quad (1.2)$$

$$sprdde_{it} = \alpha + \eta * d_{it} + \vartheta * d_{it} * prim_{it} + \mu * (1-d_{it}) * prim_{it} + \alpha_i + u_{it} \quad (1.3)$$

$$sprdde_{it} = \alpha + \eta * d_{it} + \vartheta * d_{it} * prim_{it} + \mu * (1-d_{it}) * prim_{it} + \delta * d_{it} * prim_{it}^2 + \pi * (1-d_{it}) * prim_{it}^2 + \alpha_i + u_{it} \quad (1.4)$$

$$sprdde_{it} = \alpha + \eta * d_{it} + \psi * d_{it} * gdbt_{it} + \rho * (1-d_{it}) * gdbt_{it} + \vartheta * d_{it} * prim_{it} + \mu * (1-d_{it}) * prim_{it} + \alpha_i + u_{it} \quad (1.5)$$

$$sprdde_{it} = \alpha + \eta * d_{it} + \psi * d_{it} * gdbt_{it} + \rho * (1-d_{it}) * gdbt_{it} + \vartheta * d_{it} * prim_{it} + \mu * (1-d_{it}) * prim_{it} + \delta * d_{it} * prim_{it}^2 + \pi * (1-d_{it}) * prim_{it}^2 + \varphi * d_{it} * gdbt_{it}^2 + \gamma * (1-d_{it}) * gdbt_{it}^2 + \alpha_i + u_{it} \quad (1.6)$$

where $sprdde_{it}$ is the 10-year government bond spread in percent of country i at time t, d_{it} is the dummy stress variable of country i at time t, $gdbt_{it}$ is the public debt as percentage of GDP of country i at time t, $prim_{it}$ is the primary balance as percentage of GDP of country i at time t, α is the constant term, α_i is the country's i fixed effect, and u_{it} is the error term (white noise).

We decided to conduct a country-fixed effect panel model to mitigate the effects of the small data size and large number of variables in the analysis. This approach helps us to avoid the risk of having

[3] Initially, we performed various Hausman tests to check which model is appropriate (Fixed effect or Random effect). The results of the tests clearly indicate that the fixed effect (FE) is most appropriate model since p-values obtained are all less than 5% level.

too many variables in the regression model compared to the number of available observations (over-fitting). In addition, we used the country-fixed effect panel to allow for the heterogeneity among the various countries in each panel group. We believe that the deterioration of these fiscal variables can have non-linear effects on bond spreads during bad economic conditions that amplified the effects compared to during normal economic conditions. Therefore, we decided to design dummy stress variables that track public debt and primary balance, to capture potential non-linear effects during bad economic growth while becoming zeros in normal economic periods. This approach complements those generally followed in the literature that combine the effects of the variables during normal and bad economic periods. Gomez-Puis et al. (2014) applied a panel model based on a linear approach using several macroeconomic variables such as fiscal deficit, public debt, private debt, bank debt, foreign debt, market liquidity, volatility index. However, this approach suffers from serious endogeneity problems due to the large number of variables considered. In contrast, De Grauwe and Ji (2013) analyzed the non-linear impact on bond spreads using few macroeconomic variables. However, they captured the non-linear effects of the squared public debt over both normal and bad economic periods. Their results showed the significance of non-linear effects while using squared public debt, however, this approach may fail to distinguish between the impact of government debt during normal and bad economic conditions. This is quite important because investors are generally risk takers during normal economic growth and tolerate higher government indebtedness. In contrast, investors are generally risk adverse during economic recessions, causing them to be very sensitive to the level and change in government indebtedness. Furthermore, the application of regime switch, which attempts to capture the impact of the global and sovereign debt crises using a dummy variable that takes the value of 1 after 2008 and 0 before the global financial crisis, is generally applied in most studies. The innovation in our approach is that we do not need to make such an assumption to capture stressful periods because the country could experience bad market conditions at any given period, if the economic output during that year is lower than in average.

In the panel approach, we specify several econometric equations that capture the non-linear effects of public debt and primary balance on bond spreads. Our objective through these non-linear variables is to capture the role played by fiscal variables within European, initial euro area, new euro area, and standalone groups. These dummy underlying variables (d*gdbt, (1-d)* gdbt, d* prim, (1-d)*prim) help to disentangle public debt and primary balance into two states (bad and normal economic conditions). It is important to distinguish the impact of public debt and primary balance during these two states since the exposure during bad economic conditions could cause investors to re-evaluate their exposures. For example, squared public debt variable takes into account the greater sensitivity of the deteriorations of public debt over the years, as investors expect higher probability to face losses with increasing public debt. Similarly, "dummy times public debt squared" and "dummy times primary balance squared" which represent the dummy stress variable multiplied by the squared of fiscal variables, captures the sensitivity of further deteriorations in the underlying fiscal variables on bond spreads during both states. The significance of their effects are particularly dominant when considering countries with high public debt ratios such as in the initial euro area group. Therefore, multiplying the dummy variables during normal and bad economic conditions with the square of the fiscal variables can provide crucial information, because it allows to detect the impact of fiscal variables on bond spreads when the state of the economy changes from normal to bad economic conditions.

1.5 Results of the regressions

In this section, the results of the estimations of the linear and non-linear models are respectively shown for the groups of European, initial euro area, new euro area, and standalone countries. To obtain standard errors that are robust to heteroscedasticity and serial correlation (within cluster) in the error terms, we used the "white cross-section" method for the coefficients of the covariance matrix.

Table 4. Impact of fiscal variables on bond spreads in the European group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.05382*** [0.00648]	-0.02644*** [0.00943]			0.05126*** [0.00642]	-0.03254*** [0.01041]
(1-d)*gdbt	0.05209*** [0.00708]	0.02315** [0.00971]			0.05036*** [0.00690]	0.01349 [0.00992]
d*gdbt^2		0.00049*** [0.00008]				0.00051*** [0.00009]
(1-d)*gdbt^2		0.00015* [0.00008]				0.00021** [0.00008]
d*prim			-0.06124*** [0.01613]	-0.08188*** [0.01792]	-0.03868*** [0.01395]	-0.06562*** [0.01387]
(1-d)*prim			0.01690 [0.01800]	0.01643 [0.01815]	-0.00543 [0.01382]	-0.01240 [0.01159]
d*prim^2				-0.00036*** [0.00012]		-0.00050*** [0.00012]
(1-d)*prim^2				-0.00308*** [0.00112]		-0.00207*** [0.00069]
d	0.47230* [0.27409]	1.95731*** [0.36628]	0.98328*** [0.12219]	0.88359*** [0.11557]	0.49519* [0.26457]	1.83600*** [0.36295]
c	-2.15375*** [0.36476]	-1.13930*** [0.32433]	0.56416*** [0.06198]	0.66003*** [0.07175]	-2.06923*** [0.35900]	-0.80035** [0.31850]
Obs.	1404	1404	1404	1404	1404	1404
R-squared	0.4974	0.5441	0.3828	0.3874	0.5075	0.5594
Adj R-squared	0.4871	0.5341	0.3702	0.3740	0.4968	0.5484

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 4 shows the estimation results of the impact of public debt and primary balance in the group of European countries. Equations (1.1) and (1.2) show the results of the impact of government debt; equations (1.3) and (1.4) show the results of the impact of primary balance, and equations (1.5) and (1.6) show the results of the impact of government debt and primary balance. The results can be summarized as follows. First, the coefficients of the public debt are positive and significant at 1% level in both normal and bad economic conditions (see equations (1.1) and (1.5)). This suggests that bond spreads may go up by about 5 basis points in response to a 1 percentage point increase in government debt ratio. In addition, the Wald test to check whether the coefficients of public debt are equal during both normal and bad economic conditions is accepted. Hence, the coefficients of public debt are not different during both states. In equations (1.2) and (1.6), we observe that coefficients of the dummy stress times public debt squared ($d*gdbt^2$) are positive and significant while the coefficients of dummy stress times public debt (d*gdbt) are negative and significant at 1% level. This is quite interesting because the quadratic equations have a convex form since the second derivative of the bond spread equations are non-negative. Hence, taking the first derivative of the bond spread equations equals zero, which allows us to determine the minimum level of government debt ratio during bad economic conditions. This minimum indicates the level at which further increase in government debt ratio starts to generate an increase in bond spread.

In crisis or bad times (d = 1), $\delta(sprdde_{it})/\delta(d_{it}*gdbt_{it}) = \psi + 2\varphi*gdbt_{it} = 0 \rightarrow gdbt_{it} = -\psi/2\varphi$

→ In equation (1.2), gdbt = -(-0.02644)/(2*0.00049) = 26.93

→ In equation (1.6), gdbt = -(-0.03254)/(2*0.00051) = 31.72

In crisis times, a rising government debt becomes an issue in European group when the government debt reaches a certain threshold such as 26.93%. Hence, government interventions through public policies to stabilize the economy during economic downturns can allow them to pile up more debts on the international financial markets. However, the government interventions come at a certain cost since investors are generally risk adverse during such bad economic periods, leading to a rise in long-term government bond spreads.

It is interesting to note that the coefficients of primary balance are negative and significant at 1% level as expected in all respective equations during bad economic conditions. These expected negative and significant coefficients indicate that improvement in primary balances such as higher primary surpluses or lower primary deficits contribute to significant reductions in bond spreads. Also, we observe that the coefficients of the square of primary balance during crisis times are negatively significant at 1% level in equations (1.4) and (1.6). Hence, the equations of the primary balance during bad economic times suggest a nonlinear form, with rising primary balance resulting to a decrease in bond spread. The significant effects of primary balance during crisis times contrast with the non-significant coefficients during normal economic times. In addition, we observe that the coefficient of dummy stress is positive and significant at 1% confidence level, this indicates that the variable captures periods of bad economic conditions as expected.

In general, the results show that the state of the economic conditions is still quite important when determining the magnitude and significance of public debt in the European group. The primary balance during bad economic conditions has a significant impact on bond spreads. It is important to note that the government debt are mostly greater than 26.93%, which can explain why they have generally been faced with rising level of spreads during various crises.

Table 5. Impact of fiscal variables on bond spreads in the initial euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.06408*** [0.00820]	-0.03878*** [0.01262]			0.06093*** [0.00837]	-0.04364*** [0.01354]
(1-d)*gdbt	0.04604*** [0.00719]	-0.02281* [0.01184]			0.04514*** [0.00718]	-0.02703** [0.01270]
d*gdbt^2		0.00056*** [0.00010]				0.00057*** [0.00010]
(1-d)*gdbt^2		0.00037*** [0.00009]				0.00038*** [0.00010]
d*prim			-0.06561*** [0.01927]	-0.08390*** [0.02407]	-0.03029** [0.01539]	-0.04575*** [0.01767]
(1-d)*prim			0.04926* [0.02953]	0.04229 [0.02676]	0.02128 [0.01792]	-0.00001 [0.01176]
d*prim^2				-0.00036** [0.00018]		-0.00033** [0.00015]
(1-d)*prim^2				-0.00479** [0.00228]		-0.00149 [0.00096]
d	-0.98497*** [0.21878]	0.17938 [0.23414]	0.99612*** [0.21734]	0.85105*** [0.18202]	-0.80441*** [0.18710]	0.24805 [0.25690]
c	-2.78462*** [0.46036]	-0.10220 [0.42391]	0.19240** [0.09614]	0.34331*** [0.09262]	-2.76838*** [0.46324]	0.11316 [0.43317]
Obs. **R-squared** **Adj R-squared**	693 0.5084 0.4989	693 0.5656 0.5560	693 0.3065 0.2932	693 0.3146 0.2994	693 0.5181 0.5075	693 0.5772 0.5653

Note: standard errors are shown in brackets. *** $p < 1\%$, ** $p < 5\%$, * $p < 10\%$. Equations present a balanced panel in the group of initial euro area countries. We control for country fixed effects. Sample periods included are from 2000Q1 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 5 shows the estimation results of the impact of public debt and primary balance in the group of initial euro area countries. The results can be summarized as follows. First, the coefficients of the public debt are positive and significant at 1% level in both normal and bad economic conditions (see equations (1.1) and (1.5)). This suggests that bond spreads may go up by about 6.1 basis points during downturns compared to 4.5 basis points during normal times in response to a 1 percentage point increase in government debt ratio. In addition, the Wald tests further reject that the coefficients of public debt are equal during both normal and bad economic conditions. This confirms that public debt during crisis times has a higher impact on bond spread compared to normal times in the initial euro area group. In equations (1.2) and (1.6), coefficients of dummy times public debt squared ($(1\text{-}d)*gdbt^2$, $d*gdbt^2$) are positive and significant while the coefficients of dummy times public debt ((1-d)*gdbt, d*gdbt) are negative and significant at 1% level. This indicates that the quadratic equations have a convex form since the second derivative of the bond spread equations are non-negative, which allows us to determine the minimum level of government debt ratio during crisis times and normal times.

→ In crisis times (d = 1), we obtain as previously the minimum levels of public debt ratio at 34.75% and 38.62% respectively in equations (1.2) and (1.6).

→ In normal times (d = 0), similarly we obtain the minimum levels of public debt ratio at 31.15% and 35.20% respectively in equations (1.2) and (1.6).

In crisis times, a rising government debt becomes an issue in the initial euro area group when it is above a certain threshold level. However, the government interventions come with costs since investors are generally risk adverse during such bad economic periods leading to a rise in long-term government bond spreads. This is also true during normal times with the difference being that the threshold for the government debt ratio is lower during normal times compared to crisis times.

In addition, the coefficients of primary balance are negative and significant at 1% level as expected in all equations during bad economic conditions while being non-significant during normal times. These expected negative and significant coefficients indicate that an improvement in primary balance such as rising primary surplus or lower primary deficit contributes to a significant reduction in bond spread. Also, the coefficients of the squared primary balance during crisis times are negative and significant at 5% level. Hence, this suggests that the equations of the primary balance have a nonlinear form with rising primary balance leading to decrease in bond spread. Furthermore, we observed that coefficients of dummy stress are unexpectedly negative and significant at 1% level in equations (1.1) and (1.5). However, these coefficients are positive and significant at 1% level in equation (1.3) and (1.4) and also non-significant in equations (1.2) and (1.6). For instance, taking the square of public debt ($d*gdbt^2$) allows us to capture the sensitivity to additional government indebtedness in equation (1.2). In addition, equation (1.2) seems to be most appropriate given the high adjusted R-squared at 55.60% and with a fewer number of variables compared to equation (1.6).

In general, the results show that the state of the economic conditions is important when determining the magnitude and significance of public debt in the initial euro area group. In the initial euro area group, public debts above the minimum public debt level at 34.75% during crisis times and 31.15% during normal times will cause a rise in bond spreads.

Table 6 shows the estimation results of the impact of public debt and primary balance in the group of standalone countries. The results can be summarized as follows. First, the coefficients of the public debt are positive and significant at 5% level in bad economic conditions and 1% level in normal times (see equations (1.1) and (1.5)). This suggests that bond spreads may go up by about 0.8 basis points during downturns compared to 2.7 basis points during normal times, in response to a 1 percentage point increase in government debt ratio. In addition, the Wald tests further reject the hypothesis that the coefficients of public debt are equal during crisis and normal times. Hence, the coefficient of public debt during crisis times is lower than during normal times. It is quite interesting because that could mean investors in standalone group are less concerned about crisis periods compared to normal periods. In equations (1.2) and (1.6), coefficients of dummy stress times public debt squared ($d*gdbt^2$) are positive and significant while the coefficients of dummy stress times public debt (d*gdbt) are negative and significant at 1% level. This indicates that the quadratic equations have a convex form, since the second derivative of the bond spread equations are non-negative, which allows us to determine the minimum level of public debt ratio during crisis times.

Table 6. Impact of fiscal variables on bond spreads in the standalone group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.00802** [0.00328]	-0.05727*** [0.01551]			0.00876** [0.00349]	-0.05578*** [0.01543]
(1-d)*gdbt	0.02740*** [0.00644]	0.07841*** [0.02312]			0.02732*** [0.00639]	0.08114*** [0.01949]
d*gdbt^2		0.00058*** [0.00012]				0.00058*** [0.00012]
(1-d)*gdbt^2		-0.00065*** [0.00023]				-0.00067*** [0.00020]
d*prim			-0.01690 [0.01317]	-0.01679 [0.01416]	-0.00861 [0.01277]	0.00061 [0.01415]
(1-d)*prim			-0.01272 [0.01341]	-0.01040 [0.01425]	-0.01510 [0.01317]	-0.02028 [0.01447]
d*prim^2				-0.00120* [0.00065]		-0.00099 [0.00067]
(1-d)*prim^2				-0.00106 [0.00089]		0.00016 [0.00099]
d	1.44413*** [0.26426]	3.88760*** [0.60584]	0.54673*** [0.09622]	0.53157*** [0.10916]	1.37160*** [0.26543]	3.88771*** [0.56754]
c	-0.29624 [0.31677]	-1.12781* [0.60807]	1.01310*** [0.07345]	1.06408*** [0.07899]	-0.25553 [0.31323]	-1.16806** [0.50234]
Obs.	432	432	432	432	432	432
R-squared	0.7890	0.8116	0.7767	0.7783	0.7901	0.8138
Adj R-squared	0.7839	0.8062	0.7714	0.7719	0.7841	0.8066

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of standalone countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

→ In crisis times (d = 1), we obtain the minimum levels of public debt ratio at 49.28% and 48.17% respectively in equations (1.2) and (1.6).

In crisis times, a rising government debt becomes an issue in standalone group, when it is above the minimum threshold level such as 49.28%. However, the government interventions come with costs since investors are generally risk adverse during such bad economic periods leading to a small rise in bond spreads.

However, similar analysis shows us that public debt during normal times has a concave form.

→ In normal times (d = 0), we obtain the maximum levels of public debt ratio at 60.50% and 60.83% respectively in equations (1.2) and (1.6).

This suggests that in normal times, investors would normally back up countries in the standalone group, such as the United kingdom, for example, which plan to carry out major public infrastructural projects that would allow them to remain competitive in the international financial market even at the cost of charging lower interest rates despite the increase in public debts. This could mostly be due to the high level of trust that investors would place in those countries, if they expect that those projects will lead to even higher profits in the future.

In addition, the coefficients of primary balance are non-significant in all respective equations during normal and bad economic conditions. This indicates that investors are generally not concerned by the primary balance. Furthermore, we observe that coefficients of the dummy stress are as expected, positive and significant at 1% level in all equations. This suggests that our model captures quite well periods of bad economic conditions in the standalone group. In addition, equation (1.2) seems to be most appropriate given the high adjusted R-squared at 80.62% and with fewer variables compared to equation (1.6), which shows several non-significant coefficients.

In general, the results show that the state of the economic conditions is important when determining the magnitude and significance of public debt in the standalone group. Also, the effects of public debt on bond spreads differ between crisis times and normal times. In crisis times, the increase in government debt will lead to a small rise in bond spread, if the government debt ratio reaches a minimum of about 48.17% of GDP, whereas in normal times the increase in government debt will lead to a large decrease in bond spreads after reaching a maximum of about 60.50% of GDP.

Table 7. Impact of fiscal variables on bond spreads in the new euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.04524*** [0.00823]	-0.00127 [0.03001]			0.04247*** [0.00790]	-0.00496 [0.02803]
(1-d)*gdbt	0.05837*** [0.00969]	-0.05056 [0.03540]			0.05439*** [0.00899]	-0.03031 [0.03230]
d*gdbt^2		0.00039** [0.00019]				0.00044** [0.00020]
(1-d)*gdbt^2		0.00131*** [0.00035]				0.00102*** [0.00032]
d*prim			-0.11750*** [0.02717]	-0.14445*** [0.03758]	-0.10785*** [0.03260]	-0.16018*** [0.04021]
(1-d)*prim			-0.02774 [0.01914]	-0.03239* [0.01803]	-0.02167 [0.01566]	-0.02565 [0.01703]
d*prim^2				-0.00160 [0.00119]		-0.00322** [0.00125]
(1-d)*prim^2				-0.00394* [0.00218]		-0.00406* [0.00241]
d	1.37427*** [0.46509]	0.95641* [0.56270]	1.27571*** [0.13355]	1.22356*** [0.13370]	1.18088*** [0.39585]	0.97028* [0.55443]
c	-1.29574*** [0.33800]	0.18671 [0.65435]	0.63243*** [0.06792]	0.68490*** [0.07540]	-1.17037*** [0.31486]	0.02728 [0.59228]
Obs.	378	378	378	378	378	378
R-squared	0.3785	0.3923	0.3624	0.3657	0.4269	0.4497
Adj R-squared	0.3633	0.3740	0.3468	0.3467	0.4097	0.4269

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of new euro area countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 7 shows the estimation results of the impact of public debt and primary balance in the group of new euro area countries. The results can be summarized as follows. First, the coefficients of the public debt are positive and significant at 1% level in both normal and bad economic conditions (see equations (1.1) and (1.5)). This suggests that bond spreads may go up by about 4.2 basis points during downturns, compared to about 5.4 basis points during normal times in response to a 1 percentage point increase in government debt ratio. In addition, the Wald tests further fails to reject the hypothesis that the coefficients of public debt are equal during crisis and normal times. This is quite surprising, because that would imply that investors do not really differentiate between the level of public debt during crisis times and normal times, as you would expect the impact to greater in crisis times than in normal times. In equations (1.2) and (1.6), coefficients of dummy stress times the square of public debt ($(1- d)*gdbt^2$, $d*gdbt^2$) are positive and significant while the coefficients of dummy stress times public debt (((1- d)*gdbt, d*gdbt) are negative and non-significant. This indicates that the quadratic equations have a convex form since the second derivative of the bond spread equations are non-negative, which allows us to determine the minimum level of public debt ratio during crisis and normal times.

→ In crisis times (d = 1), we obtain the minimum levels of public debt ratio at 1.264% and 5.69% respectively in equations (1.2) and (1.6).

→ In normal times (d = 0), we obtain the minimum levels of public debt ratio at 19.33% and 14.84% respectively in equations (1.2) and (1.6).

These results indicate that the minimum threshold limit of government debt ratio is far lower during crisis times compared to normal economic times. That would mean for example that in crisis times, government debt would start to positively contribute to the rise in bond spread after reaching about 5.69% of GDP, whereas it would have to wait till it reaches 14.84% of GDP during normal times to positively contribute to the increase in bond spreads. Therefore, the new euro area group is highly sensitive to rise in government debts during economic downturn.

In addition, the coefficients of primary balance, as expected, are negative and significant at 1% level in all equations during bad economic conditions, whereas these coefficients are non-significant during normal times. This indicates that investors are only concerned by the primary balance during bad economic conditions. Hence, increasing the primary balance in the new euro area group will contribute to a significant reduction in bond spreads. Also, the coefficient of the squared primary balance during crisis times is negative and significant at 5% level (see equation (1.6)), while being non-significant in equation (1.4). This may suggest that it has a nonlinear form. Furthermore, we observe that coefficients of the dummy stress are as expected, positive and significant at 1% level in all equations. This suggests that our model captures quite well the crisis periods in the new euro area group. In addition, equation (1.5) seems to be most appropriate given the high adjusted R-squared at 40.97% with relatively fewer variables compared to equation (1.6). This underlines the importance of government debt and primary balance on the rise in bond spreads.

In general, the results show that the state of the economic conditions is very important when determining the minimum levels at which public debt in the new euro area group starts to significantly contribute to the rise in bond spreads. Also, they appear to be more sensitive during bad economic conditions compared to normal economic conditions. In addition, it appears that the impact of primary balance on bond spreads is very important.

Robustness checks

We performed three robustness tests to check whether the results obtained are robust or significantly differ when we use some alternative measures. First, we tested to ensure that our results are not affected by sampling the post-crisis period starting in 2008Q1. Therefore, we reduce the overall sample period to only covers the period from 2000Q1 to 2007Q4. This allowed us to analyze the government debt on bond spreads before the global crisis in order to compare the results when we included periods after the global financial crisis. Second, we created an alternative dummy economic stress variable that does not exclude the data periods after the global financial crisis. This allowed us to determine whether the results obtained using initial dummy stress variable are sensitive to the fall in economic growth that followed the global financial crisis. Third, we replaced the primary balance variable by the change in government debt (Table 17, Appendix).

In general, the results of the first robustness tests in the European group (Table 8), in the initial euro area group (see Table 9), in the standalone group (see Table 10), and in the new euro area group (see Table 11) fail to really capture the impact of the bad economic conditions. The estimation results suggest that the magnitude of public debts on bond spreads was somewhat lower before the crisis compared to the results when we have the entire sample sizes. In addition, the quadratic equations mostly show a concave form which underscore the level of trust or lack of concern that investors had about European economies. It also shows that rising public debt above certain threshold levels such as 85.83% in crisis times and 94.02% in normal times in the European group, 133.77% in crisis times in the initial euro area group, 52.65% in crisis times and 72.57% in normal times in the standalone group, and 71.1% in crisis times in the new euro area group, will cause the long-term government bond spreads to fall. It shows that before the global financial crisis, the impact of primary balance on bond spreads was stronger during normal economic times and weaker during crisis times in the European group. However, the coefficients of primary balance are significant and unexpectedly positive signed in the euro area group. This may suggest that increasing primary deficit in euro area countries could be financed at lower costs. Also, Table 11 shows that the coefficients of primary balance were non-significant for the dataset before 2008 but were negative and significant as expected if we consider the entire dataset. In general, the results show that the international financial markets started to really pay special attention to their exposure to public debt and primary balance after the global crisis. Hence, the effects of the financial and economic crises have been quite important since the magnitude of coefficients in public debt and in primary balance are generally lower or non-significant for sample size before 2008 compared to the full sample size.

Table 8. Robustness check of the impact of fiscal variables in the European group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.03757*** [0.00354]	0.09545*** [0.00993]			0.03894*** [0.00340]	0.10442*** [0.01068]
(1-d)*gdbt	0.03916*** [0.00447]	0.08142*** [0.01295]			0.03980*** [0.00440]	0.08986*** [0.01364]
d*gdbt^2		-0.00056*** [0.00007]				-0.00062*** [0.00008]
(1-d)*gdbt^2		-0.00043*** [0.00009]				-0.00050*** [0.00010]
d*prim			0.00635 [0.00697]	0.00452 [0.00812]	0.01317** [0.00540]	0.01559** [0.00791]
(1-d)*prim			-0.01659** [0.00825]	-0.01610** [0.00720]	-0.01589** [0.00658]	-0.01589** [0.00663]
d*prim^2				0.00056 [0.00046]		0.00213*** [0.00055]
(1-d)*prim^2				-0.00115*** [0.00043]		-0.00101*** [0.00037]
d	0.10137 [0.17156]	-0.27649 [0.21260]	0.03369 [0.06589]	-0.01244 [0.07184]	0.03210 [0.17605]	-0.39970* [0.22041]
c	-1.46010*** [0.23292]	-2.19103*** [0.37561]	0.50150*** [0.03832]	0.53878*** [0.04654]	-1.47047*** [0.22420]	-2.35595*** [0.38414]
Obs.	598	598	598	598	598	598
R-squared	0.7186	0.7304	0.6885	0.6918	0.7242	0.7428
Adj R-squared	0.7047	0.7161	0.6732	0.6754	0.7096	0.7273

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2007Q4. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 9. Robustness check of the impact of fiscal variables in the initial euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.00620*** [0.00093]	0.01289*** [0.00289]			0.00735*** [0.00097]	0.01356*** [0.00326]
(1-d)*gdbt	0.00200 [0.00153]	-0.00419 [0.00510]			0.00343** [0.00147]	-0.00347 [0.00523]
d*gdbt^2		-0.00005** [0.00002]				-0.00005** [0.00002]
(1-d)*gdbt^2		0.00005 [0.00003]				0.00006* [0.00003]
d*prim			0.01405*** [0.00194]	0.01082*** [0.00279]	0.01455*** [0.00167]	0.01292*** [0.00278]
(1-d)*prim			0.01089*** [0.00218]	0.01022*** [0.00206]	0.00892*** [0.00184]	0.00765*** [0.00168]
d*prim^2				0.00021** [0.00009]		0.00013 [0.00009]
(1-d)*prim^2				-0.00002 [0.00016]		0.00005 [0.00011]
d	-0.34616*** [0.10248]	-0.65356*** [0.18614]	-0.07405*** [0.02262]	-0.07886*** [0.02411]	-0.33813*** [0.09671]	-0.65105*** [0.17973]
c	0.04098 [0.11402]	0.19135 [0.19983]	0.13418*** [0.02114]	0.13678*** [0.02300]	-0.06868 [0.10715]	0.09786 [0.20309]
Obs. **R-squared** **Adj R-squared**	348 0.5062 0.4872	348 0.5434 0.5230	348 0.5133 0.4946	348 0.5169 0.4953	348 0.5707 0.5515	348 0.6100 0.5877

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of initial euro area countries. We control for country fixed effects. Sample periods included are from 2000Q1 to 2007Q4. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 10. Robustness check of the impact of fiscal variables in the standalone group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.02299*** [0.00761]	0.19249*** [0.06222]			0.02839*** [0.00644]	0.16372*** [0.05859]
(1-d)*gdbt	0.05389*** [0.00599]	0.12091*** [0.02439]			0.06301*** [0.00720]	0.10922*** [0.02319]
d*gdbt^2		-0.00183*** [0.00063]				-0.00134** [0.00064]
(1-d)*gdbt^2		-0.00083*** [0.00026]				-0.00057* [0.00030]
d*prim			0.02072 [0.02717]	0.00542 [0.02353]	0.06784*** [0.02220]	0.03471 [0.02332]
(1-d)*prim			-0.03116 [0.01977]	-0.02560 [0.01787]	-0.02917*** [0.00856]	-0.02494*** [0.00794]
d*prim^2				0.00174 [0.00212]		0.00865*** [0.00246]
(1-d)*prim^2				-0.00138 [0.00092]		-0.00007 [0.00063]
d	1.53458*** [0.33555]	-0.93012 [1.30131]	-0.03289 [0.08466]	-0.10838 [0.08092]	1.57680*** [0.28084]	-0.93980 [1.49209]
c	-1.48465*** [0.28853]	-2.71227*** [0.58834]	1.09544*** [0.08221]	1.15473*** [0.08943]	-1.82537*** [0.32171]	-2.69284*** [0.47399]
Obs.	184	184	184	184	184	184
R-squared	0.8069	0.8161	0.7503	0.7546	0.8441	0.8520
Adj R-squared	0.7957	0.8032	0.7358	0.7374	0.8332	0.8379

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2007Q4. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 11. Robustness checks of the impact of fiscal variables in the new euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
d*gdbt	0.08737*** [0.01426]	0.15295*** [0.03418]			0.08744*** [0.01435]	0.17968*** [0.03615]
(1-d)*gdbt	0.08606*** [0.01516]	0.00762 [0.03347]			0.08568*** [0.01525]	0.01089 [0.03308]
d*gdbt^2		-0.00108** [0.00044]				-0.00138*** [0.00045]
(1-d)*gdbt^2		0.00083** [0.00038]				0.00081** [0.00036]
d*prim			-0.00428 [0.03748]	-0.00469 [0.04227]	0.01024 [0.03306]	0.06304 [0.02923]
(1-d)*prim			-0.01724 [0.01636]	-0.01779 [0.01590]	-0.01034 [0.01676]	-0.01291 [0.01759]
d*prim^2				-0.00020 [0.00606]		-0.00295 [0.00462]
(1-d)*prim^2				-0.00132 [0.00162]		-0.00246 [0.00231]
d	0.03437 [0.23303]	-1.52227*** [0.30343]	0.26947 [0.16987]	0.25254 [0.19154]	0.01689 [0.23785]	-1.79371*** [0.31014]
c	-2.25543*** [0.47949]	-1.01629* [0.61089]	0.53789*** [0.06925]	0.55549*** [0.07732]	-2.23900*** [0.48829]	-1.05841* [0.61874]
Obs.	161	161	161	161	161	161
R-squared	0.4623	0.5590	0.3948	0.3955	0.4638	0.5783
Adj R-squared	0.4303	0.5265	0.3588	0.3508	0.4242	0.5347

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2007Q4. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and d: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

In the second robustness tests, we construct an alternative dummy stress variable by averaging the real GDP growth rate over the full sample size from 2000 to 2015 rather than from 2000 to 2007. The intuition behind this, was to capture periods of weak economic growth that heavily impacted European countries during and after the global financial crisis. In general, the robustness tests of the dummy stress variable in the European group (see Table 12), the initial euro area group (see Table 13), the standalone group (see Table 14), and the new euro area group (see Table 15) only slightly differ from the initial results previously obtained. Also, the coefficients obtained when using the alternative dummy stress (DD) show similar results in the respective groups with slightly smaller coefficients than previously. Hence, we can conclude that the estimation results suggest that the dummy stress variable is quite robust.

Table 12. Robustness check of the dummy stress variable in the European group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
dd*gdbt	0.05793*** [0.00612]	-0.05022*** [0.01271]			0.05566*** [0.00616]	-0.05825*** [0.01225]
(1-dd)*gdbt	0.04070*** [0.00537]	0.02100** [0.00853]			0.04077*** [0.00524]	0.01406* [0.00791]
dd*gdbt^2		0.00068*** [0.00010]				0.00072*** [0.00010]
(1-dd)*gdbt^2		0.00009** [0.00004]				0.00014*** [0.00004]
dd*prim			-0.05461*** [0.01702]	-0.08036*** [0.02183]	-0.03264** [0.01434]	-0.07102*** [0.01564]
(1-dd)*prim			0.01246 [0.01655]	0.00667 [0.01531]	0.00665 [0.01247]	-0.01301 [0.01000]
dd*prim^2				-0.00041*** [0.00016]		-0.00074*** [0.00013]
(1-dd)*prim^2				-0.00202 [0.00128]		-0.00106 [0.00070]
dd	-0.17711 [0.32228]	2.41968*** [0.45368]	-1.12929*** [0.14793]	1.04775*** [0.13096]	-0.09551 [0.30941]	2.39816*** [0.44993]
c	-1.50648*** [0.27451]	-0.78507** [0.31832]	1.86867*** [0.15135]	0.80119*** [0.07541]	-1.51220*** [0.26858]	-0.54085 [0.29488]
Obs.	1404	1404	1404	1404	1404	1404
R-squared	0.5344	0.6057	0.4127	0.4170	0.5415	0.6202
Adj R-squared	0.5250	0.5971	0.4008	0.4042	0.5315	0.6107

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and dd: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 13. Robustness check of the dummy stress variable in the initial euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
dd*gdbt	0.07371*** [0.00807]	-0.05788*** [0.01395]			0.07207*** [0.00835]	-0.07356*** [0.01465]
(1-dd)*gdbt	0.04016*** [0.00523]	-0.00585 [0.00987]			0.04079*** [0.00526]	-0.01475 [0.00983]
dd*gdbt^2		0.00073*** [0.00011]				0.00080*** [0.00011]
(1-dd)*gdbt^2		0.00022*** [0.00005]				0.00027*** [0.00005]
dd*prim			-0.05577** [0.02236]	-0.07883* [0.04076]	-0.02071 [0.01799]	-0.07537** [0.02941]
(1-dd)*prim			0.00518 [0.02019]	0.02733 [0.02417]	0.01380 [0.01238]	0.00531 [0.01004]
dd*prim^2				-0.00040 [0.00030]		-0.00080*** [0.00022]
(1-dd)*prim^2				-0.00313** [0.00137]		0.00004 [0.00061]
dd	1.78136*** [0.36898]	1.16683*** [0.35831]	1.33519*** [0.26862]	1.22939*** [0.23165]	-1.66187*** [0.35538]	1.37795*** [0.37411]
c	-4.25782*** [0.49578]	-0.57162 [0.42084]	0.35295*** [0.08223]	0.43716*** [0.09393]	-2.53489*** [0.33849]	-0.24927 [0.41705]
Obs.	693	693	693	693	693	693
R-squared	0.5741	0.6505	0.3450	0.3576	0.5781	0.6671
Adj R-squared	0.5660	0.6428	0.3325	0.3433	0.5688	0.6577

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of initial euro area countries. We control for country fixed effects. Sample periods included are from 2000Q1 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and dd: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 14. Robustness check of the dummy stress variable in the standalone group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
dd*gdbt	0.00520 [0.00450]	-0.09314*** [0.01939]			0.00621 [0.00479]	-0.09228*** [0.01863]
(1-dd)*gdbt	0.01654*** [0.00354]	0.04001** [0.01918]			0.01649*** [0.00343]	0.04612** [0.01786]
dd*gdbt^2		0.00099*** [0.00018]				0.00101*** [0.00017]
(1-dd)*gdbt^2		-0.00021 [0.00015]				-0.00026* [0.00014]
dd*prim			-0.01522 [0.01454]	-0.01100 [0.01644]	-0.01390 [0.01422]	0.01123 [0.01771]
(1-dd)*prim			-0.01823 [0.01293]	-0.01760 [0.01341]	-0.01764 [0.01270]	-0.02391* [0.01260]
dd*prim^2				-0.00200** [0.00082]		-0.00202** [0.00087]
(1-dd)*prim^2				-0.00103 [0.00084]		-0.00007 [0.00087]
dd	1.03345*** [0.22493]	3.74674*** [0.56137]	0.46072*** [0.07272]	0.47740*** [0.08955]	0.95447*** [0.24241]	3.82717*** [0.55095]
c	0.31886 [0.19415]	-0.26903 [0.57304]	1.16369*** [0.05623]	1.20819*** [0.05870]	0.35410* [0.19137]	-0.38848 [0.52737]
Obs.	432	432	432	432	432	432
R-squared	0.7828	0.8161	0.7731	0.7761	0.7846	0.8216
Adj R-squared	0.7776	0.8108	0.7677	0.7697	0.7784	0.8147

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and dd: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

Table 15. Robustness checks of the dummy stress variable in the new euro area group

Variables	(1.1)	(1.2)	(1.3)	(1.4)	(1.5)	(1.6)
dd*gdbt	0.04072*** [0.00903]	0.00642 [0.03337]			0.04011*** [0.00896]	0.00476 [0.02677]
(1-dd)*gdbt	0.04563*** [0.00871]	0.07408** [0.03040]			0.04441*** [0.00808]	0.09990*** [0.02711]
dd*gdbt^2		0.00034* [0.00021]				0.00047** [0.00020]
(1-dd)*gdbt^2		-0.00036 [0.00031]				-0.00062** [0.00028]
dd*prim			-0.12138*** [0.03495]	-0.18135*** [0.04568]	-0.11998*** [0.04377]	-0.25557*** [0.05057]
(1-dd)*prim			-0.04140* [0.02156]	-0.03980** [0.01959]	-0.02496 [0.01629]	-0.01301 [0.01253]
dd*prim^2				-0.00302** [0.00140]		-0.00656*** [0.00165]
(1-dd)*prim^2				0.00088 [0.00213]		-0.00001 [0.00160]
dd	1.39838** [0.58982]	2.40202*** [0.68331]	1.36251*** [0.12743]	1.35181*** [0.13484]	1.11251** [0.49870]	2.24626*** [0.58967]
c	-0.78966** [0.31253]	-1.15323** [0.57719]	0.83904*** [0.07371]	0.82557*** [0.07875]	-0.75244** [0.29315]	-1.61100*** [0.50114]
Obs. **R-squared** **Adj R-squared**	378 0.4081 0.3936	378 0.4197 0.4023	378 0.3967 0.3819	378 0.4045 0.3866	378 0.4547 0.4383	378 0.5000 0.4793

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in the group of European countries. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3. gdbt: public debt as percent of GDP; prim: primary balance as percent of GDP; and dd: dummy stress variable that take the value of 1 during stressful economic periods or 0 otherwise.

To summarize, we found that non-linear effects of public debts during normal and bad economic conditions contribute to the widening of bond spreads in the European group, the initial euro area group, the standalone group, and the new euro area group. In addition, the nonlinear and statistically significant impact of public debt during bad economic conditions in the European group suggests a minimum threshold level of about 27% of GDP, from which further increases in public debt will cause an increase in bond spreads. Similarly, this is the case in the initial euro area and the new euro area groups, where we found minimum threshold levels during normal and crisis times. In the initial euro area group, the minimum threshold levels are about 34% of GDP during crisis times and about 31% of GDP during normal times. Meanwhile, in the new euro area the minimum threshold levels are about 1% of GDP during crisis times and about 15% of GDP during normal times. However, the impact in the standalone group is slightly different because we found a minimum threshold level of about 48% of GDP during crisis times suggesting that countries with rising public debt above that threshold will be faced with increasing bond spreads. In contrast, we found a maximum threshold during normal times suggesting that countries that are highly trusted by investors such as Sweden, Norway, or the United kingdom could experience significant decrease in government borrowing costs when investing, for example in areas that could help sustain their competitive advantages such as in public infrastructures and technology. Moreover, the impact of primary balance appears to be more important in the new euro area group compared to other groups. Also, the primary balance has a nonlinear effect, in which further increases in primary balance leads to a decrease in bond spreads in most groups.

In addition, the magnitude of the impact of public debt are far greater in all panel groups following the global economic recession in 2008. Thus, this could explain the reason why financial markets discriminate between the euro area group and the standalone group, because countries in the euro area group are currently experiencing economic recessions or low economic growth, in addition to the significant deterioration in public debt over the years. The rapid deterioration of public debt during bad economic conditions can partly explain the surge in bond spreads.

1.6 Theoretical implications of econometric results

The results of the panel approach suggest that public debt remains a major determinant of bond spreads in the groups of European countries, initial euro area countries, new euro area countries, and standalone countries. High and increasing public debts particularly in the initial euro area group played significant non-linear impact on the surge in bond spreads during the crisis periods compared to normal economic periods. The deterioration of public debt led investors to require higher yields to compensate for their additional risk exposures due to potential rating downgrade or even default. In contrast, financial markets seem less concerned with the levels of public debt in the standalone group during crisis times and normal times compared to the initial euro area group. In particular, the magnitude of the coefficients of public debt in the standalone group during crisis times was very low compared to normal times. This may be due to the presence of some countries that are characterized by a strong financial center and investors' protection laws (e.g. the United kingdom,). Moreover, some countries benefited from large natural resources such as oil (e.g. Norway). Therefore, scared investors during the crisis could have preferred to buy government bonds issued by countries in the standalone group since they were perceived as more robust and safe. It is interesting to note the contrasting results obtained between the standalone group and the (initial or new) euro area group, with the impact of public debt on bond spreads which is lower in the standalone group than in the (initial and new) euro area group both during crisis and normal times. In addition, the high minimum threshold level of public debt at 48% of GDP in the standalone group during crisis times shows their relative high debt tolerance limit in terms of the impact of rising public debt on bond spreads. If we compare the minimum levels of government debt ratios in the initial euro area group and the new euro area group, that are during crisis times respectively at 34% and 1% of GDP to the minimum level in the standalone group, which is at 48%, we can conclude that rising public debt starts to lead to an increase in bond spreads in the euro area countries before standalone countries are affected. Also, the high levels of public debt in most countries in the euro area group cannot compare with low levels of public debt in most countries in the standalone group, and may explain the surge in bond spreads in euro area countries given their high sensitivity to further public indebtedness. However, the results in normal times are also quite interesting. Our estimations show that the standalone group with public debt above a maximum threshold level of 61% of GDP experience a decrease in bond spreads while public debt rises. Whereas, the initial euro area group and the new euro area group experience an increase in bond spreads when public debt reaches a minimum threshold level of respectively 31% and 15% of GDP.

This approach complements that of De Grauwe and Ji (2013) who argue that there was a disconnection between bond spreads and the underlying increases in public debts in the euro area before the crisis. The readjustment occurred as investors increasingly started to worry about potential default or break-up, leading to the rise in bond spreads. After the creation of the monetary union, initial euro area member countries enjoyed, for about a decade, favorable bond yields that led to the accumulation of public debts. In the standalone group, the ability of central banks to adjust the monetary policy to fit each country either helped to minimize significantly the accumulation of public debt or to stimulate the economy to minimize the impact of the recession following the global financial crisis. Especially as central banks can set minimum reserve requirements to prevent banks to issue too many loans to households or non-financial organizations, and also prevent banks from purchasing large amount of government debts. In addition, the financial and economic deregulations allowed core euro area countries with large capitals such as Germany, Netherlands, and France to directly invest in the other euro area countries. These factors contributed to the rapid deteriorations of public debt in the affected countries (e.g. Greece, Ireland, and Portugal) and allowed them to borrow large amount of foreign debts at low costs. As the global financial crisis occurred and was subsequently followed by the sovereign debt crisis, the fragility of their national economies was greatly exposed given the private sector indebtedness and their exposures to foreign investors further amplified the effects of public debt on widening the bond spreads in the initial euro area group. The slowdown in the economy forced various national governments to depend on the international financial markets to obtain the necessary funding for the bailout of the banking sector. However, faced with already high and rising public debts beyond certain threshold levels, posed serious threats that led to surge in bond spreads in the initial and new euro area groups. Consequently, while short term actions such as government borrowing at high costs helped to save financial institutions from the collapse that could cause the national economy to suffer severely, they also triggered the loss of confidence in the sustainability of public debt in some euro area countries causing the widening of the government bond spreads. These were triggered through the inability to refinance the government debts when foreign investors ran away to limit their exposure to losses during economic downturns. The investors' flight for safety caused record purchases of US Treasury Bills and German Bund. However, the increase in public debts in the standalone group are generally already taken into account given the high borrowing costs that these countries have to pay during normal economic times compared to euro area countries. During the crisis times, investors view these standalone economies more favorably because they generally have low level of public debt that are below threshold limits with the exception of some countries such as the United Kingdom.

In general, the model suggests that policymakers in the standalone group should not actually be too worried about the exposures of their countries to the financial markets. In fact, it could be important for countries in the standalone group to avoid de-leveraging at the same time than with countries in the initial and new euro area groups in order to help to stabilize their economies. However, the focus of policymakers in euro area countries should be to reduce their vulnerabilities on the international financial markets during economic downturns. The potential solution to minimize the impact on bond spreads with free flow of capitals among euro area can be, either a policy that seeks to reduce government dependence on the international financial markets or to establish an organization that provides financial assistance to euro area countries experiencing or being threatened by financing difficulties such as the European Stability Mechanism (ESM). However, in order to achieve further European integration, it is necessary that governments facing difficulties in securing funding, are able to borrow funds at reasonable costs in times of stress. In addition, dissimilarities between the standalone group and the euro area group in times of stress could indicate the needs to establish a common deposit guarantee scheme to provide financial stability, and prevent depositors from making panic withdrawals from their banks. This will help to prevent severe economic consequences in affected European countries.

In future research, it would be interesting to analyze the impact of private debt, foreign private debt, and foreign public debt for various European countries using other econometric estimation methods such as the Bayesian VARs approach. This approach could be especially relevant since it can accommodate for short datasets, as it would be possible to obtain the results in each country rather than for a group. It could also be very interesting to extend the analysis to countries in Asia and in the Americas to allow for possible generalization.

1.7 Conclusion

In this chapter, we studied the impact of fiscal variables during normal and bad economic periods for 26 European economies that we separated into three panel groups (initial euro area group, standalone group, and new euro area group). We examined the impact of fiscal variables (public debt and primary balance) on bond spreads in order to determine whether they exhibit non-linear effects during challenging economic periods. We found some evidences that suggest the widening of bond spreads in the (initial and new) euro area groups and the standalone group during the crisis periods, where partly caused by rising public debts and primary balance. In particular, the impact of primary balance on bond spreads in most groups suggests nonlinearity with a clearly negative relationship, whereas the effects of public debt suggest non-linearity with a more complex relationship. In addition, the magnitude of the impact of public debt in the standalone group showed that while public debt remained a significant driver of bond spreads during bad economic conditions, its impact was far less compared to the groups of initial and new euro area countries. However, the results suggest that rising public debt in the standalone group during normal times contributes to the decrease in bond spreads, whereas it leads to an increase in bond spreads in the initial and in the new euro area groups. It was interesting to find that the magnitude of the impact of public debt in the initial euro area group was higher during crisis times compared to normal times. This indicates the significant deterioration that occurred before the global crisis. However, the magnitude of the impact of public debt in new euro area group did not differ significantly between normal times and crisis times. The significant large magnitude of public debt during bad economic conditions can partly explain the widening of the bond spreads. Hence, the high and increasing exposures of the initial euro area group on the international financial markets during economic crises caused the increase in bond spreads.

Finally, it is crucial to understand the impact of the underlying fiscal variables on long-term sovereign bond spreads at various European levels (such as in the initial euro area group, the new euro area group, the standalone group, and the European group) in order to tailor policies to the needs of these groups. While the contribution of the underlying fiscal variables on long-term government bond spreads may vary from a country to another, it is crucial for policymakers to understand which particular factors within the euro area are driving bond spreads to optimize the policy responses. The information obtained in our analysis can help policymakers in targeting the right causes and to understand the negative consequences that some fiscal policies may have. The establishment of the common market characterized with the freedom of movement of capitals and cross-holdings of government debts contributed to the decrease in borrowing costs particularly in the euro area countries, with the elimination of exchange rate risks and the reduction in transaction costs among them. In addition, the reduction in regulatory constraints particularly among euro area group facilitated major mergers and acquisitions between banks (e.g. RBS, Fortis, and ABN AMRO) which contributed to the financial integration and fostered economic growth. Unfortunately, the unintended consequences of these policies have contributed to make some of these peripheral euro area countries highly vulnerable during times of stress. Meanwhile, a major advantage is that the participation in the international financial markets encouraged competitions by expanding the number of investors potentially interested in the purchase of debt securities. This helps to lower borrowing costs during normal economic periods. While this is a very attractive policy during normal economic periods, it also exposes countries to the volatility of financial markets and foreign investors' whims when countries become too dependent on funding. Particularly, euro area countries in which domestic investors could not fill the void left when foreign investors rapidly fled risks, were exposed to the risk of economic downturn. A policy objective that leads to the increase in the exposure of foreign investors should be designed such that it also depends on the ability of domestic residents to generate funding in time of need. For example, the increase in domestic private savings, such that the economy can cope with a sudden stop in foreign capital inflows, could be interesting without limiting the pool of potential foreign investors within the euro area. An adequate policy objective would be to either control for the level of dependence on foreign investors or to setup emergency measures enabling euro area countries to borrow in order to smooth the outflows of capitals. In addition, as governments in the standalone group do not need to reduce their indebtedness, this could help to support the affected euro area countries in minimizing the impact of current austerity measures. The attempts by policymakers in the selected standalone group to reduce their public debts in order to avoid similar negative consequences would have limited effects on bond spreads and could rather threaten the overall European economy. However, we insist on the fact that these policy responses are mostly valid at the European level for some countries within the various panel groups.

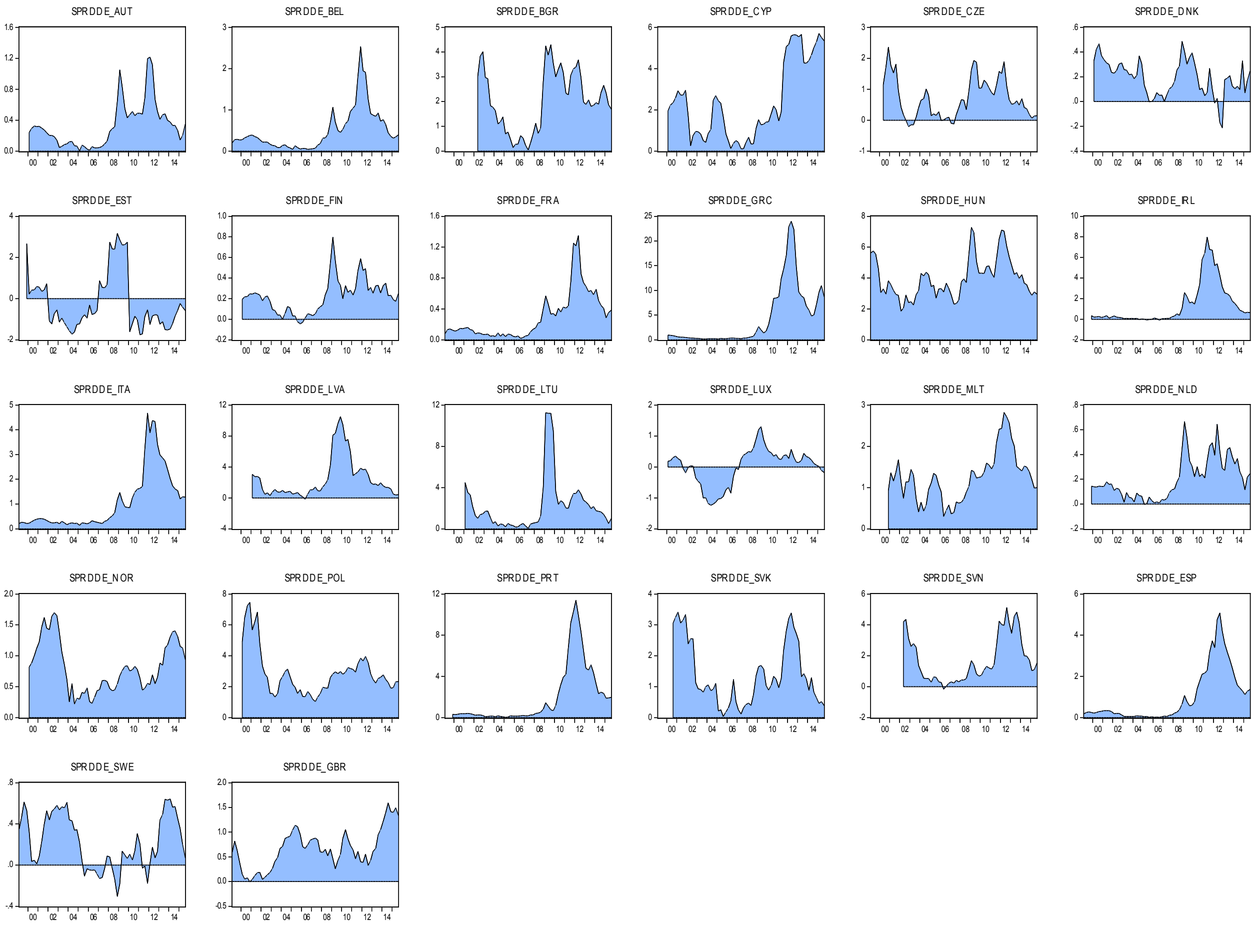
In further work, our analysis should be extended to individual European countries. In addition, as mentioned above, it would be interesting to also analyze the impact of private debt.

1.8 Appendix

Country abbreviation:

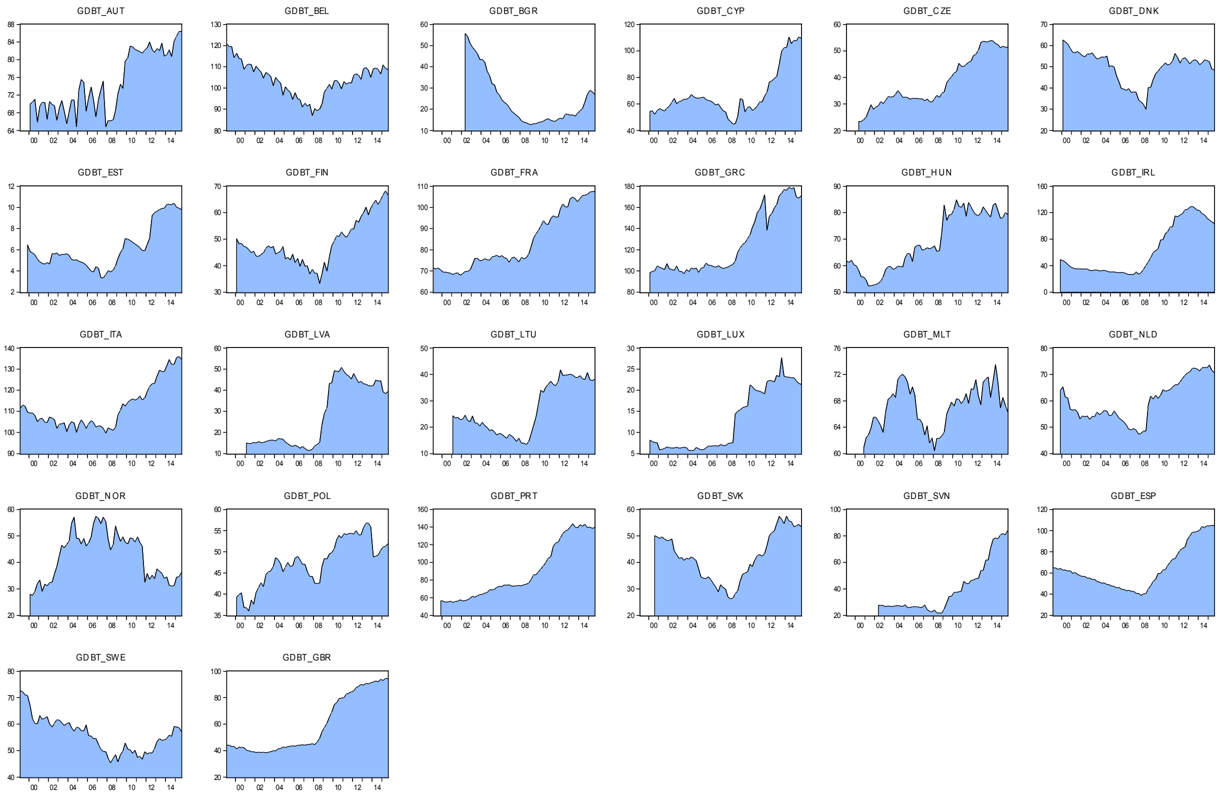
AUT: Austria, BEL: Belgium, BGR: Bulgaria, CYP: Cyprus, CZE: Czech Republic, DNK: Denmark, EST: Estonia, FIN: Finland, FRA: France, GRC: Greece, HUN: Hungary, IRL: Ireland, ITA: Italy, LVA: Latvia, LTU: Lithuania, LUX: Luxembourg, MLT: Malta, NLD: Netherlands, NOR: Norway, POL: Poland, PRT: Portugal, SVK: Slovakia, SVN: Slovenia, ESP: Spain, SWE: Sweden, GBR: United kingdom.

Figure 3. Long-term government bond spreads



Source: European Central Bank (ECB), OECD Economic Outlook, Macrobond
Note: Bond spreads (SPRDDE) are derived from the differences with the 10-year German Bund using monthly data from January 2000 to September 2015 and then transformed to quarterly data.

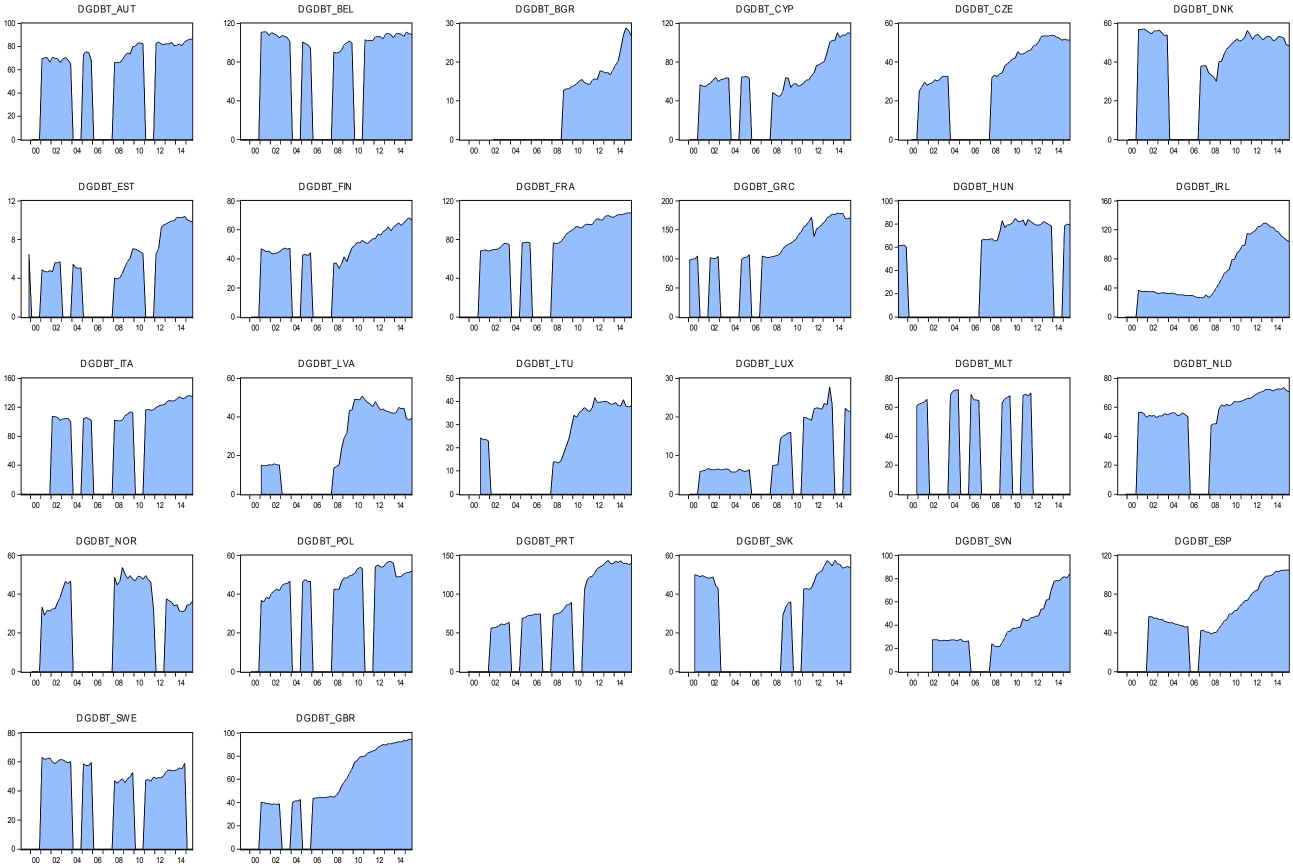
Figure 4. General government debt as percentage of GDP



Source: Eurostat, OECD Economic outlook, ECB

Note: Quarterly general government debt (GDBT) from 2000Q1 to 2015Q3.

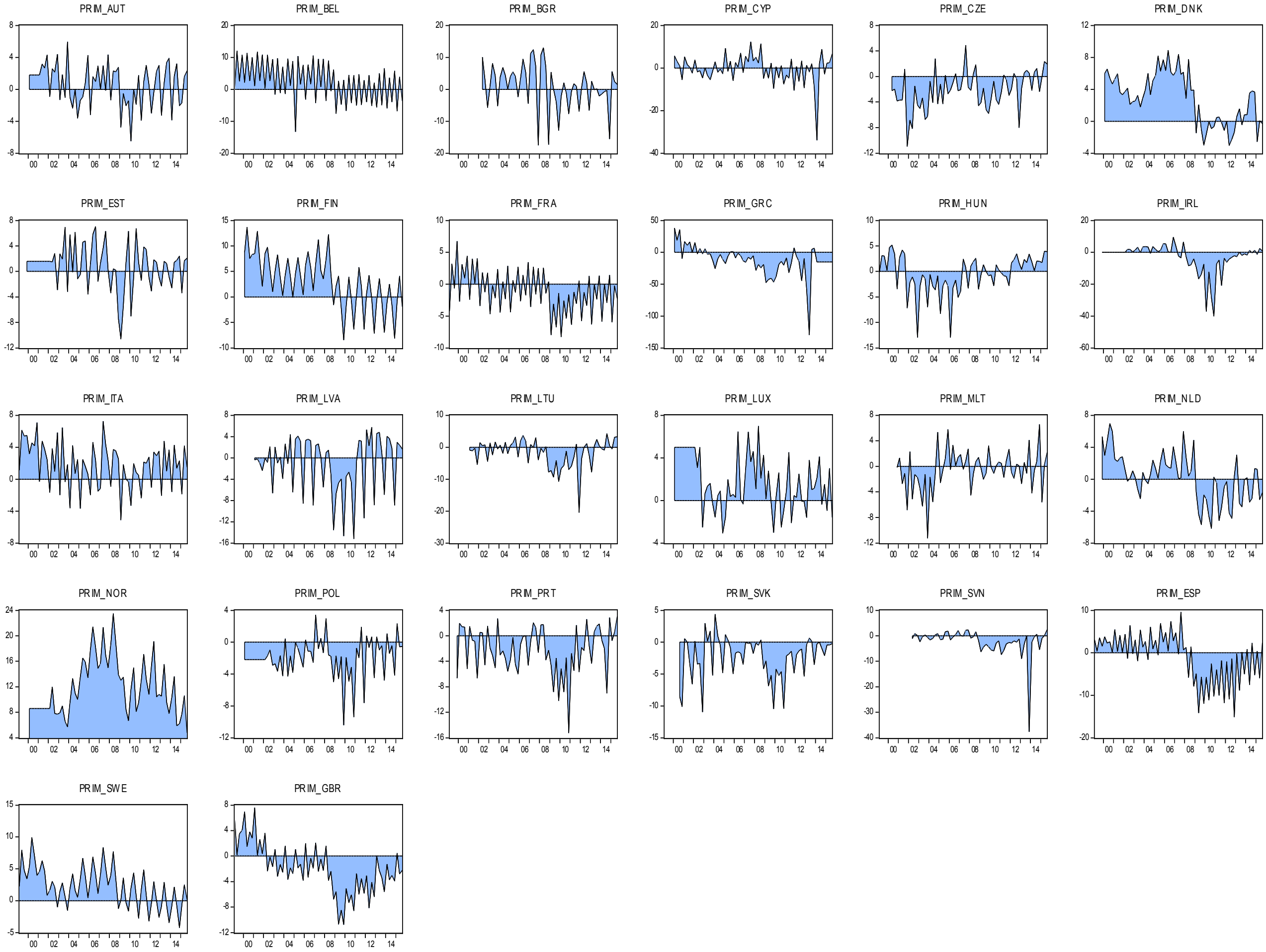
Figure 5. Dummy stress general government debt



Source: Eurostat, OECD Economic outlook, and ECB

Note: Dummy stress public debt ratio (D*GDBT).

Figure 6. Primary balance as percentage of GDP



Source: ECB and Macrobond

Note: Primary balance ratio (PRIM).

Table 16. Pedroni panel cointegration test

	Statistics	V.1	V.2	V.3	V.4	V.5
European	Panel v-	0.013	0.417	0.583	0.667	0.692
	Panel rho-	0.309	0.299	0.455	0.989	0.974
	Panel PP-	0.233	0.094	0.179	0.927	0.869
	Panel ADF-	0.020	0.596	0.589	0.983	0.963
	Group rho-	0.920	0.811	0.881	1.000	1.000
	Group PP-	0.703	0.282	0.453	0.998	0.996
	Group ADF-	0.052	0.766	0.823	0.999	0.995
Euro area	Panel v-	0.987	0.503	0.620	0.558	0.567
	Panel rho-	0.985	0.260	0.454	0.921	0.867
	Panel PP-	0.999	0.174	0.313	0.886	0.772
	Panel ADF-	0.999	0.775	0.616	0.981	0.920
	Group rho-	1.000	0.757	0.888	0.997	0.988
	Group PP-	1.000	0.531	0.707	0.993	0.972
	Group ADF-	1.000	0.952	0.874	0.998	0.985
New euro area	Panel v-	0.082	0.410	0.429	0.533	0.550
	Panel rho-	0.332	0.295	0.337	0.741	0.579
	Panel PP-	0.250	0.171	0.184	0.447	0.281
	Panel ADF-	0.155	0.650	0.628	0.786	0.806
	Group rho-	0.699	0.361	0.302	0.925	0.838
	Group PP-	0.446	0.142	0.115	0.669	0.454
	Group ADF-	0.215	0.666	0.603	0.906	0.903
Standalone	Panel v-	0.168	0.301	0.450	0.604	0.654
	Panel rho-	0.364	0.565	0.619	0.897	0.881
	Panel PP-	0.210	0.318	0.362	0.654	0.683
	Panel ADF-	0.048	0.301	0.571	0.603	0.686
	Group rho-	0.789	0.900	0.925	0.992	0.989
	Group PP-	0.433	0.581	0.695	0.885	0.903
	Group ADF-	0.069	0.524	0.831	0.823	0.835

Note: **V.1**: sprdde, d*gdbt, (1-d)*gdbt; **V.2**: sprdde, d*prim, (1-d)*prim; **V.3**: sprdde, d*cgdbt, (1-d)*cgdbt; **V.4**: sprdde, d*gdbt, (1-d)*gdbt, d*prim, (1-d)*prim; **V.5**: sprdde, d*gdbt, (1-d)*gdbt, d*cgdbt, (1-d)*cgdbt. The results provided indicate the p-values.

In the third robustness test, we replace the primary balance by the change in government debt. The intuition behind this, was that change in government debt provides a similar and slightly different measurement. Hence, we would expect that using the change in government debt rather than the primary balance should not lead to major differences with the previous results. Moreover, it is expected that a change in government debt is associated with a positive impact on long-term government bond spread. The results in Table 17 suggest that the main conclusion remains valid when using the change in government debt.

Table 17. Robustness check of the impact of change in government debt

	European		**Initial euro area**		**Standalone**		**New euro area**	
Variables	**(1.5)**	**(1.6)**	**(1.5)**	**(1.6)**	**(1.5)**	**(1.6)**	**(1.5)**	**(1.6)**
d*gdbt	0.053*** [0.0064]	-0.034*** [0.0093]	0.063*** [0.0083]	-0.049*** [0.0127]	0.007*** [0.0031]	-0.059*** [0.0149]	0.039*** [0.0072]	-0.010 [0.0298]
(1-d)*gdbt	0.051*** [0.0069]	0.018* [0.0097]	0.045*** [0.0073]	-0.033*** [0.0113]	0.028*** [0.0065]	0.074*** [0.0224]	0.055*** [0.0088]	-0.055* [0.0330]
d*gdbt^2		0.001*** [0.0001]		0.001*** [0.0001]		0.001*** [0.0001]		0.000** [0.0002]
(1-d)*gdbt^2		0.000* [0.0001]		0.000*** [0.0001]		-0.001*** [0.0002]		0.001*** [0.0003]
d*cgdbt	0.023** [0.0114]	0.009 [0.0206]	0.012 [0.0192]	-0.011 [0.0390]	0.003 [0.0116]	-0.011 [0.0076]	0.051*** [0.0140]	0.053*** [0.0138]
(1-d)*cgdbt	0.011* [0.0065]	0.003 [0.0042]	0.005 [0.0086]	0.009* [0.0047]	-0.008 [0.0085]	-0.008 [0.0079]	0.000 [0.0089]	-0.014* [0.0086]
d*cgdbt^2		0.001* [0.0007]		0.002 [0.0012]		0.001*** [0.0004]		0.000 [0.0007]
(1-d)*cgdbt^2		0.001** [0.0003]		0.001*** [0.0003]		0.000 [0.0006]		0.002* [0.0010]
d	0.414 [0.2668]	1.974*** [0.3642]	-1.023*** [0.2139]	0.158 [0.2464]	1.473*** [0.2724]	3.880*** [0.5894]	1.316*** [0.4329]	0.942* [0.5486]
c	-2.101*** [0.3544]	-0.970*** [0.3130]	-2.742*** [0.4641]	0.290 [0.3955]	-0.300 [0.3172]	-1.083*** [0.5914]	-1.191*** [0.3045]	0.302 [0.5999]
Obs. **R-squared** **Adj R-squared**	1404 0.5029 0.4920	1404 0.5619 0.5510	693 0.5096 0.4987	693 0.5865 0.5748	432 0.7894 0.7834	432 0.8248 0.8180	378 0.4131 0.3955	378 0.4279 0.4042

Note: standard errors are shown in brackets. *** p < 1%, ** p < 5%, * p < 10%. Equations present a balanced panel in all panel groups. We control for country fixed effects. Sample periods included are from 2002Q2 to 2015Q3 at the exception of initial euro area countries that is from 2000Q1 to 2015Q3. gdbt: public debt; prim: primary balance; and d: dummy variable that take the value of 1 during stressful economic periods or 0 otherwise.

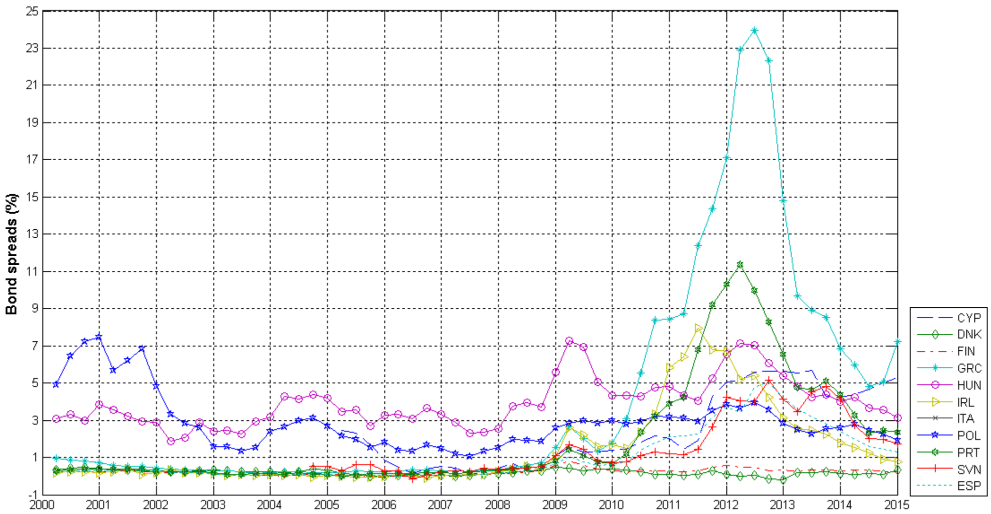
Chapter 2: Testing the impact of public debt on bond spreads during periods of increased volatility in European stock markets

2.1. Introduction

In this chapter, we investigate how the increased volatility in European stock markets affected in the relationship between government debt and bond spreads, using the dynamic panel threshold regression developed by Proaño, Schoder et al. (2014) and Kremer, Bick et al. (2013). Through the introduction of the stock market volatility as threshold variable, we intend to extract valuable information from the evolution of government debt, which may present significant non-linear effects during certain periods. We argue that this relationship could be more pronounced for certain levels of stock market volatility since a country experiencing high volatility may indicate that it is suffering from political, economic, and financial instabilities.

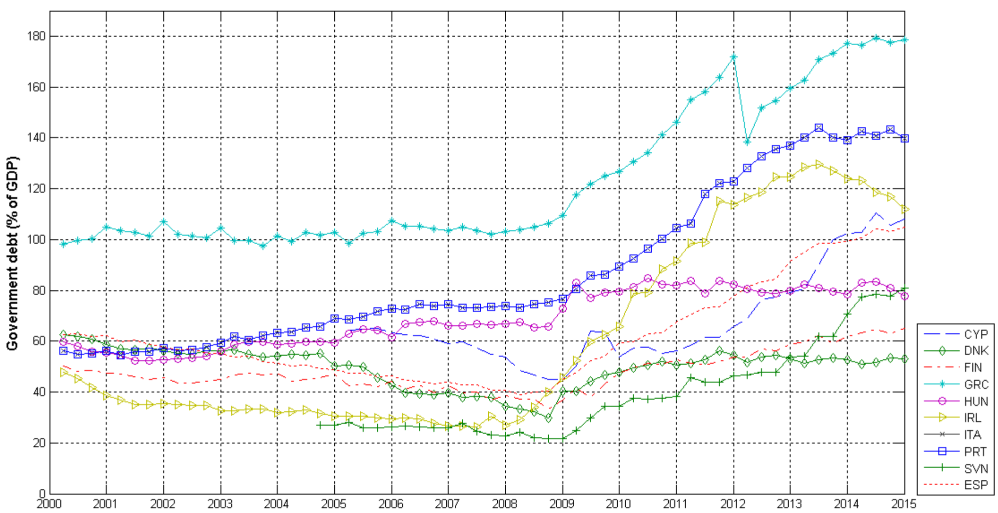
Intuitively, this non-linear model is appealing because it allows us to assess the role of stock market volatility during economic downturn or financial instability. In the aftermath of the recent financial and economic crises, it is crucial to determine the periods during which government debt may display such significant non-linear effects since it can provide considerable economic important information to policymakers. The unprecedented surge in long-term government bond yield spreads in most euro area countries relative to Germany reflects increasing concerns in financial markets about rising government debts. After the intensification of the global financial crisis and subsequent euro crisis with its epicenter in Greece, Ireland, and Portugal, long-term government bond yield spreads in most euro area countries started to increase dramatically after several years at low levels following the creation of the monetary union. It is understandable that the widening of government bond spreads (see Figure 7) can be interpreted as a reassessment of investors to their exposures in European sovereign debts (see Figure 8) as stock markets became highly volatile. However, the differentiation of country risk across the euro area was relatively quite low before the global financial crisis in 2008 despite large or increasing level of government debt in some euro area countries such as Greece and Portugal. Hence, we argue that important change in stock markets exerted great pressures on European countries with weak fiscal position as they faced with prolonged periods of high levels of stock market volatility.

Figure 7. Long-term government bond yield spreads in selected European countries.



Note: 10- year government bond yield spreads computed relatively to German bond in quarterly observations estimated from 2000Q1 to 2015Q3. CYP: Cyprus, DNK; Denmark, FIN: Finland, GRC: Greece, HUN: Hungary, IRL: Ireland, ITA: Italy, POL: Poland, PRT: Portugal, SVN: Slovenia, ESP: Spain.
Source: ECB, OECD, and Macrobond

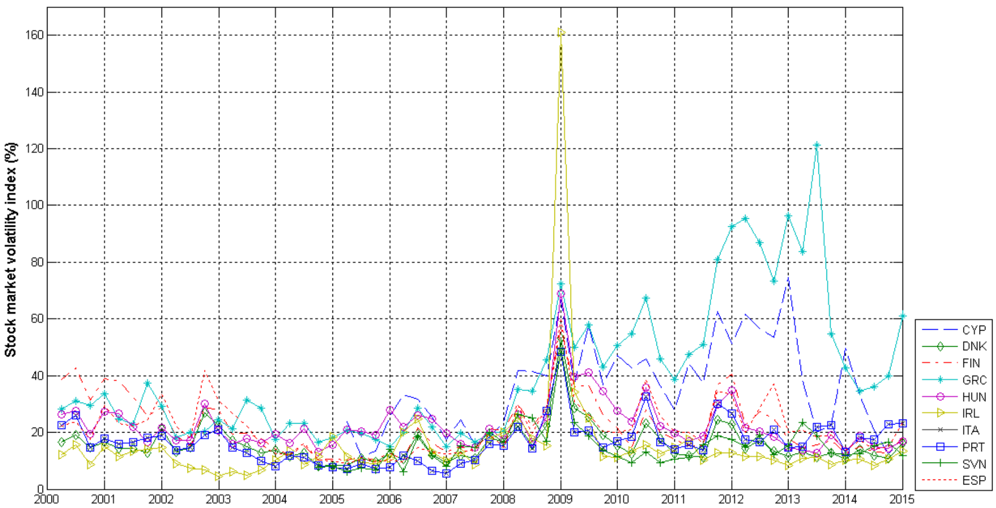
Figure 8. Government debt in selected European countries.



Note: Quarterly observations of the general government debt, as percentage of GDP starting from 2000Q1 to 2015Q3.
Source: OECD and Macrobond

Typically, we expect that a government fiscal policy can have a greater impact on bond spread developments during periods of economic downturn or financial crisis compared to normal times. Given the scale of the euro crisis, it is crucial to adequately assess the impact of fiscal policies on bond spread developments during high market volatility. A country with a large public debt may be exposed to significant amount of losses if investors' confidence about its ability to service the debt drops, especially when experiencing falling revenues and rising costs. However, the levels of public debts in countries such as Cyprus, Ireland, and Spain were relatively lower than 60% prior to the global financial crisis observed in 2008 or even decreasing. It is interesting to note that these countries experienced severe surge in bond spreads compared to some euro area countries with higher levels of government debts such as Belgium and France. This suggests that the deterioration of other variables such as political, economic, and financial variables, may be at play and captured through high levels of stock markets volatility (see Figure 9). Given the major uncertainty surrounding financial institutions and the risk that political parties could repudiate their debt obligations, European stock markets have been facing significantly high volatility starting from 2008. Thus, there could exist a possible non-linear relationship between bond spread and public debt after the stock market volatility exceeds certain threshold limits in European countries.

Figure 9. Stock market volatility index in selected European countries.



Note: Stock market volatility indices are in percentages and computed using daily prices starting from 2000Q1 to 2015Q3
Source: Macrobond

The empirical literature that focuses on the non-linear impact of government debt on bond spread with the objective to determine the thresholds is quite limited. Typically, the attempts in the literature are based on the determination of a single threshold variable that analyzes the impact of sovereign debt (or inflation) on economic growth. In that order, the innovation in Proaño, Schoder et al. (2014) concerns the investigation of the non-linear contributions of sovereign debt on economic growth during financial stress using two threshold variables. Through empirical analysis, they identified the sovereign debt ratio and the financial stress index as threshold variables beyond which economic growth starts to be impaired, using a dynamic country-specific and a dynamic panel threshold regressions for 16 OECD countries. This area in the literature emphasizes the impact of financial market stress as the source of non-linearity in the relationship between fiscal policy and economic growth. Afonso, Baxa et al. (2011) argue that the state of financial markets represents an important factor in determining the effects of fiscal shocks on economic growth, and not just the level of government indebtedness itself. Nonetheless, another perspective in the empirical literature, such as in Reinhart and Rogoff (2010), employs a non-linear threshold approach to determine the impact of government debt on economic growth. They argue that government debt beyond a certain threshold such as 90% of GDP starts to cause a negative impact on economic growth. However, Herndon, Ash et al. (2013) questioned the integrity of the Reinhart-Rogoff paper due to uncovered serious data omissions from certain countries, such as New Zealand and Belgium that have government debt ratios exceeded 90% and strong growth rates. After correcting for the omitted data, this seems to negate their main finding that government debts beyond a threshold at 90% significantly reduce economic growth. In addition, Minea and Parent (2012) discussed the results of Reinhart and Rogoff (2010) and demonstrated that additional evidence are required due to some complex nonlinearities present in the growth effects on fiscal policies in high government debt regime. These complex nonlinearities indicate that on the one hand, high government debt above a certain threshold reduces economic growth. However, on the other hand, increasing government debt is still positively associated to the rise in economic growth.

This paper builds upon the above studies and contributes to the existing literature on economic and financial crises with the assessment of risks stemming from underlying macroeconomic variables and instability of stock markets. We argue on the importance of potential non-linear effects of stock markets in the relationship between government debts and bond spreads. Brunnermeier and Oehmke (2012) argued that banks' holding of sovereign debts can cause instability in the banking system and can expose them to financial distress. Fearing the risks to be exposed to important sovereign debts, banks could react by reducing or tightening conditions on loans to businesses and households to keep capitals. This behavior can lead to a climate of risk aversion with investors requiring higher risk premiums to fund even profitable projects. In addition, this framework allows us to assess the aspect of the relationship between bond spread and government debt in the specific case of a monetary union such as in De Grauwe and Ji (2013). De Grauwe and Ji (2013) argued that bond spreads may be more sensitive in euro area countries that in countries with independent monetary policies (namely “standalone countries”). Also, they suggest that, during the periods they examined, the impact of government debts on bond spreads in euro area countries was initially disconnected but became significantly higher during bad economic periods. In contrast, the relationship between government debt ratios and bond spreads in standalone countries was weak but remained independent of the state of financial markets even after the turmoil. Meanwhile, Schoder (2014) argued that investor sentiment is even more volatile in peripheral euro area countries than in core euro area countries. Based on these papers, the non-linear effects of government debts on bond spreads should be more acute in euro area countries than in standalone countries (similarly, in peripheral euro area countries than in core euro area countries) when facing with prolonged high market volatility.

In this paper we contribute to that fiscal related literature by estimating the effects of the government debt ratios on bond spreads through to two regimes based on the dynamic panel threshold regressions in European countries. In the dynamic panel threshold regressions, we consider up to two regime-dependent thresholds: one on the level of government debt ratio and the other on the level of the volatility index. According to our knowledge, there has been no attempt to analyze empirically the effects of government debt on bond spreads based on the state of European stock markets. Also, collecting quarterly data starting from 2000-Q1 to 2015-Q3 can help us to make better inferences about the impact of the monetary union than taking longer series in order to focus only on the period concerned by the existence of the monetary union. With these specificities, we believe that this chapter can better address the causes of the dissimilarities on bond spreads between euro area countries and standalone countries. In addition, we capture potential differences between core euro area and peripheral euro area countries since these groups have adopted quite similar reforms that strengthen economically and financially the relationship between them.

Our empirical analysis suggests several interesting results: (1) We find strong empirical evidences suggesting that the impact of government debts on bond spreads are positive and significant at 1% level in initial euro area countries, peripheral euro area countries, and core euro area countries when government debt ratios reach levels beyond certain thresholds. As expected, an increase in government debt ratio leads to an increase in bond spread when considering the government debt as the only threshold variable. Moreover, the magnitude of the coefficients that are positive and significant in high government debt regimes is greater than that observed in low government debt regimes in the initial euro area group and in the peripheral euro area group. (2) Using volatility threshold to define the state of stock market allows us to capture the impact of government debt on bond spreads when their effects are magnified such as during highly volatility in initial euro area countries and peripheral euro area countries compared to during low volatility. We can note that, using the volatility as threshold variable, and subsequently testing the results obtained by using an alternative threshold variable as index return allows us to ensure that the results are robust. We observe positive and significant coefficients of government debts on spreads in the all panel groups as expected. This implies that a country may experience a surge in bond spreads due to the state of volatility of the stock market depending on whether the country presents high or low government debt ratio. In particular, government debts in peripheral euro area countries seem highly sensitives to the state of volatility of the stock markets. Hence, we identify the level of volatility of the stock market as a crucial variable to capture non-linear effects of government debt on rising bond spreads. (3) Using a combination of government debt and stock index return, we found evidence suggesting that high government debt ratio and sharp fall in stock index return beyond certain thresholds tends to greatly increase bond spreads in European countries. In addition, the non-significant coefficient of government debt when government debt ratio and stock index return are beyond their respective thresholds in standalone and peripheral euro area countries may indicate that we should consider other variables, which could be driving bond spreads such as political factors. To conclude, our empirical results generally confirm that there is a significant and positive relationship between bond spread and government debt based on the levels of stock market volatility or index return.

This paper is organized as follows: In section 2, we introduce the data and the control variables used in our empirical analysis. Section 3 explains the methodology of the dynamic panel threshold model and the relationship between government debt on bond spreads in European countries. Section 4 presents our estimation results. Section 5 concludes the paper.

2.2. Data description and variables

In this empirical analysis, we use a quarterly dataset ranging from 2000Q1 to 2015Q3 consisting of 29 European countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, and the United kingdom.[4]

The endogenous variable is the 10-year government bond spread in percent, which is computed using long-term government bond yields relative to the German government bond yield. Our data were obtained from the following sources: OECD database, European Central Bank (ECB) database, and Macrobond[5]. The general government debt as percentage of GDP is defined based on the Maastricht treaty definition as the consolidated gross debt of the entire government sector at the end of the quarter. We computed the annualized volatility (VOL) in percentage at daily frequency using the daily stock index prices for the individual 29 European stock markets obtained from the Macrobond database and multiplied by the square root of the number of trading days in a year (252 days). Then, the annualized volatility in daily frequency is then averaged over three months to obtain quarterly frequency. The volatility is used to measure the level of strain in the economy, with high and persistent volatility indicating potential financial or economic crisis. In addition, we include the unit labor cost (ULC) in quarterly frequency obtained from the OECD and ECB databases[6] as a control variable.

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[4] Due to missing data points, Bulgaria, Croatia, Cyprus, Czech republic, Latvia, Lithuania, Malta, Romania, Slovakia, and Slovenia respectively cover the following periods: 2002Q2-2015Q3, 2005Q4-2015Q3, 2000Q2-2015Q3, 2001Q1-2015Q3, 2001Q1-2015Q3, 2001Q1-2015Q3, 2005Q2-2015Q3, 2000Q3-2015Q3, 2004Q3-2015Q3, and 2005Q2-2015Q3. In addition, we excluded Croatia from the analysis due to lack of data.

[5] We obtain the 10-year government bond yields for OECD member countries in the OECD Economic Outlook 96 database at the exception of Estonia. The dataset for the remaining non-OECD member countries such as Bulgaria, Croatia, Cyprus, Malta, were obtained from the European Central bank (ECB) database. Finally, we approximated the Estonian 10-year government bond yield with the projected long-term interest rate on government bonds found in Macrobond.

[6] We obtain the unit labor cost of OECD member countries in the OECD Economic Outlook 96 and the remaining countries such as Bulgaria, Croatia, Cyprus, Malta, from the European Central bank (ECB) database.

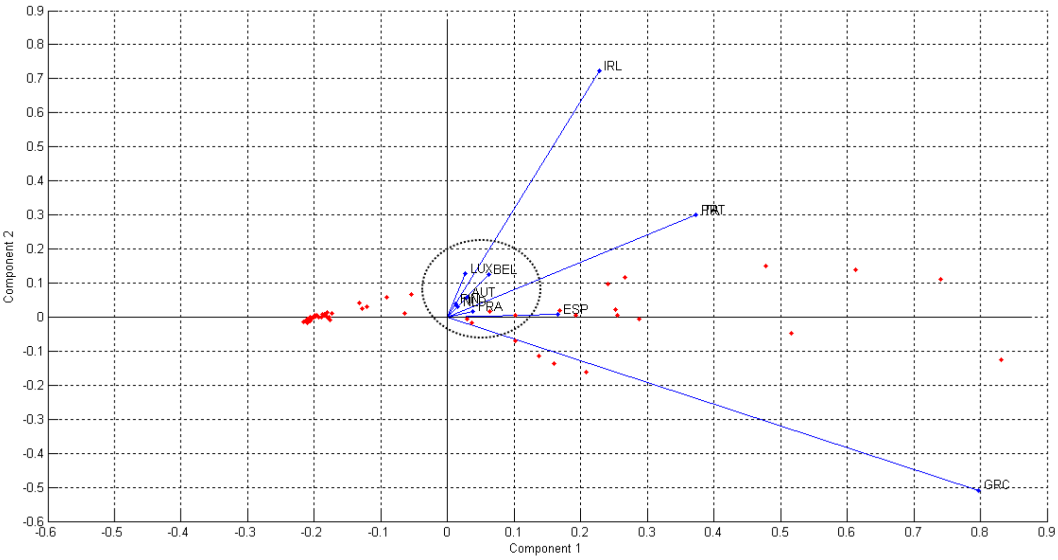
In order to capture the effects of government debts on bond spreads, we selected government debt ratio as it covers past government actions and as it can have an incidence on fiscal sustainability. The volatility captures the states of stock markets in either direction. However, persistent high volatility stock market can indicate the presence of fear in the market due to financial or economic crisis. Also, we introduced the index returns as an alternative threshold variable for robustness check since the effects of falling index prices are interpreted differently by investors than rising index prices, which is not differentiated in the computation of volatility. In addition, unit labor cost reflects the performance of a country average cost of labor per unit of output produced and is a broad measure of the international price competitiveness. European countries are generally highly dependent on trade and strongly compete with each other to generate economic growth. A rising unit labor cost decreases the competitiveness of a country causing the bond spread to increase.

Despite the relatively short time horizon, the dataset offers the advantage that the impact of the monetary union could be analyze by comparing the results obtained from euro area countries and standalone countries. Also, this is quite important because data with longer horizon are not comparable with today's economic conditions. In addition, short term period reduces the likelihood of finding several structural changes in the dataset. Therefore, the results of dynamic panel threshold regressions can estimate adequate threshold values that better fit the development in today's market conditions. We considered six groups of European countries that will be analyzed in the subsequent section. We put together countries with independent monetary policies and denoted the group as "*Standalone*". In this group of standalone countries, we did not consider European countries that later joined the euro area, as we believe that efforts to meet the pre-conditions to join the euro area could have important consequences on the development of macroeconomic variables. Thus, we selected only countries with no formal agreement to join the monetary union. Similarly, we put together countries that initially joined the euro area in addition to Greece in 2001 and denoted the group as "*Initial EMU*". Similarly, we put together countries that later join the euro area and denoted the group as "*New EMU*". To distinguish between members of initial EMU countries that can be considered as core or peripheral EMU countries, we applied a principal component analysis on the 10-year government bond spreads relative to Germany. In Figure 10, the biplot represents the bond spreads in initial euro area countries. This biplot reveals how strongly bond spreads in these countries are correlated with each other. On the basis of this result, we decided to group together countries that represent tight correlations of their bond spreads.

Also, the distance between two countries in the bitplot indicates the amount of variabilities in bond spreads. It indicates that the two principal components in euro area countries account for at least 98% of the total variance, which means the biplot provides a very good approximation. We observed that the 10-year government bond spreads from Austria, Belgium, Finland, France, Luxembourg, and the Netherlands are generally clustered together (grouped as core EMU countries). Also, this group substantially differ from those in Greece, Ireland, Italy, Portugal, and Spain (grouped as peripheral EMU countries).

We grouped various EMU countries into two main groups based on the fact that countries with similar amounts of variabilities will be clustered together or near each other's on the graph. This method allows us to identify core EMU countries since we expect fewer divergences in bond spreads. In contrast, we expect greater divergences in bond spreads for peripheral EMU countries.

Figure 10. Biplot of bond spreads in initial euro area countries.



Note: We applied the principal component analysis to obtain the biplot of the 10-year government bond spreads in euro area countries. Initial euro area countries can be grouped into two main groups such as core euro area group (circle with an elliptic curve) and peripheral euro area group. We circle together countries that are clustered near each other due to similar amount of variabilities in bond spreads.

Therefore, we summarized the composition of the various panel groups[7] in Table 18 that would be used during the dynamic panel threshold analysis.

Table 18. List of countries within each panel group.

PANEL GROUPS	LIST OF COUNTRIES	Nr.
EUROPEAN	Austria (AUT), Belgium (BEL), Bulgaria (BGR), Croatia (HRV), Cyprus (CYP), Czech republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), the Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT), Romania (ROM), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), Switzerland (CHE), United kingdom (GBR)	29
STANDALONE	Bulgaria (BGR), Croatia (HRV), Czech republic (CZE), Denmark (DNK), Hungary (HUN), Norway (NOR), Poland (POL), Romania (ROM), Sweden (SWE), Switzerland (CHE), United kingdom (GBR)	11
INITIAL EMU	Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Greece (GRC) [8],, Ireland (IRL), Italy (ITA), Luxembourg (LUX), the Netherlands (NLD), Portugal (PRT), Spain (ESP)	11
CORE EMU	Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Luxembourg (LUX), the Netherlands (NLD)	6
PERIPHERY EMU	Greece (GRC), Ireland (IRL), Italy (ITA), Portugal (PRT), Spain (ESP)	5
NEW EMU	Croatia (HRV), Cyprus (CYP), Estonia (EST), Latvia (LVA), Lithuania (LTU), Malta (MLT), Slovakia (SVK), Slovenia (SVN)	8

2.3. Econometric methodology

Motivated by the issues raised in previous section, we applied the dynamic panel estimation techniques in the analysis of the effects on long-term government bond spreads in European countries. The regressions that are applied throughout this study follow the approach developed by Proaño, Schoder et al. (2014) and Kremer, Bick et al. (2013). To this aim, we considered the following three panel threshold models in order to account for the level of government debt ratio as well as the level of high stock market volatility that can affect the impact of government debt on bond spreads. These threshold regressions allow us to distinguish between countries within the low or high government debt regime and also countries with low or high volatility regime, respectively.

[7] The composition of the panel groups are quite robust since we obtained similar results when performing the biplots with respect to 10-year government bond spreads relative to the United States rather than Germany.

[8] We included Greece in the group of euro area countries despite joining the Eurozone a year later because we believe that this delay will not significantly affect the results.

More specifically, we first studied the potential non-linear impact of government debt ratio on bond spread depending on the level of government debt ratio itself; second, we studied how the impact of government debt ratio on bond spread depending on the level of market volatility; and finally, how the effect of government debt ratio on bond spread is dependent on both the level of government debt ratio and the level of market volatility.

Following the approach in Proaño, Schoder et al. (2014) and Kremer, Bick et al. (2013), we first considered the dynamic panel threshold regression with the specification that a threshold level is based on government debt ratio beyond which a rise in government debt ratio leads to an increase in bond spread. Hence, the government debt ratio is assumed to be the only threshold variable. This model can be written as:

$$\begin{aligned} sprdde_{it} = \mu_i + \varphi.z_{it} + \beta_{gdbt}{}^{L}.gdbt_{i,t-1}.I(gdbt_{i,t-1} \leq \gamma_{gdbt}) \\ + (\beta_{gdbt}{}^{H}.gdbt_{i,t-1}.+ \delta^{H}).I\,(gdbt_{i,t-1} > \gamma_{gdbt}) + \varepsilon_{it} \end{aligned} \quad (1)$$

where $sprdde_{it}$ refers to the 10-year government bond spread relative to Germany in year t for country i. μ_i is a country-specific fixed effect, ε_{it} an *i.i.d.* country-specific random disturbance with zero mean and a variance $\sigma_{\varepsilon i}{}^2$, and z_{it} is a vector which could contain the control variable unit labor cost ($ulc_{i,t}$) that is an endogenous explanatory regime-independent variables. γ_{gdbt} is the threshold level of the government debt ratio and is assumed to be exogenous. I(.) is an indicator function which takes on the value of 1 if the condition in its argument holds and otherwise takes on a value of 0. $GDBT_{i,t}$ is the exogenous government debt variable . δ is the difference between the intercept in low government debt ratio regime (i.e. μ_i), and the intercept in high government debt ratio regime (i.e. $\mu_i + \delta$). $\beta_{gdbt}{}^{L}$ and $\beta_{gdbt}{}^{H}$ are coefficients of the government debt ratio respectively representing the effects during low and high government debt regimes.

We estimated the dynamic panel threshold model following the approach by Caner and Hansen (2004). However, given that the Caner and Hansen (2004) procedure does not apply to panel data, we first had to make their framework suitable enough to deal with the country-specific fixed effects μ_i from the model we used. Thus, country-specific fixed effects μ_i are eliminated from the model to ensure that the regression results are not biased using the transformation method called "forward orthogonal deviation". Arellano and Bover (1995) proposed this transformation which eliminates individual country-specific fixed effects while leaving the lagged dependent endogenous variables as valid instruments. However, we decided not to include the lagged bond spread variable because while its introduction dramatically improves the model fit.

To analyze the impact of government debt on bond spreads in low and high government debt ratio regimes, we applied the methodology suggested by Kremer, Bick et al. (2013) that extends the threshold estimation for the case of panel data and uses forward orthogonal deviations to eliminate individual country-specific fixed effects. This procedure subtracts the average of all future available observations of a variable to eliminates the country-specific fixed effects such that the estimation procedure proposed by Caner and Hansen (2004) can be used without violating the asymptotic of the estimator. The forward orthogonal deviation transformation is applied to all variables with the exception of the threshold variable(s). Thus, for the error term, the forward orthogonal deviations transformation obtained is given by:

$\epsilon^*_{it} = (\mathrm{T{-}t/T{-}t{+}1})^{1/2}[\epsilon_{it}-(1/(T-t))*(\epsilon_{i(t+1)}+\ldots+\epsilon_{iT})]$

and $\mathrm{Var}(\varepsilon_{it}) = \sigma^2 I_T$ is not serially correlated and $\mathrm{Var}(\epsilon_{it}^*) = \sigma^2 I_{T-1}$ which also has no serial correlation.

Applying the transformation procedure to Eq. (1) leads it to be rewritten as:

$$\begin{aligned} sprdde^*_{it} = \mu_i + \varphi.z^*_{it} + \beta_{gdbt}{}^{L}.gdbt^*_{i,t-1}.I(gdbt_{i,t-1} \leq \gamma_{gdbt}) \\ + (\beta_{gdbt}{}^{H}.\ gdbt^*_{i,t-1}. + \delta^{H}).I(gdbt_{i,t-1} > \gamma_{gdbt}) + \varepsilon_{it} \end{aligned} \qquad (2)$$

where the superscript "*" denotes the data after the transformation.

In addition, we restricted the number of variables to avoid potential overfitting of the endogenous variable that can lead to bias in the estimated coefficients. Also, the low number of observations available in the different states will weaken the robustness of our estimations, particularly after we subdivided the dataset into groups (e.g. core EMU and periphery EMU countries). In order to estimate robust threshold values, we specified that a change of regime in the estimation of the thresholds should exclude the lowest and highest 5% of all the observations. This is to minimize the impact of potential breaks, mostly indicated by sudden shifts or extreme values within the data on the results. However, while the decision to reject the lowest and highest 5% of all the observations during the threshold estimation was quite arbitrary, such a simple rule allowed us to reduce the likelihood that few extreme values or outliers in the dataset would tilt the result toward those extremes when estimating the thresholds. This procedure is also applied in Proaño, Schoder et al. (2014) to minimize the effects of these few extreme values on the results. Therefore, the estimated threshold values would be more robust if we remove few extreme values or outliers when determining the volatility index variable across each panel group.

Similarly, we analyzed the non-linear impact of government debt on bond spread using the level of volatility as threshold variable. We want to determine whether the impact of government debt on bond spreads substantially differ during periods of low and high stock market volatility. This model can help us to analyze how the impact of government on bond spreads depends on the level of volatility. In this regression model, the two regimes are presented as follows: low volatility (L) and high volatility (H).

$$\mathrm{sprdde}^*_{it} = \mu_i + \varphi.z^*_{it} + \beta_{\mathrm{gdbt}}{}^{L}.\mathrm{gdbt}^*_{i,t-1}.I(\mathrm{vol}_{i,t-1} \leq \gamma_{\mathrm{vol}}) \qquad (3)$$

$$+ (\beta_{\mathrm{gdbt}}{}^{H}.\ \mathrm{gdbt}^*_{i,t-1} + \delta^{H}).I(\mathrm{vol}_{i,t-1} > \gamma_{\mathrm{vol}}) + \varepsilon^*_{it}$$

where vol_{it} is the stock index volatility and the other parameters and variables are as previously stated.

Finally, we analyzed the non-linear impact of government debt on bond spread using the level of government debt ratio itself as well as on the level of volatility as threshold variables. We want to determine whether the impact of government debt on bond spreads maybe primarily due to a combination of high government debt ratio and high stock market volatility. This model can help us to analyze how the impact of government debt on bond spreads depends on the level of government debt ratio as well as on the level of volatility. In this regression model with two threshold variables, this gives rise to up to four regimes. These four regimes are presented as follows: low government debt ratio and low volatility (LL), high government debt ratio and low volatility (HL), low government debt ratio and high volatility (LH), and high government debt ratio and high volatility (HH).

Thus, we consider the following panel threshold model:

$$sprdde^{*}_{it} = \mu_i + \varphi.z^{*}_{it} + \beta_{gdbt}{}^{LL}.\ gdbt^{*}_{i,t-1}\ .I(gdbt_{i,t-1} \leq \gamma_{gdbt},\ vol_{i,t-1} \leq \gamma_{vol}) \quad (3)$$

$$+ \beta_{gdbt}{}^{HL}.\ gdbt^{*}_{i,t-1} + \delta^{HL}).I(gdbt_{i,t-1} > \gamma_{gdbt},\ vol_{i,t-1} \leq \gamma_{vol})$$

$$+ \beta_{gdbt}{}^{LH}.\ gdbt^{*}_{i,t-1} + \delta^{LH}).I(gdbt_{i,t-1} \leq \gamma_{gdbt},\ vol_{i,t-1} > \gamma_{vol})$$

$$+ \beta_{gdbt}{}^{HH}.\ gdbt^{*}_{i,t-1} + \delta^{HH}).I(gdbt_{i,t-1} > \gamma_{gdbt},\ vol_{i,t-1} > \gamma_{vol}) + \varepsilon^{*}_{it}$$

where the variables and parameters are expressed as before.

In addition, to reduce the computational effort for identifying the threshold values, we round the government debt values to full integers and the volatility to one decimal digit for search.

2.4. Estimation results

In the following section, we present the results of the estimation using the dynamic panel threshold method in the following groups of countries: European, Initial EMU, Standalone, Core EMU, Peripheral EMU, and New EMU. First, we analyze how government debt ratio affects the impact of government debt on bond spread. Second, we analyze how stock market volatility affects the impact of government debt on bond spreads. Finally, we analyze how both government debt ratio and stock market volatility affect the impact of government debt on bond spreads.

2.4.1. Government debt ratio as threshold variable

Table 19 reports the estimation results of the regression model described in equation (2) to analyze the impact of government debt on bond spreads using government debt ratio as threshold variable.

In column 2, the government debt thresholds are endogenously estimated , with the 95% confidence interval of the threshold value. Columns 3 and 4 respectively present the number of observations in low and high government debt ratio regimes. In addition, all the estimated government debt ratio thresholds are highly significant at 5% level (see Figure 11, Appendix). Furthermore, it is interesting to note that the value of the threshold variable beyond which a regime change occurs is much higher in the European group, the standalone group, the initial EMU group, and the peripheral EMU group, compared to the core EMU group and the new EMU group. Hence, given the low government debt thresholds in the core EMU group and the new EMU group, most observations are located in the high government debt ratio regimes.

Table 19. Results of the impact of public debt on bond spreads with public debt as threshold.

	γ_{gdbt}	L	H	ulc_t	$\beta^{L}{}_{gdbt}$	$\beta^{H}{}_{gdbt}$	δ^{H}	R_2 R_2 adj
EUROPEAN	88.16 [83.25, 90.51]	1373	319	0.0505***	0.0775***	0.1350***	-7.5884***	14.98 14.83
STANDALONE	67.59 [62.72, 67.72]	502	126	0.0135	0.0259**	-0.0263*	9.5553***	16.26 15.85
INITIAL EMU	98.93 [98.52, 115.18]	458	224	0.0160***	0.0403***	0.1699***	-14.6023***	37.40 37.12
CORE EMU	6.86 [6.75, 7.86]	25	347	0.0030	0.8154***	0.0146***	5.8403***	24.31 23.68
PERIPHERAL EMU	98.93 [96.29, 113.54]	146	164	0.0223***	0.0583***	0.1602***	-12.8654***	37.20 36.57
NEW EMU	6.07 [5.75, 17.30]	41	341	0.0411***	-0.6195***	0.0832***	-5.2016***	20.95 20.31

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in equation (2) with endogenously estimated government thresholds.

Column 5, the coefficients of unit labor cost as control variable are as expected positive and significant at 1% level. Clearly, an increase in unit labor cost will cause the bond spreads to rise.

Columns 6 and 7 present the impact of government debt ratio in low and high government debt regimes respectively. We are primarily interested in these two coefficients. The coefficients of government debt ratio appear to be positive and significant at 1% level as expected in the groups of European initial EMU, core EMU, and peripheral EMU countries in both government debt regimes. It is interesting to note that, in those groups, the coefficients of government debt are higher in high regime compared to low government debt regime with the exception of the core EMU group. In addition, we obtain negative and significant coefficients of government debt in the standalone group and the new EMU group. Clearly, these negative results are unexpected and could suggest the need to consider other threshold variables since using government debt as threshold maybe inadequate in the groups of standalone and new EMU countries. In addition, the endogenously estimated government thresholds in initial EMU and peripheral EMU countries are identical at 98.93%, while it is far lower in core EMU countries at 6.86%. This shows the strong impact of peripheral euro area countries on the euro area economies as the government debt ratios in these peripheral countries rose significantly. However, the result in core EMU countries could also indicates that other threshold variables may better capture the impact of government debts on bond spreads.

Table 20. Results of the impact of public debt on bond spreads with a preset public debt threshold.

	L	H	ulc_t	β^L_{gdbt}	β^H_{gdbt}	δ^H	R_2 R_2 *adj*
EUROPEAN	987	705	0.0458***	0.0451***	0.0821***	-1.9427***	13.92 13.77
STANDALONE	463	165	0.0669***	0.0374**	0.0418**	3.6599**	15.12 14.70
INITIAL EMU	235	447	0.0102*	0.0095**	0.1003***	-6.4529***	31.67 31.36
CORE EMU	149	223	0.0069**	0.0172***	0.0172***	-0.0659	7.07 6.30
PERIPHERAL EMU	86	224	0.0265***	0.0086	0.1119***	-7.7914***	31.76 31.08
NEW EMU	289	93	0.0328***	0.0800***	0.0556***	2.4775**	15.70 15.01

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in equation (2) with government debt threshold that has been exogenously fixed at 60% of GDP.

To ensure that the robustness of our results, we assumed that the government debt threshold level is set at 60% of GDP, as specified as one of the Euro convergence criteria to ensure debt sustainability (see Table 20). Fixing the government debt threshold at 60% of GDP greatly reduces R-squared adjusted in the core EMU group and the new EMU group compared to other groups. The robustness check shows that the coefficients of government debt in high and low regimes are similar in core EMU countries. However, it validates that coefficients are higher in high regime compared to low regime in European, initial EMU, and peripheral EMU countries.

Overall, our results suggest that the impact of government debt on bond spread is mostly positive and significant. Also, we obtained various levels of government debt ratios at which the increase of government debts beyond those levels would significantly cause the bond spread to rise. However, countries with large government debts such as some countries in core euro area countries (e.g. Belgium and France) do not necessarily undergo an increase in bond spread such as experienced in peripheral euro area countries. However, the strong sensitivity of the results to the level of government debt thresholds in standalone, core euro area, and new euro area countries seems to suggest the need to consider other thresholds variables rather than government debt as main source of non-linearities. In the next section, we introduce the volatility index as regime dependent threshold.

2.4.2. Volatility index as threshold variable

In this section, we analyze the non-linear effects of government debt on bond spread using the volatility index as threshold variable. We argue that when the stock market is highly volatile beyond a certain threshold, a rise in government debt leads to an increase in bond spread. A country with volatility above a certain threshold would most likely undergo severe financial stress, economic downturn, or great political instability. This transmission is possible through the banking sector which holds significant portions of short and long-term government debt securities. High financial stress causes banks to require higher bond yields due to the higher risk exposures. As the government has to pay higher interest rate to fund its activities, this further deteriorate the fiscal position causing the bond spread to rise. As the financial stress, economic downturn, or political instability causes the economy to be more sensitive to changes in government debt, non-linear effects can also be experienced in a country with relatively lower level of government debt ratio.

Table 21 reports the estimation results of the regression model described in equation (3) with the government debt ratio as regime dependent variable using the stock market volatility index as threshold variable. The coefficients of unit labor cost are, as expected, positive and significant at 1% level as previously indicated with the exceptions of the standalone and initial EMU groups that are non-significant. Also, we find strong evidence suggesting that government debt ratios are positive and significant at 1% level in low and high volatility regimes for all panel groups. In addition, the coefficients of government debt in high volatility regime are higher compared to low regime in initial EMU and peripheral EMU countries. This contrast with the results in European and standalone countries that show higher coefficients during low volatility regime compared to high regime. Meanwhile, the coefficients of government debt indicate similar coefficients in low and high volatility regimes in the core EMU and the new EMU groups. Comparing the results between core and peripheral euro area countries mostly show that development of bond spreads in euro area countries are mostly driven by peripheral member states. This suggests that the impact of government debt during high volatility is about twice more important than during low volatility on bond spreads in peripheral euro area countries. However, core euro area and new euro area countries do not seems to have been affected by the high volatility compared to periods of low volatility. Also, the higher coefficients of government debt during low volatility regime compared to high regimes in the groups of European and standalone countries suggests the needs to consider additional threshold variables or to extend the analysis to two thresholds: some countries could be more affected by high level of government debt while others could be more affected by high stock market volatility. In addition, the endogenously estimated volatility thresholds are all significant at 5% level in all panel groups (see Figure 12 in Appendix).

Table 21. Results of the impact of public debt on bond spreads with volatility as threshold.

	γ_{vol}	L	H	ulc_t	β^L_{gdbt}	β^H_{gdbt}	δ^H	R_2 R_2 *adj*
EUROPEAN	7.42 [7.42, 7.44]	85	1607	0.0449***	0.3972***	0.0671***	15.5186***	37.05 36.94
STANDALONE	4.97 [4.15, 4.97]	37	591	0.0061	1.0592***	0.0038	45.9735***	95.78 95.76
INITIAL EMU	38.50 [36.76, 38.50]	630	52	-0.0052	0.0553***	0.1295***	-4.4532***	48.15 47.92
CORE EMU	23.18 [12.46, 28.55]	282	90	0.0098***	0.0165***	0.0153***	0.3415***	21.42 20.77
PERIPHERAL EMU	45.51 [43.13, 45.51]	285	25	0.018***	0.060***	0.132***	-3.775**	51.51 51.03
NEW EMU	18.63 [18.32, 20.17]	275	107	0.032***	0.075***	0.074***	1.201***	29.94 29.38

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in equation (3) with endogenously estimated volatility thresholds.

The robustness check with an arbitrary assumed volatility index threshold level set at 25% mostly validates previous results that were obtained using endogenously estimated volatility thresholds with the exception of the European group. Setting the volatility threshold arbitrary at 25% to capture stock market crash for example causes the coefficients of government debt to be higher during high volatility regime than in low regime for the initial EMU group and the peripheral EMU group. However, this result causes the adjusted R-squared to be lower in all groups.

Table 22. Results of the impact of public debt on bond spreads with a preset volatility threshold.

	L	H	ulc_t	β^{L}_{gdbt}	β^{H}_{gdbt}	δ^{H}	R_2 R_2 adj
EUROPEAN	1317	375	0.0349***	0.0642***	0.0843***	-0.3270	14.37 14.21
STANDALONE	468	160	0.0576***	0.0795***	0.0351***	2.5966***	8.90 8.45
INITIAL EMU	521	161	0.0033***	0.0570***	0.0991***	-2.0971***	40.29 40.02
CORE EMU	290	82	0.0065***	0.0162***	0.0151***	0.3186***	19.01 18.34
PERIPHERAL EMU	231	79	0.0154***	0.0585***	0.1229***	-4.1853***	42.62 42.05
NEW EMU	328	54	0.0310***	0.0811***	0.0740***	1.4901***	24.85 24.24

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 05% and 10%, respectively. The interval of feasible threshold values is in brackets. Panel threshold regression model presented in equation (3). ULC is an exogenous variable.

Overall, using the volatility index as threshold variable leads to better estimation results than using government debt as threshold variable. Also, the results suggest that government debts have positive and significant effects on bond spreads in all panel groups. However, the results are very sensitive to the threshold values in European countries and standalone countries. Due to the potential limitations of using the volatility index as threshold since it captures both upward and downward movements on the stock market in the same way, we decided to perform an additional test using stock index return. The stock index return allows us to distinguish between fall and rise in stock index prices with our primary interest being fall in stock index prices. Thus, we performed similar regressions using the stock index return as threshold variable.

In Table 23, the results of the impact on bond spreads are presented while using stock index return as threshold variable. The coefficients of government debt are positive and significant at 1% level in all panel groups. This result only differs with the initial endogenous estimated volatility in the group of European countries. The coefficient of government debt is slightly higher in high index return regime compared to low regime in European countries. In addition, the positive stock index return thresholds that are displayed in the second column show the fall in stock indices (we multiplied stock index returns by minus one). Also, the plot of the likelihood ratio with stock index return as threshold (see Figure 13, Appendix) suggests that the endogenously estimated thresholds are significant at 5% level in all panel groups.

Table 23. Results of the impact of public debt on bond spreads with index return as threshold.

	γ_r	L	H	ulc_t	$\beta^L{}_{gdbt}$	$\beta^H{}_{gdbt}$	δ^H	R_2 R_2 adj
EUROPEAN	0.2913 [0.227, 0.321]	1563	129	0.0296***	0.0669***	0.0833***	0.1588	14.18 14.03
STANDALONE	0.0415 [-0.066, 0.185]	430	198	0.0697***	0.0938***	0.0630***	1.8738***	9.96 9.52
INITIAL EMU	0.3262 [0.326, 0.327]	629	53	0.0105**	0.0651***	0.1077***	-1.8236***	40.15 39.88
CORE EMU	0.0389 [-0.011, 0.121]	251	121	0.0131***	0.0185***	0.0144***	0.4066***	16.87 16.19
PERIPHERAL EMU	0.3262 [0.321, 0.327]	283	27	0.0201***	0.0726***	0.1425***	-4.3068***	40.60 40.00
NEW EMU	0.1762 [0.153, 0.236]	327	55	0.0237***	0.0826***	0.0799***	1.7450***	26.70 26.11

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Panel threshold regression model presented in equation (3). ULC is an exogenous variable. % change in price from one day to another.

In addition, we performed a robustness check with an arbitrary index return threshold that we set at 0.5% to be higher than the previously estimated endogenous index return thresholds. The estimated regressions with a predetermined stock index return at 0.5% are presented in Table 24. It is interesting to note that the results of these regressions are quite robust when compared to the endogenously estimated stock index thresholds in Table 23.

Table 24. Results of the impact of public debt on bond spreads with a preset index return threshold.

	L	H	ulc_t	β^L_{gdbt}	β^H_{gdbt}	δ^H	R_2 R_2 adj
EUROPEAN	1642	50	0.0310***	0.0668***	0.0881***	0.1140	13.73 13.58
STANDALONE	609	19	0.0686***	0.0828***	0.0635***	1.7480**	8.64 8.19
INITIAL EMU	661	21	0.0129***	0.0658***	0.1012***	-0.9957*	35.61 35.32
CORE EMU	361	11	0.0091***	0.0150***	0.0183***	0.2414	11.24 10.51
PERIPHERY EMU	300	10	0.0303***	0.0772***	0.1422***	-4.3157**	34.71 34.06
NEW EMU	372	10	0.0310***	0.0814***	0.0666***	3.8105***	23.06 22.44

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 05% and 10%, respectively. The interval of feasible threshold values is in brackets. Panel threshold regression model presented in equation (3). ULC is an exogenous variable. % change in price from one day to another. Robustness check with stock market return at 0.5%

2.4.3. Government debt ratio and volatility index as threshold variables

In the previous two sections, we first studied how the level of government debt beyond a certain threshold affects the impact of government debt on bond spreads. We also studied how volatility at certain thresholds influences the effects of government debt on bond spreads. Through these two approaches, we found that the positive effects of government debt on bond spreads do not exclusively depend on the level of government debt in all groups. However, the economic theory suggests that increasing government debt would cause the bond spreads to rise when both government debt and stock market volatility are very high. Therefore, we extended the analysis to how the effects of the government debt on bond spreads depend on the level of the government debt itself as well as the level of the volatility. Table 25 below reports the estimation results with government debt and volatility index as threshold variables. However, the results of the estimations should be taken with caution for groups of countries in the various states with observations that are less than 30.

The coefficients of the unit labor cost are as expected positive and significant at 1% level in the European group, the peripheral EMU group, and the new EMU group and respectively 5% and

10% in the standalone group and in the initial EMU group. We note that the coefficients of government debt in the European group display quite interesting results despite the negative coefficient in LL regime. In the group of European countries, Table 25 shows that in the HH states, with government debt and volatility beyond the threshold limits, the impact of government debt ratio on bond spreads is significant. Also, in the European group with high government debt ratio or high volatility seems to be characterized by a positive and significant influence of government debt ratios on bond spreads. However, interpreting the estimation results in the remaining groups is quite difficult due to the few number of observations in the standalone group, especially in the state of HL. In addition, we obtain several negative coefficients of the government debt.

Subsequently, we applied similar regressions using the stock index return rather than the volatility index. Table 26 presents the estimation results with government debt and stock index return as threshold variables. It appears that using the stock index return better captures the impact of government debt on bond spreads since we obtained less negative coefficients despite the lack of fit with lower R-squared adjusted. However, we also observed that the number of observations in several states are lower than 30 in the various groups. European group with high government debt and high stock index return (positive stock index return indicates a fall in prices since we multiplied the stock index return with the negative sign) would experience a surge in bond spreads. Also, the European group in the remaining regimes (LL, HL, and LH) generally exhibit similar effects of government debt on bond spreads. Despite the lack of robustness in the results in other panel groups, we can say that countries facing with high government debt ratios and fall in stock index prices will experience a significant increase in bond spreads in the European group and the initial EMU group. However, two negative and significant coefficients of government debt in low debt and low index return (LL) in the core EMU and the new EMU groups may indicate that different threshold variables could be needed. Furthermore, non-significant coefficients of government debt in high debt and high return regime (HH) in the standalone group and the peripheral EMU group may suggest that extending the model to two thresholds could be inadequate.

Table 25. Results of the impact of public debt on bond spreads with public debt and volatility index as threshold variables.

	γ_{gdbt}	γ_{vol}	LL	HL	LH	HH	ulc_t	$\beta^{LL}{}_{gdbt}$	$\beta^{HL}{}_{gdbt}$	$\beta^{LH}{}_{gdbt}$	$\beta^{HH}{}_{gdbt}$	δ^{HH}	R_2 R_2 adj
EUROPEAN	54	9.2	88	77	759	768	0.0518***	-0.0775***	0.0637***	0.0202**	0.0880***	-3.8311***	27.21 27.00
STANDALONE	88	9.6	60	3	519	46	0.0425**	0.2601***	0.0600***	0.0713***	0.0207*	3.6372**	29.36 28.78
INITIAL EMU	127	29	537	26	97	22	0.0077*	0.0439***	0.0537***	0.0534***	-0.1638***	41.7438***	55.72 55.39
CORE EMU	7	13	12	76	15	269	0.0009	-0.1505***	0.0146***	-0.0189	0.0160***	0.1297*	28.82 27.83
PERIPHERAL EMU	134	36	256	17	15	269	0.0179***	0.0496***	0.0589***	0.0617***	-0.0894	30.9307***	58.28 57.58
NEW EMU	11	19	44	230	18	90	0.0395***	-0.2960***	0.0772***	-0.2543***	0.0845***	0.6402	30.47 29.52

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in eq.(4) with two endogenous estimated threshold variables such as government debt and volatility index.

Table 26. Results of the impact of public debt on bond spreads with public debt and index return as threshold variables.

	γ_{gdbt}	γ_{retn}	LL	HL	LH	HH	ulc_t	$\beta^{LL}{}_{gdbt}$	$\beta^{HL}{}_{gdbt}$	$\beta^{LH}{}_{gdbt}$	$\beta^{HH}{}_{gdbt}$	δ^{HH}	R_2 R_2 adj
EUROPEAN	85	0.1	1026	241	331	94	0.0470***	0.0850***	0.0705***	0.0909***	0.1369***	-6.7207***	16.19 15.94
STANDALONE	82	0.1	427	55	118	28	0.0646***	0.1062***	0.0794***	0.1086***	-0.0022	8.4070***	11.57 10.84
INITIAL EMU	119	0.3	573	51	47	11	0.0130***	0.0404***	0.0603***	0.0457***	0.0958**	1.6811	47.93 47.54
CORE EMU	7	0.0	18	207	9	138	0.0109***	-0.0901***	0.0166***	0.0111	0.0145***	0.2623***	24.17 23.12
PERIPHERAL EMU	132	0.3	248	30	9	138	0.0372***	0.0559***	0.0714***	0.0596***	0.0179	16.3614	46.98 46.10
NEW EMU	11	0.2	54	278	8	42	0.0353***	-0.2503***	0.0836***	0.0010	0.0889***	1.3726***	27.21 26.22

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in eq.(4) with two endogenous estimated threshold variables such as government debt and stock index return.

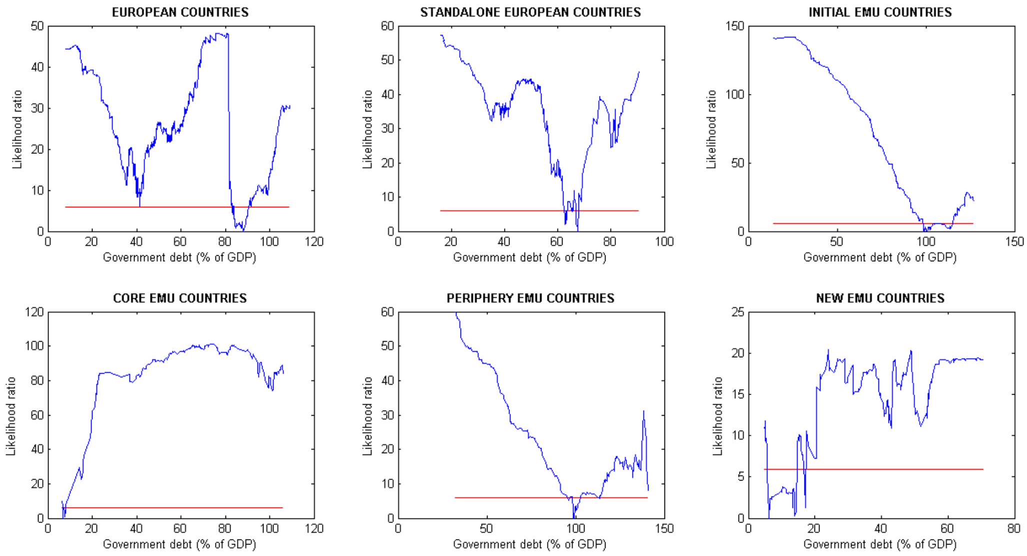
2.5. Concluding remarks

We have empirically shown that rising levels of government debt ratios beyond certain thresholds played a significant role on the surge observed in various European bond spreads. However, we also showed that the large impact of government debt does not exclusively depends on the level of government debt ratio but also depends on other factors such as the state of volatility of stock market. Using several European countries that we grouped based according to according to their ability to independently manage their domestic monetary policy and the date at which they joined the euro area.

We based our econometric analysis on the dynamic panel threshold regression techniques to investigate non-linearities in the relationship between bond spread, government debt ratio, and volatility. To sum up, we found the following results: First, we found the evidence of a positive and significant effects of government debt on bond spreads in the peripheral euro area group during high government debt regimes. Also, it seems that rising bond spreads in the initial euro area group are mostly driven by the peripheral euro area group compared to the core euro area group when the government debts reach levels beyond thresholds. This impact is at least twice more important in the initial euro area or the peripheral euro area groups when government debt ratios are beyond the thresholds compared to when they are below the thresholds. However, we found that using government debt as threshold fails to capture the impact of government debt in some panel groups such as in the standalone and the new euro area groups. Hence, we considered the volatility index as threshold variable. The results suggested that a rise in government debt ratio will have about twice the impact on bond spread during periods of high market volatility compared to periods of low volatility in the peripheral euro area and the initial euro area groups. This means that neglecting the state of stock market volatility could lead us to underestimate the impact of government debt on bond spreads. In addition, we performed an additional test that took into account a potential limitation when using the volatility as threshold variable. Using the stock index return allowed us to differentiate between falling and rising index price. However, the results are quite robust compared to previous estimations with some minor differences. Moreover, when we considered for two threshold variables, we observed that while the approach may be adequate for the European group, it mostly fails when we subdivide into various panel groups due to lower number of observations in all four states. Furthermore, the results obtained when we used government debt and volatility as threshold variables are quite disappointing. Hence, we considered a similar analysis with government debt and stock index return as threshold variables. The results obtained for the group of European countries in all the four different states are robust with sufficiently large number of observations. It shows that European group that have high level of government debts beyond the threshold as well as stock index returns that have fallen the beyond threshold will cause the highest impact of government debt on bond spreads compared to the impact of government debt in the remaining states. By extension, this result would mean that a high level of government debt ratio alone would not automatically mean that an increase in government debt would cause the bond spread to rise. To sum up, we identified that stock market volatility or stock index return could be a crucial source of non-linearity in the relationship between government debt and bond spread. At high levels of stock market volatility, government debt ratios in peripheral euro area economies significantly contributed to the rise in bond spread, regardless of the level of government debt. However, that does not mean that the level of government debt ratio is always important. In addition, negative market sentiment due to prolonged falling prices in European stock markets coupled with rising government indebtedness could be crucial to explain the increase in bond spreads in the European group. Clearly, our analysis confirm the vulnerabilities of the peripheral euro area group compared to the core euro area group due to large government indebtedness and volatile stock market. Also, it shows potential limitations with the need to consider larger sample sizes or different threshold variables since we do not account for all factors that are likely to have some major impact on bond spreads. In future research, we would like to study the impact of political risk factors on bond spreads during bad economic conditions such as experienced in Greece, Ireland, and Spain. It would be interesting to study such effects particularly in a country with high government debt and subjected to political uncertainty.

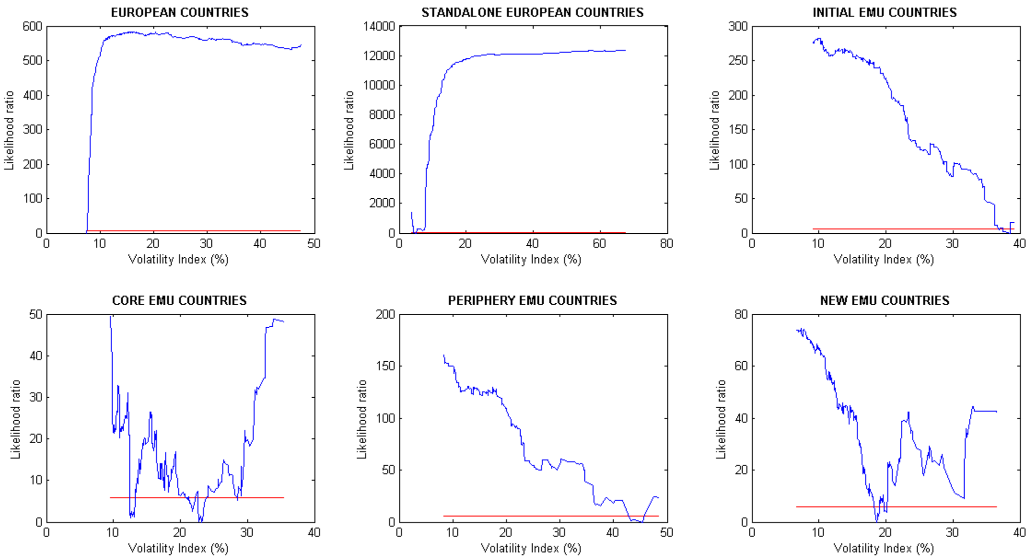
2.6 Appendix

Figure 11. The likelihood ratio with government debt ratio as threshold variable.



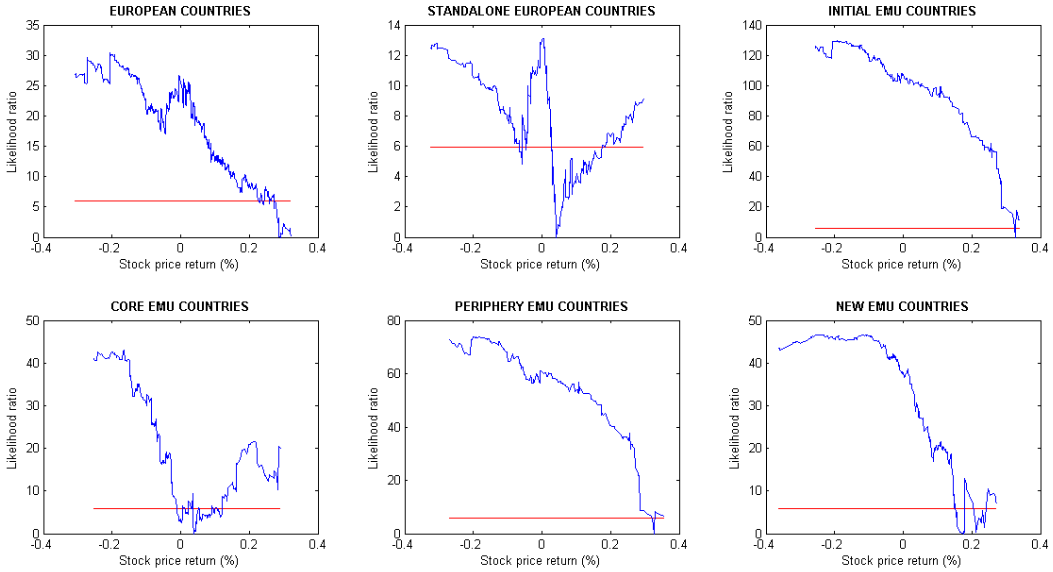
Note: The likelihood ratio is indicated in blue line and the red line represents the 5% confidence level. It shows that the estimated government thresholds are significant at 5% level in all panel groups given that the blue line cross the red line at least once.

Figure 12. The likelihood ratio with the volatility index as threshold variable.



Note: The likelihood ratio is indicated in blue line and the red line represents the 5% confidence level. It shows that the estimated volatility thresholds are significant at 5% level in all panel groups given that the blue line cross the red line at least once.

Figure 13. The likelihood ratio with the stock market return as threshold variable.



Note: The likelihood ratio is indicated in blue line and the red line represents the 5% confidence level. It shows that the estimated stock market return thresholds are significant at 5% level in all panel groups given that the blue line cross the red line at least once.

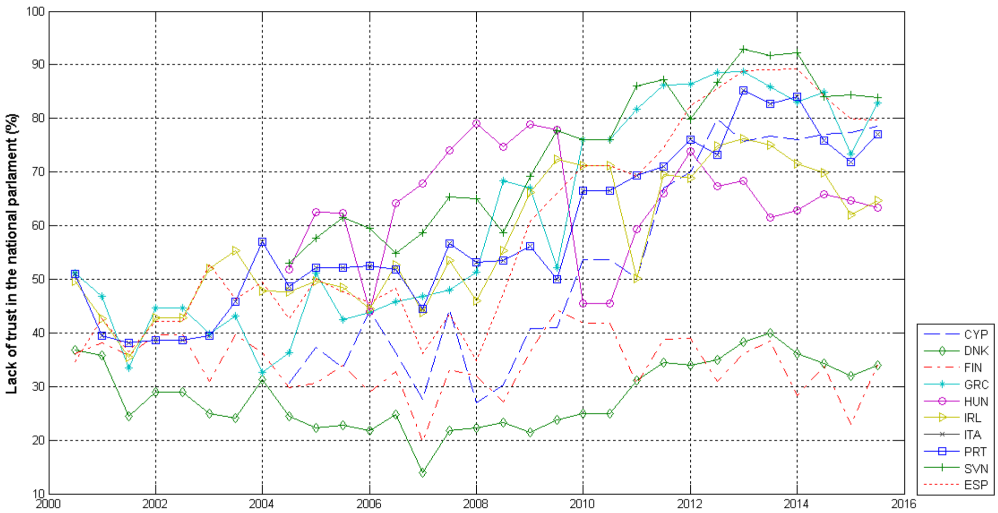
Chapter 3: Testing the impact of political risks on bond spreads during periods of high volatility in European stock markets

3.1. Introduction

The ongoing European economic crisis has engendered a political crisis due to deeply unpopular bailout program in both creditors and debtors countries. A rising political risk in Europe and an ongoing economic weakness risk undermine government actions or potential policies and could have negative effects on future economic developments. A country's ability or willingness to repay its debt can be seriously impacted by the state of its political system and willingness to honor its contractual obligations. This implies that uncertainty surrounding potential changes in government policies can severely affect the borrowing costs of that country. In some recent studies on political risk, there is some evidence to suggest an existing strong relationship between political risk and sovereign risk (see Bekaert, Harvey et al. (2014), Huang, Wu et al. (2015), Moser (2007)). It can be argued that citizens lack of trust in their national leaders in dealing with the financial and economic crises. in European countries experiencing high volatility might have become an increasing concern when analyzing the political uncertainty on European sovereign bond spreads. As sentiment in the financial markets and economic conditions worsened, this adversely exacerbated political uncertainty with major power shifts in several European countries such as Greece, Hungary, France, Ireland, Italy, the Netherlands, Portugal, Spain, and Switzerland. In this context, the trust between the citizens and their national leaders was really shaken given the extreme stress caused by economic crisis, austerity measures, social instabilities, and particularly alarming frictions between major European economies such as Germany, the United kingdom, and France that may have long-lasting effects on government policies. Consequently, the sharp decline in public trust in government and national parliament could explain the major political power shifts. In addition, the vulnerability of some European markets poses a serious threat to Europe's economic recovery and, to some extent, to the existence of the euro.

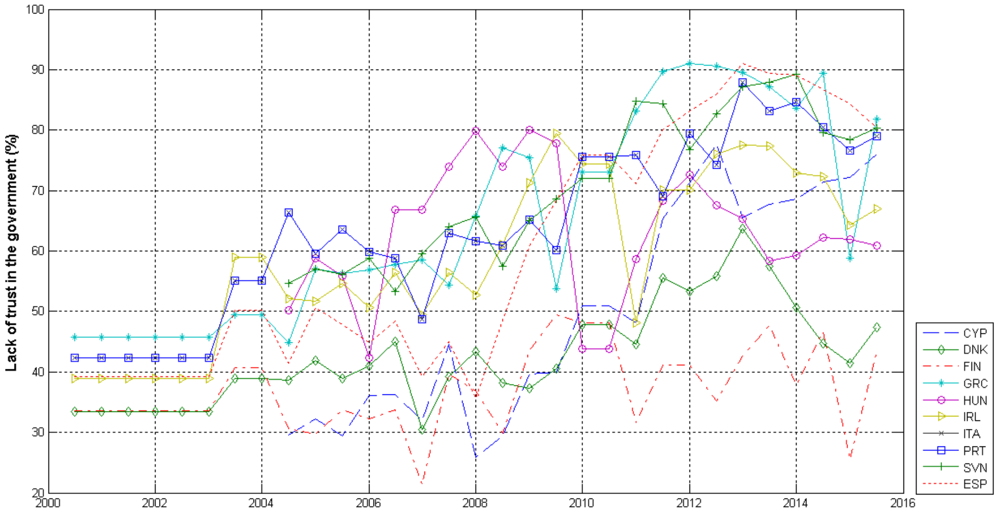
In this chapter, we investigate the issue of rising political uncertainty in European countries using information obtained from the Eurobarometer (European commission) as proxy for a political risk variable. Specifically, we assess the relationship between country-specific political risks and sovereign bond spreads in 27 European countries using the dynamic panel threshold approach. Using this approach allows us to capture the impact of political risk during high market volatility. Hence, we can determine the potential impact that results for example from increase or decline in public trusts in important institutions, such as, parliament, government, and political parties. Empirically, we would expect that countries with ongoing weak economic outlook would face more political uncertainty causing a rise in sovereign bond spreads. Thus, our objective is to adequately measure political uncertainty arising from these country-specific political variables that can threaten the ability of a government to function properly during crisis times.

Figure 14. Falling public trust in the national parliament



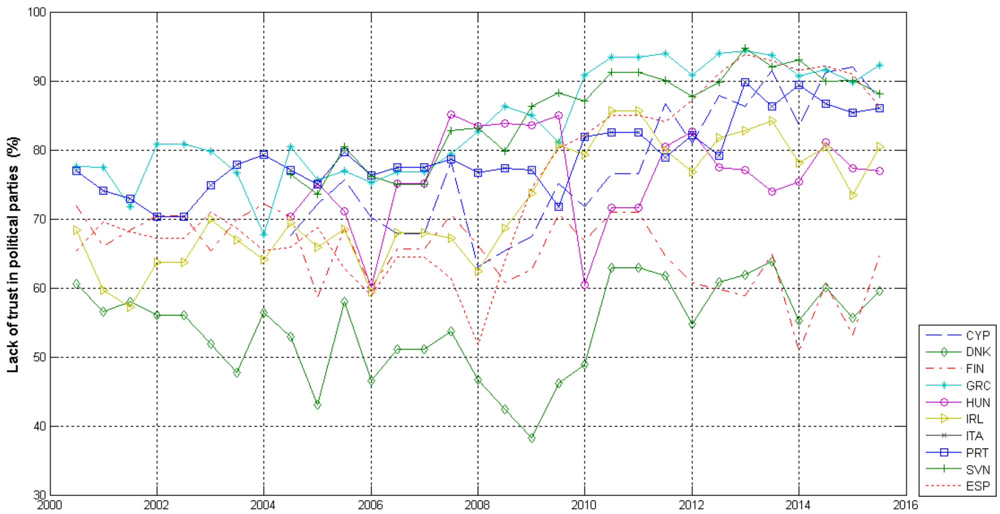
Note: Percentage of citizens who do not trust their national parliament in some selected European countries
Source: Eurobarometer - European Commission

Figure 15. Falling public trust in the government



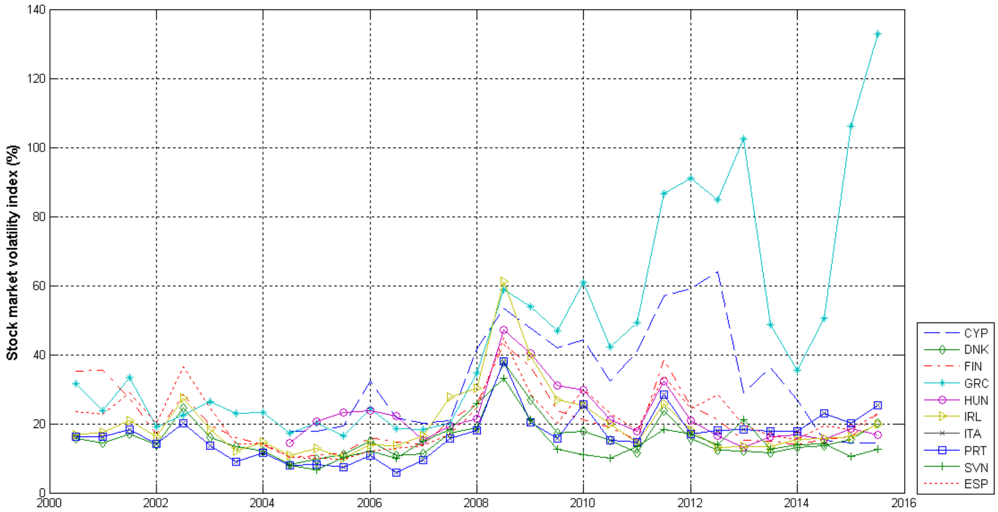
Note: Percentage of citizens who do not trust their government in some selected European countries
Source: Eurobarometer - European Commission

Figure 16. Falling public trust in political parties



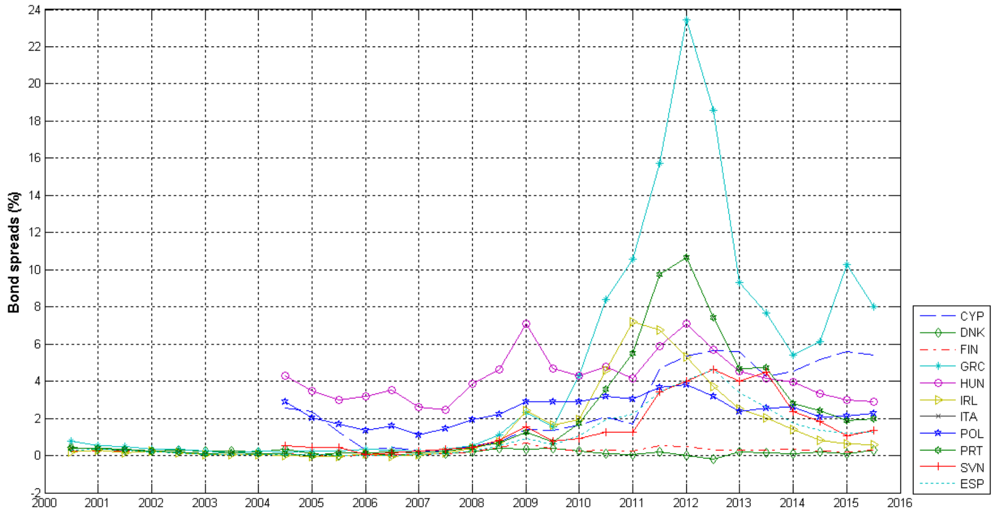
Note: Percentage of citizens who do not trust political parties in some selected European countries
Source: Eurobarometer - European Commission

Figure 17. Volatility index



Note: Annualized volatility index in percentage for some selected European countries
Source: Macrobond

Figure 18. Long-term government bond spreads



Note: 10-year government bond spreads relative to Germany in percentage
Sources: European Central Bank and Macrobank

The role of rising country-specific political risk variables on the developments of long-term bond spreads cannot be overemphasized given the current bad financial and economic conditions in Europe. Figure 14, Figure 15, and Figure 16, present the evolution of the lack of public trust in national parliament, government, and political parties respectively. In general, we observe from these three graphs increasing level of lack of public trust in these important institutions. In fact, citizens trust in national parliament, government, and political parties mostly declined since 2008 in Greece, Ireland, Italy, and Portugal. In addition, Figure 17 shows the development of volatility index with persistent high volatility in Cyprus and Portugal after 2008. This suggests that increasing political uncertainties in the ongoing bad economic and financial conditions may have partly contributed to the surge in bond spreads (see Figure 18), which have been more pronounced especially in Greece, Ireland, and Portugal. As the economic conditions continue to deteriorate, it is not difficult to understand why people who took part in the Eurobarometer surveys have attributed less confidence to these public institutions. Across the surveyed countries, many citizens blame their national leaders for the political infightings and place little faith in policymakers' ability to develop and implement appropriate regulations rather than to use their influences for personal gains. Hence, we can generally attribute the rise in 10-year government bond yield in Italy to the inability of top Italian government officials to address the issues facing the country in order to remain competitive and increase their levels of accountability. This follows from the failure of the political party Forza Italia led by former prime minister Silvio Berlusconi to undertake difficult structural reforms to address a combination of economic issues, such as rising budget deficit, slow growth, and unsustainable large public debt. Another example of the unstable political state in Europe can be seen with the election in Greece of the anti-austerity political party Syriza with its leader Alexis Tsipras. His election followed Greek citizens' discontent with the two traditional parties which shocked financial markets, causing the Greek's bond yields to surge given his opposition to the bailout terms suggested by the troika (European Central Bank, International Monetary Fund, and the European Commission). This might suggest a tough stance in his talks with the troika. However, political agreements reached between Greece and the troika, in exchange for funds, slightly contributed to some reduction in long-term government bond yields; whereas, the failure to maintain such political agreements resulted in a sudden surge in bond spreads that was even more devastating. These events highlight the importance that country-specific political risks (confidence in the government, change of government, etc.) can play in triggering a surge in bond spreads amid vulnerable financial markets. Generally, the 10-year government bond spreads remained relatively high in most European countries in comparison to the pre-crisis period. This indicates that rising political risks with substantial social effects could be a major concern to investors due to anxiety amongst key policymakers about the adequate policy responses. It is important that the steady deterioration in trust over several years in government, national parliament, or political parties be of major concerns since serious public mistrusts can have severe consequences during crisis and cannot be easily recovered.

Our results reveal that there is a significant and positive link between political risk and 10-year government bond spreads in our panel groups. As expected, the magnitude of the impact of political risk are generally strong during high market volatility compared to period of low volatility (with the exception of the standalone group). Clearly, results show that increasing political risks over the years have strong positive effects on bond spreads. In addition, the extension to two threshold variables allows us to highlight the importance of high political risk and volatility. At the exception of the standalone group, we found the highest impact of political risk in the regime is characterized by high political risk and high volatility. Furthermore, from the results, we can conclude that the rising level of bond spreads during the economic crisis in euro area countries was mostly driven by the deterioration of political risk in peripheral euro area countries rather than in core euro area countries. Also, the different magnitudes for each panel group underscore the differences in public institutions and managements in Europe.

This research relates to current evidence in the literature about the relationship between political risk and sovereign bond yields such as in Baldacci, Gupta et al. (2011), Pastor and Veronesi (2012), Bekaert, Harvey et al. (2014) et al., Gao and Qi (2013) and Huang, Wu et al. (2015). We extend this line of research with an empirical analysis of the impact of political risk on European bond spreads that captures three dimensions of citizens lack of trust in public institutions. While several researchers analyzed the relationship between political risks and government bond spreads, to the best of our knowledge, there is no previous research in the literature on the importance of political risk along these three dimensions with the help of the dynamic panel threshold using volatility as threshold variable to capture periods of normal and bad economic conditions. In addition, we perform a robustness check using index return rather than volatility as threshold variable. Our main finding suggests that our groups (the initial euro area group, the core euro area group, the peripheral euro area group, and the new euro area group) are more vulnerable to either high volatility or the combination of high political risk and high volatility. This could partly explain the recent surge in long-term government bond yields in some peripheral euro area countries in contrast to countries in the standalone group that did not experience comparable levels of high volatility in stock markets.

The chapter is organized as follows: section 2 explains the data and variables used in this research, section 3 describes the construction of the dynamic panel threshold model and our estimation method, section 4 presents the empirical results for the models, section 5 presents the policy implications of this study, and finally, in section 6 we draw the conclusion.

3.2. Data description and variable construction

This research involves three major types of data: (1) 10-year government bond yields[9]. from the OECD Economic Outlook 96 database, European Central Bank, and Macrobond, (2) political risk indicators from the Eurobarometer database (European commission), and (3) the stock market volatility index collected from the Macrobond database. These data are based on semi-annual dataset ranging from 2000.S2 to 2015.S2 for 27 European countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech republic, Denmark, Estonia, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United kingdom.[10]

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[9] We obtain the 10-year government bond yields for OECD member countries in the OECD Economic Outlook 96 database at the exception of Estonia. The dataset for the remaining non-OECD member countries such as Bulgaria, Croatia, Cyprus, Malta, were obtained from the European Central bank database. Finally, we approximated the Estonian 10-year government bond yield with the projected long-term interest rate on government bonds found in Macrobond.

[10] Specifically, the dataset for a few number of countries were rather limited ranging from 2004.S2-2015.S2. These countries are listed as follow: Bulgaria, Croatia, Cyprus, Czech republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, and Romania.

Table 27. Description of the variables

Variables	Description and source
10-year government bond spread (*sprdde*)	10-year government bond yields measured in per cent per annum with the subtraction of the German government bond rate. We obtained the data from the European Central Bank, OECD Economic Outlook 96 database, and Macrobond.
Political risk (*pol*)	The political risk indicator is constructed as the first principal component of three political risk indicators, namely lack of trust in parliament, lack of trust in government, and lack of trust in political parties. A rise in the indicator denotes an increase in political risk. Its units are in pure number. The lack of public trust in parliament measures the percentage of surveyed citizens who not trust their national parliament to do the right thing for the country. Lack of public trust in government measures the percentage of surveyed citizens who not trust their government to do the right thing for the country or the fact that the government will fail to keep its election promises. Lack of public trust in political parties measures the percentage of surveyed citizens who not trust their political parties since they are not trustworthy and would serve the interest of a few powerful people or their own. These variables are in semi-annual frequency and obtained from the Eurobarometer dataset (European commission).
Volatility index (*vol*)	We compute in percentage, the annualized volatility index using daily stock index historical prices that we multiplied by the square root of number of trading days in a year, that is 252. The annualized volatility in daily frequency is then averaged over six month to obtain semi-annual frequency. Daily data are obtained from the Macrobond dataset. The volatility indices are computed for each country using national stock indexes such as: ATX, BEL20, SOFIX, CROBIS, CYSE 20, PX-GLOB, OMX Tallinn, OMX Copenhagen 20, OMX Helsinki 25, CAC40, ATHEX, BUX, ISEQ Benchmark 20, MIB, OMX Riga, OMX Vilnius, LuxX, MSE, AEX, WIG 20, PSI 20, BET, SAX, SBI TOP, IBEX 35, OMX Stockholm, and FTSE 100.
Global risk aversion (*gra*)	Daily global risk aversion indicator obtained from the ECB Risk Dashboard. It is constructed as the first principal component of five risk aversion indicators, namely Commerzbank Global Risk Perception, UBS FX Risk Index, Westpac's Risk Appetite Index, BoA ML Risk Aversion Indicator, and Credit Suisse Risk Appetite Index. A rise in the indicator denotes an increase in risk aversion. Its units are in pure number.
Consumer confidence indicator (*cci*)	Monthly consumer confidence indicator provides measurement for consumer sentiment and intention. It serves to determine consumer behavior in general and the country's economic condition. The data obtained from the consumer surveys, DG ECFIN are in percentages.

Note: As explained above, we filled missing data points with previous data points.

To determine the threshold values and estimate the impact of political risk variables on bond spreads, we apply the dynamic panel threshold model with balanced panel data[11]. Table 27 shows

[11] To obtain a balance panel, we approximated the missing data points with data points from previous periods for all variables. It is important to have a balanced panel to simplify our regressions and to avoid potential disturbances that could be caused by the missing observations.

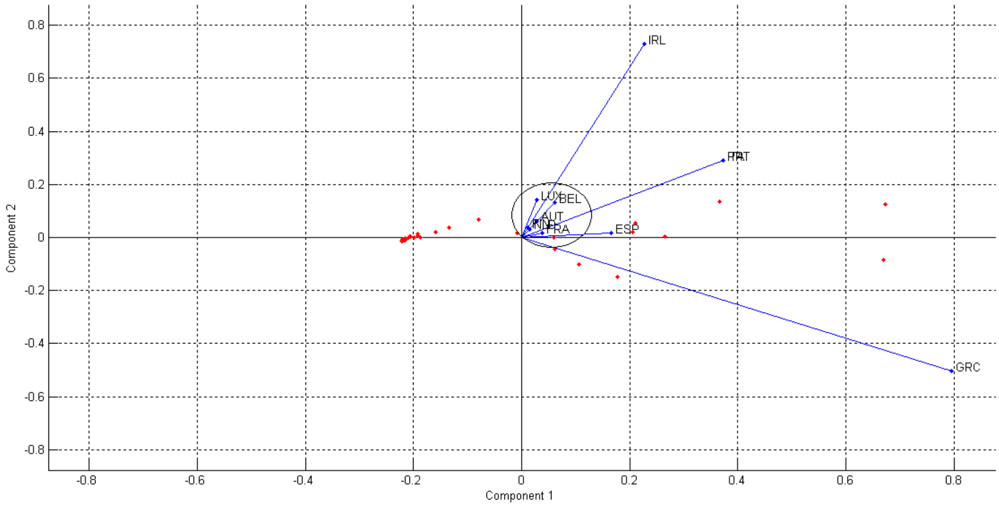
the various variables that are used in our regressions, their definitions and the data source. We obtained monthly 10-year government bond rates from the OECD Economic Outlook 96 database for the various European countries. We further complemented our dataset on 10-year government bond yields with monthly frequency data obtained from European Central Bank database and daily frequency data from Macrobond to cover a large number of countries. Then, using the monthly (or daily) frequency data, we computed the average over six months to obtain semi-annual data. Finally, we subtracted the German government bond rate from the respective European 10-year government bond rates to get the 10-year government bond spreads with semi-annual frequency. The constructed 10-year government bond spreads are denoted (*sprdde*). In this study, we selected the 10-year government bond yields because most European economies are developed economies and tend to have exposure to long-term government bonds to minimize potential issues such as rollover risk. Also, they can borrow at relatively lower costs.

In particular, the political risk variables are constructed using surveys data from the Eurobarometer data that are publicly available on the European Commission's website. The European Commission regularly carries out public opinion in the member states to understand the underlying factors affecting governances in European countries. Using these three variables that measure the lack of trust in public institutions allow us to construct a political risk variable by taking the first principal component. This helps to gain some insights into the political developments that are currently affecting various EU countries.

As already explained in Table 27, using the national volatility indexes of major stock markets helps us to cover a broad range of sectors (e.g. technology, energy, financial, telecommunication, etc.) in the economy since important national companies are listed. Stock market volatility represents a certain measure of risk of the economy. For example, the significant large increases in market volatility observe in the euro area has been concomitant with the financial turmoil and high vulnerability of the euro area economies. We noted that, volatility captures both positive and negative changes in prices. In the construction of the volatility index, positive and negative changes in prices of similar magnitudes are not differentiated. However, positive and negative changes in index prices are differently interpreted by investors. Therefore, we considered the index return as an additional control variable that can differentiate between fall and rise in prices. In addition, we multiplied the index price return by (-1) to fully focus on falling index prices since large fall indicates the overall weakness of the economy.

Our panel groups include countries with similar characteristics in terms of monetary union adhesion or not, or even in terms of the date of their entry in the Eurozone. In the first group, we put together all countries and denoted this group as "*European*". In the second group, we put together countries with independent monetary policies, which have no formal agreement to join the monetary union and denoted this group as "*standalone*". This will allow us to determine the impact of the monetary union when comparing the standalone and euro area groups. In the third group, we put together countries that initially joined the euro area in addition to Greece in 2001 and denoted this group as "*initial EMU*". Also, we put together countries that later joined the euro area and denoted this group as "*new EMU*" since they have been less affected by the monetary union.

Figure 19. Biplot of bond spreads in initial euro area countries



Note: We applied the principal component analysis on the 10-year government bond spreads for the initial euro area countries. The result shows that bond spreads in euro area countries substantially differ and can be grouped into two main groups such as core euro area countries (circle with an elliptic curve) and peripheral euro area countries. We circled together countries that are clustered near each other due to similar amount of variabilities in bond spreads.

To distinguish between countries in the initial EMU group, we applied a principal component analysis on the 10-year government bond spreads relative to Germany. In Figure 19, the biplot represents the bond spreads of initial euro area countries. The biplot reveals how strongly bond spreads in these initial euro area countries are correlated with each other such that they can be grouped together. Also, they provide the amount of variabilities accounted for by the first two principal components. It indicates that the two principal components in euro area countries account for about 98.31% of the total variance, which means the biplot provides a very good approximation. We observed that the 10-year government bond spreads from Austria, Belgium, Finland, France, Luxembourg, and the Netherlands are generally clustered together (grouped as "*core EMU*"). Meanwhile, the countries in this group substantially differ from other countries: Greece, Ireland, Italy, Portugal, and Spain (grouped as "*periphery EMU*").

Table 28. List of countries within each panel group

PANEL GROUPS	LIST OF COUNTRIES	Nr.
EUROPEAN	Austria (AUT), Belgium (BEL), Bulgaria (BGR), Croatia (HRV), Cyprus (CYP), Czech republic (CZE), Estonia (EST), Denmark (DNK), Finland (FIN), France (FRA), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxembourg (LUX), Malta (MLT), the Netherlands (NLD), Poland (POL), Portugal (PRT), Romania (ROM), Slovakia (SVK), Slovenia (SVN), Spain (ESP), Sweden (SWE), United kingdom (GBR)	27
STANDALONE	Bulgaria (BGR), Croatia (HRV), Czech republic (CZE), Denmark (DNK), Hungary (HUN), Poland (POL), Romania (ROM), Sweden (SWE), United kingdom (GBR)	9
INITIAL EMU	Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Greece (GRC)[12], Ireland (IRL), Italy (ITA), Luxembourg (LUX), the Netherlands (NLD), Portugal (PRT), Spain (ESP)	11
CORE EMU	Austria (AUT), Belgium (BEL), Finland (FIN), France (FRA), Luxembourg (LUX), the Netherlands (NLD)	6
PERIPHERY EMU	Greece (GRC), Ireland (IRL), Italy (ITA), Portugal (PRT), Spain (ESP)	5
NEW EMU	Cyprus (CYP), Estonia (EST), Latvia (LVA), Lithuania (LTU), Malta (MLT), Slovakia (SVK), Slovenia (SVN)	7

We summarized the composition of the various panel groups[13] in Table 28 above, these groups will be further referred to in the explanation of our dynamic panel threshold analysis.

[12] We included Greece in the group of initial euro area countries despite joining the Eurozone a year later because we believe that this delay will not significantly affect our results.

[13] The composition of the panel groups are quite robust since we obtained similar results when performing the biplots with respect to 10-year government bond spreads relative to the United States rather than Germany.

In Table 29, we report the Pearson correlation coefficients between the variables. We note that there is a positive correlation between bond spreads and the country-specific political risk. Also, as expected, we observed positive correlations between volatility, bond spread, and political risk. Meanwhile, the negative correlation coefficients between consumer confidence index and the other variables show that as consumers sentiment improves for example because of better economic conditions, this significantly lessens the risk of defaults and political tensions.

Table 29. Correlation coefficients

Variables	SPRDDE	POL	GRA	VOL	CCI
SPREADDE	1.000	0.412	0.087	0.422	-0.666
POL	0.412	1.000	-0.049	0.167	-0.255
GRA	0.087	-0.049	1.000	0.486	-0.172
VOL	0.422	0.167	0.486	1.000	-0.343
CSI	-0.666	-0.255	-0.172	-0.343	1.000

This table presents the Pearson correlation coefficients between the bond spread and the political risk variables. SPRDDE: 10-year government bond spreads relative the German government bond rate, POL: political risk representing the first component of the variables, lack of trust in national parliament, lack of trust in government, and lack of trust in political parties, GRA: global risk aversion, VOL: volatility index, CCI: consumer confidence indicator.

3.3. Empirical approach

Rising political risk in a country can undermine its economic development leading to social, economic, and financial instability. This will have a negative effect on the country's ability to repay its debt leading to the surge in long-term government bond spreads. In this section, we describe our econometric models with the objective to determine the relationship between bond spreads, political risks, and market volatility.

We applied a dynamic panel threshold model to determine the impact of political risk on bond spreads using both ordinary least squares (OLS) and General method of moment (GMM) techniques. This follows-up existing empirical studies that used similar approaches (Hansen (1999), Hansen (2000), Drukker, Pedro et al. (2005), Kremer, Bick et al. (2013), Proaño, Schoder et al. (2014), Vinayagathasan (2013)). In this dynamic threshold approach, we first consider a model with volatility index as threshold variable while political risk is the regime dependent exogenous variable. This model can be written as:

$$\text{sprdde}_{it} = \mu_i + \varphi.z_{it} + \beta_{pol}{}^{L}.\text{pol}_{i,t-1}.\text{I}(\text{vol}_{i,t-1} \leq \gamma_{\text{vol}}) + (\beta_{pol}{}^{H}.\text{pol}_{i,t-1} + \delta^{H}).\text{I}(\text{vol}_{i,t-1} > \gamma_{\text{vol}}) + \varepsilon_{it} \qquad (1)$$

where sprdde$_{it}$ refers to the 10-year government bond spread relative to Germany in year t for country i. μ_i is a country-specific fixed effect, ε_{it} an *i.i.d.* country-specific random disturbance with zero mean and a variance $\sigma_{\varepsilon i}{}^2$, and z_{it} is a vector which could contains endogenous and exogenous explanatory regime-independent variables such as global risk aversion ($GRA_{i,t}$) and consumer confidence indicator ($CCI_{i,t}$). γ_{vol} is the threshold level of the volatility index and is assumed to be exogenous. $I(.)$ is an indicator function which takes on the value of 1 if the condition in its argument holds and otherwise takes on a value of 0. POL$_{i,t}$ is the exogenous political risk variable. δ is the difference between the intercept in low volatility regime (i.e. μ_i), and the intercept in high volatility regime (i.e. $\mu_i + \delta$). $\beta_{pol}{}^{L}$ and $\beta_{pol}{}^{H}$ are coefficients of the political risk variable respectively representing the effects during low and high volatility regimes

We estimated the dynamic panel threshold model following the approach by Caner and Hansen (2004). However, given that the Caner and Hansen (2004) procedure does not apply to panel data, we first had to make their framework suitable enough to deal with the country-specific fixed effects μ_i from the model we used. Thus, country-specific fixed effects μ_i are eliminated from the model to ensure that the regression results are not biased using the transformation method called "forward orthogonal deviation". Arellano and Bover (1995) proposed this transformation which eliminates individual country-specific fixed effects while leaving the lagged dependent endogenous variables as valid instruments. However, we decided not to include the lagged bond spread variable because while its introduction dramatically improves the model fit.

To analyze the impact of political risk on bond spreads in low and high volatility regimes, we applied the methodology suggested by Kremer, Bick et al. (2013) that extends the threshold estimation for the case of panel data and uses forward orthogonal deviations to eliminate individual country-specific fixed effects. This procedure subtracts the average of all future available observations of a variable to eliminates the country-specific fixed effects such that the estimation procedure proposed by Caner and Hansen (2004) can be used without violating the asymptotic of the estimator. The forward orthogonal deviation transformation is applied to all variables with the exception of the threshold variable(s). Thus, for the error term, the forward orthogonal deviations transformation obtained is given by:

$\epsilon^*_{it} = (T-t/T-t+1)^{1/2}[\epsilon_{it}-(1/(T-t))*(\epsilon_{i(t+1)}+\ldots+\epsilon_{iT})]$

and $Var(\varepsilon_{it}) = \sigma^2 I_T$ is not serially correlated and $Var(\epsilon_{it}^*) = \sigma^2 I_{T-1}$ which also has no serial correlation.

Applying the transformation procedure to Eq. (1) leads it to be rewritten as:

$$sprdde^*_{it} = \mu_i + \varphi.z^*_{it} + \beta_{pol}{}^L.pol^*_{i,t-1}.I(vol_{i,t-1} \leq \gamma_{vol}) + (\beta_{pol}{}^H.pol^*_{i,t-1} + \delta^H).I(vol_{i,t-1} > \gamma_{vol}) + \varepsilon^*_{it} \quad (2)$$

where the superscript "*" denotes the data after the transformation.

In addition, we restricted the number of variables to avoid potential overfitting of the endogenous variable that can lead to bias in the estimated coefficients. Also, the low number of observations available in the different states will weaken the robustness of our estimations, particularly after we subdivided the dataset into groups (e.g. core EMU and periphery EMU countries). In order to estimate robust threshold values, we specified that a change of regime in the estimation of the thresholds should exclude the lowest and highest 5% of all the observations. This is to minimize the impact of potential breaks, mostly indicated by sudden shifts or extreme values within the data on the results. However, while the decision to reject the lowest and highest 5% of all the observations during the threshold estimation was quite arbitrary, such a simple rule allowed us to reduce the likelihood that few extreme values or outliers in the dataset would tilt the result toward those extremes when estimating the thresholds. This procedure is also applied in Proaño, Schoder et al. (2014) to minimize the effects of these few extreme values on the results. Therefore, the estimated threshold values would be more robust if we remove few extreme values or outliers when determining the volatility index variable across each panel group.

Similarly, we analyze the non-linear impact of political risk on bond spread using the level of political risk itself as well as on the level of volatility as threshold variables. We want to determine whether the impact of political risk on bond spreads maybe primarily due to a combination of high political risk and high stock market volatility. This model can help us to analyze how the impact of political risk on bond spreads depends on the level of political risk as well as on the level of volatility. In this regression model with two threshold variables, this gives rise to up to four regimes. These four regimes are presented as follows: low political risk and low volatility (LL), high political risk and low volatility (HL), low political risk and high volatility (LH), and high political risk and high volatility (HH).

Thus, we consider the following panel threshold model:

$$\begin{aligned} \text{sprdde}^*_{it} = \mu_i + \varphi.z^*_{it} + \beta_{pol}^{LL}.\text{pol}^*_{i,t-1}\ .I(\text{pol}_{i,t-1} \le \gamma_{pol}, \text{vol}_{i,t-1} \le \gamma_{vol}) + \\ \beta_{pol}^{HL}.\ \text{pol}^*_{i,t-1} + \delta^{HL}).I(\text{pol}_{i,t-1} > \gamma_{pol}, \text{vol}_{i,t-1} \le \gamma_{vol}) + \\ \beta_{pol}^{LH}.\ \text{pol}^*_{i,t-1} + \delta^{LH}).I(\text{pol}_{i,t-1} \le \gamma_{pol}, \text{vol}_{i,t-1} > \gamma_{vol}) + \\ \beta_{pol}^{HH}.\ \text{pol}^*_{i,t-1} + \delta^{HH}).I(\text{pol}_{i,t-1} > \gamma_{pol}, \text{vol}_{i,t-1} > \gamma_{vol}) + \varepsilon^*_{it} \end{aligned} \tag{3}$$

where the variables and parameters are expressed as before.

In addition, to reduce the computational effort for identifying the threshold values, we round the political risk values to full integers and the volatility to one decimal digit for search.

3.4. Estimation results

In the following section, we present the results of the estimation using the dynamic panel threshold method in the following groups of countries: European, Initial EMU, Standalone, Core EMU, Peripheral EMU, and New EMU. First, we analyze how stock market volatility affects the impact of political risk on bond spreads. Then, we analyze how both political risk and stock market volatility affect the impact of political risk on bond spreads.

3.4.1. Volatility as threshold variable

Table 30 presents the estimation results of the regression model described in equation (2) to analyze the impact of political risk on bond spreads using volatility as the threshold variable.

Table 30. Results of the impact of political risk on bond spreads with volatility as threshold

	γ_{vol}	L	H	cci_t	gra_t	β^L_{pol}	β^H_{pol}	δ^H	R_2 R_2 adj
EUROPEAN	30.68 [29.72, 34.81]	622	84	0.0084	0.0441***	0.0447***	0.1319***	1.0205***	34.12 33.73
STANDALONE	6.85 [2.60, 23.36]	26	218	-0.0095	0.0641***	0.0922***	0.0093**	0.3258	37.72 36.64
INITIAL EMU	36.62 [35.28, 36.62]	300	30	-0.0231**	0.0081	0.0371***	0.2014***	1.6410***	48.21 47.55
CORE EMU	13.29 [11.05, 13.29]	45	135	0.0018	0.0093***	0.0049	0.0090***	0.2379***	17.52 15.57
PERIPHERAL EMU	42.09 [39.66, 42.09]	134	16	-0.0444***	0.0243*	0.0459***	0.1999***	1.8458***	55.79 54.53
NEW EMU	26.15 [13.12, 26.27]	130	24	-0.0045	0.0797***	0.0389***	0.1074***	1.0306**	53.68 52.37

Note: estimation of the impact of political risk on bond spreads with volatility index as threshold. SPRDDE: 10-year government bond spreads relative to the German government bond rate, POL: political risk, VOL: volatility index, GRA: global risk aversion, CCI: consumer confidence indicator. ***, **, and * denote the level of significance at 1%, 5%, and 10% level respectively.

In column 2, the volatility thresholds are endogenously estimated, with the 95% confidence interval of the threshold value. Columns 3 and 4 respectively present the number of observations in low and high volatility regimes. At the exception of core euro area group and standalone group, the vast majority of observations lies in the low volatility regime. In addition, all the estimated volatility thresholds are highly significant at 5% level (see Figure 20, Appendix). Furthermore, it is interesting to note that the value of the threshold variable beyond which a regime change occurs is much higher in the European group, the initial EMU group, the peripheral EMU group, and the new EMU group compared to the standalone group and to the core EMU group. Hence, impact of political risk on bond spreads occurs only at extremely high values of stock market volatility in the peripheral EMU group. However, the estimated threshold values are relatively quite low in the standalone group and the core EMU group. It is important to know that comparing the findings in the initial EMU group and in the standalone group may suggest that countries within the euro area are more sensitive to political risk than in the standalone countries during high volatility. However, separating euro area countries into the core EMU group and the peripheral EMU helps us to have more flexible results. The high volatility experienced in the peripheral EMU group compared to the core EMU and standalone groups could be explained by stock markets sudden or dramatic decline in stock indexes over extended periods of times, which starts to highly affect bond spreads.

It is important that each regime has at least 30 observations to obtain robust estimation. However, the number of observations in the high volatility regime are less than 30 for the peripheral EMU and the new EMU groups as well as, in low volatility regime, for the standalone group.

The control variables in columns 5 and 6 respectively present the estimated coefficients for consumer confidence indicator (CCI) and global risk aversion (GRA). The effect of one unit change in consumer confidence on bond spreads is negative and statistically significant for the initial EMU group and the peripheral EMU group. The estimated coefficients are non-significant in the other groups. Also, the effect of one unit change in global risk aversion is positive and mostly significant in all panel groups at the exception of the initial EMU group. These results are as expected since a rise in CCI is associated with normal economic conditions with investors more willing to take risks, which leads to a decrease in bond spreads. Meanwhile, a rise in GRA will lead to an increase in bond spreads to compensate investors for the additional risk exposures.

We are mainly interested in the coefficients of political risk in high and low volatility regimes. In columns 7 and 8, the coefficients of political risk are positive and mostly significant respectively in low and high volatility regimes. Hence, the estimated results obtained suggest that a rise in political risk increases bond spreads in almost all panel groups. Also, the results suggest that the impact of political risk on bond spreads are high during times of high volatility as compared to times of low volatility with the exception of standalone group. In general, the coefficients of political risk in the high volatility regimes are higher than in low volatility regimes in the European group, the initial EMU group, the peripheral EMU group, and the new EMU group. For example, a 1 unit increase in political risk will cause an increase of about 4.59 basis points (bps) during low volatility regime in the peripheral EMU group but a jump of about 19.99 bps during high volatility regime. This suggests that the impact of the political risk is magnified during periods of high volatility compared to periods of low volatility. However, the coefficient of political risk appears to be non-significant during low volatility regime and significant during high volatility regime with an increase of bond spreads to about 0.9bps in response to a 1 unit increase in political risk. The result obtained for the standalone group is slightly unexpected since we would expect the coefficient of political risk to be higher during high volatility compared to low volatility regimes. However, we observed that the estimated volatility threshold in the standalone group at 6.85% is relatively quite low compared to the peripheral EMU group at 42.09%. This suggests that countries in standalone group did not experience extended periods of stock markets decline.

In general, with the exception of the standalone group, the results suggest that political risk has a stronger impact on bond spreads during periods of high volatility in the initial EMU group and in the new EMU group rather than in the standalone group. Also, within the euro area, a rise in political risk that affects bond spreads is primarily observed in the peripheral euro area countries.

Table 31. Results of the impact of political risk on bond spreads with index return as threshold

	γ_{retn}	L	H	cci_t	gra_t	β^L_{pol}	β^H_{pol}	δ^H	R_2 R_2 adj
EUROPEAN	0.09 [0.05, 0.18]	554	152	0.0047	0.0485***	0.0448***	0.0873***	0.5803***	32.74 32.34
STANDALONE	-0.16 [-0.19, -0.06]	25	219	-0.0226**	0.0612***	-0.0019	0.0087**	0.6757***	40.05 39.00
INITIAL EMU	0.06 [0.05, 0.08]	240	90	-0.0424***	-0.0056	0.0311***	0.0871***	1.0298***	45.15 44.45
CORE EMU	0.15 [-0.01, 0.15]	160	20	0.0023	0.0118***	0.0063***	0.0400***	0.2705***	16.42 14.44
PERIPHERAL EMU	0.06 [0.05, 0.07]	103	47	-0.0752***	-0.0197	0.0411***	0.0942***	1.8373***	54.69 53.39
NEW EMU	0.07 [0.00, 0.17]	113	41	-0.0324***	0.0490***	0.0378***	0.0690***	1.0829***	54.46 53.18

Note: estimation of the impact of political risk on bond spreads with index return as threshold. SPRDDE: 10-year government bond spreads relative to the German government bond rate, POL: political risk, RETN: index price return, GRA: global risk aversion, CCI: consumer confidence indicator. ***, **, and * denote the level of significance at 1%, 5%, and 10% level respectively.

Table 31 presents the estimation results of the regression model described in equation (2) using index return as threshold to check the robustness of previously obtained results. In general, the main conclusions are the same regarding the positive and significant coefficients of political risk in both high and low index return regimes. Similarly, all the estimated index return thresholds are highly significant at 5% level (see Figure 21, Appendix). Also, we observed coefficients of political risk that were higher in high index price return[14] regimes compared to low index price return regimes in the European group, the initial EMU group, the core EMU group, the peripheral EMU group, and new the EMU group. It is interesting to note that the index return threshold is negative and mostly indicates a rise in stock prices in the standalone countries. The result shows that political risk is non-significant when low index return regime and positive and significant in high index return regime. The magnitude of the coefficient of political risk in high index return for the standalone group is quite small and may be due to the relatively weak fall in indexes prices.

when3.4.2. Political risk and volatility as threshold variables

Table 32 presents the estimation results of the regression model described in equation (3) to analyze the impact of political risk on bond spreads using political risk and stock market volatility as threshold variables. It is important to note that the results in all panel groups may not be reliable due to a low number of observations in at least one of the four regimes.

The estimated political risk and volatility thresholds are highly significant at 5% level (see Figure 22, Appendix). Figure 22 plots the likelihood ratios for different threshold values of political risk and volatility. The transparent surface in red indicates the critical values for which, a set of combinations of political risk values and volatility values with likelihood ratios below indicates the significance at 95% confidence level. The estimated thresholds are non-significant for the European group while being significant for the remaining panel groups. The lowest number of observations are generally observed in high political risk and low volatility regimes (HL) and in high political risk and high volatility regimes (HH).

As explained previously, the coefficients of consumer confidence and global risk aversion respectively have the expected negative and positive signs and are statistically significant. It is important to note that the coefficients of political risk are positive and mostly significant and generally become more pronounced when we are moving from one of the three regimes to high

[14] It is important to remember that high index price return is equivalent to large fall in index prices since we multiplied the index return by (-1).

political risk and high volatility regime (HH) in all panel groups at the exception of the standalone group. However, it is interesting that the coefficients mostly decrease when we are moving from low volatility to high volatility in the group of standalone countries. This reinforces the previous results that we obtained using the volatility as the only threshold variable. This suggests that the a rise in political risk causes a surge in bond spreads only during crisis times when experiencing both high political risk and high volatility. Looking at the results in the standalone group and in the initial EMU group (or even in the new EMU group) can lead us to conclude that euro area countries are more vulnerable to political risk during crisis times compared to standalone countries. It is interesting to note that while the coefficient of political risk for the core EMU group is non-significant in low political risk and low volatility regime (LL), the impact in other regimes are quite weak compared to the peripheral EMU group. In particular, a 1 unit increase in political risk will cause an increase of about 2.11 bps in high political risk and high volatility regime (HH) for the core EMU group while it will cause a jump from about 4.70 bps during low political and low volatility regime (LL) to about 24.06 bps in high political and high volatility regime (HH) for the peripheral EMU group. Hence, the estimated results obtained suggest that the effects of political risk are more pronounced in the peripheral EMU countries rather than in the core EMU countries in all regimes. We can conclude that peripheral euro area countries mostly suffer from rising political risk at high levels of political risk during periods of high volatility. Similarly, the effects of rising political risk at high levels of political risk during high volatility periods are also present in the new euro area member states at relatively lower magnitudes than in the peripheral euro area countries.

In addition, we performed an additional regression using political risk and return index as threshold variables for robustness check (see Table 33). In general, the results confirm previous main findings and only slightly differ. The estimated political risk and index return thresholds are highly significant at 5% level (see Figure 23, Appendix). The coefficients of political risk are found to be positive and statistically significant for all panel groups with the exception of the standalone group and the core euro area group. Also, the coefficients of political risk variables are generally higher during high index return regime compared to periods of low regime in the following groups: European group, initial euro area group, core EMU group, peripheral EMU group, and new EMU group. However, using the return index threshold rather than the volatility threshold leads us to obtain coefficients of similar magnitude in high political risk and high volatility regimes for the peripheral EMU group and the new EMU group. This suggests that rising political risk beyond certain high levels of political risk during periods of sharp fall in prices is mainly responsible for the surge in bond spreads for peripheral euro area countries and new euro area countries. However, that is not exactly the case in standalone countries and core euro area countries since they experienced relatively modest increases in bond spreads.

Table 32. Results with political risk and volatility as threshold variables.

	γ_{pol}	γ_{vol}	LL	HL	LH	HH	cci_t	gra_t	β^{LL}_{pol}	β^{HL}_{pol}	β^{LH}_{pol}	β^{HH}_{pol}	δ^{HH}	R_2 R_2 adj
EUROPEAN	16	28.8	524	84	75	23	0.0125	0.0616***	0.0306***	0.0698***	0.0400***	0.3756***	-3.9488***	37.71 37.16
STANDALONE	15	7.3	26	1	190	27	-0.0149*	0.0645***	0.0889***	0.0990***	0.0115**	0.0537*	-1.1511*	39.58 37.98
INITIAL EMU	17	30.8	242	41	35	12	-0.0061	0.0224***	0.0272***	0.0596***	0.0237**	0.2548***	1.9089	50.29 49.34
CORE EMU	12	13.3	39	7	116	18	0.0028	0.0173***	0.0026	0.0073*	0.0110***	0.0211*	-0.2507	8.03 4.72
PERIPHERAL EMU	17	34.8	94	33	116	18	-0.0195	0.0372**	0.0470***	0.0568***	0.0430*	0.2406***	1.8295	54.49 52.51
NEW EMU	12	25.8	33	95	6	20	-0.0020	0.0882***	0.0110	0.0652***	0.0514***	0.1255***	0.9070**	55.26 53.34

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in eq.(4) with two endogenous estimated threshold variables such as political risk and volatility index.

Table 33. Results with political risk and index return as threshold variables.

	γ_{pol}	γ_{retn}	LL	HL	LH	HH	cci_t	gra_t	β^{LL}_{pol}	β^{HL}_{pol}	β^{LH}_{pol}	β^{HH}_{pol}	δ^{HH}	R_2 R_2 adj
EUROPEAN	18	0	370	44	255	37	0.0056	0.0616***	0.0303***	0.0669***	0.0345***	0.1325***	0.9078	34.26 33.67
STANDALONE	15	-0.1	56	7	160	21	-0.0239***	0.0655***	0.0045	-0.0139	0.0167***	0.0082	-0.4129	38.87 37.26
INITIAL EMU	16	0.1	209	48	62	11	-0.0333***	0.0104	0.0125*	0.0651***	0.0228**	0.4930***	-7.0036***	44.39 43.32
CORE EMU	-6	0.1	39	112	9	20	0.0041	0.0123***	0.0042*	0.0106***	0.0061	0.0837***	-0.0243	16.28 13.27
PERIPHERAL EMU	26	0.1	86	20	9	20	-0.1025***	-0.0459***	0.0606***	0.0182*	0.0309***	0.2711*	-2.2451	54.29 52.31
NEW EMU	17	-0.1	37	6	91	20	-0.0347***	0.0807***	0.0202*	0.0959***	0.0136*	0.2186***	-3.0189***	53.03 51.02

Notes: Standard errors are in parenthesis. ***, ** and * denote the level of significance at 1%, 5% and 10%, respectively. The interval of feasible threshold values is in brackets. Dynamic panel threshold regression model presented in eq.(4) with two endogenous estimated threshold variables such as political risk and stock index return.

In summary, the regression results obtained using the endogenously estimated thresholds when analyzing the impact of political risk on bond spreads indicate that rising political risk significantly contributed to the rise in bond spreads in all panel groups. However, the effects of rising political risk are stronger when political risk and volatility reach levels beyond certain threshold values in for the following groups: initial EMU group, core EMU group, peripheral EMU group, and new EMU group. However, the impact of political risk on bond spreads differs in the standalone group since rising political risk and volatility beyond certain threshold levels does not necessary imply stronger impact on bond spreads. Based on the results for the standalone group and the initial EMU group (or the new EMU group), our finding also confirms the argument put forward by De Grauwe and Ji (2013) that countries within a monetary union are more sensitive to change in investors' sentiments than countries with independent monetary institutions. However, separating the initial EMU group into the core EMU group and the peripheral EMU group, and then comparing them to the standalone group suggests that this conclusion is not entirely correct. It appears that the effects of rising political risk on bond spreads for high levels of political risk and volatility are comparable in the core EMU group and in the standalone group.

3.5. Political implications

In view of the sensitivity of government bond spreads to political risk during the recent financial and economic crises, this section aims to contribute to the empirical research for policy reform. In this study, we analyzed the impact of political risks in European economies at a regional level (e.g. European, standalone, initial euro area, core initial euro area, peripheral euro area, and new euro area).

One would expect that a country-specific political risk has a positive impact on bond spreads particularly during crisis times with highly volatile stock markets. A rising political risk during bad economic conditions places the government under growing pressure to revive the economy and increases the likelihood of government changes. As a result, the fear to impose deeply unpopular measures can lead to failure in implementing major policies and cause even greater political uncertainty over time. For example, we argued that the surged in bond spreads experienced by some countries in the peripheral euro area group and in the new euro area group were mostly caused by the high levels of volatility and political risk observed in those countries compared to standalone countries and core euro area countries, which generally present relatively low levels of volatility even though they may have comparable levels of political risk. This shows that the combination of high volatility and high political risk causes the highest impact. The positive and strong links between bond spreads and political risks during highly volatile financial markets in peripheral euro area countries and new euro area countries highlight the need to achieve better accountability, develop strong government institutions free from political interferences, and to implement policy measures that ensure the stability of the financial systems such as the Banking Union, the European Deposit Guarantee Schemes, and the European Stability Mechanism. Therefore, it is crucial to prevent the surge of volatility in stock markets to crisis levels to avoid such severe economic consequences with depositors making panic withdrawals from their bank and healthy companies been unable to access credits to fund profitable projects. In addition, the low impact of political risk on bond spreads in core euro area countries and standalone countries when political risk and volatility have increased beyond certain thresholds underscores the resilience of their financial markets. The estimated volatility of stock markets is smaller for the core euro area group and the standalone group, which indicate that these two groups did not experience similar high levels of stock markets volatility as in the peripheral euro area group and the new euro area group despite having similar levels of political risk thresholds.

3.6. Concluding remarks

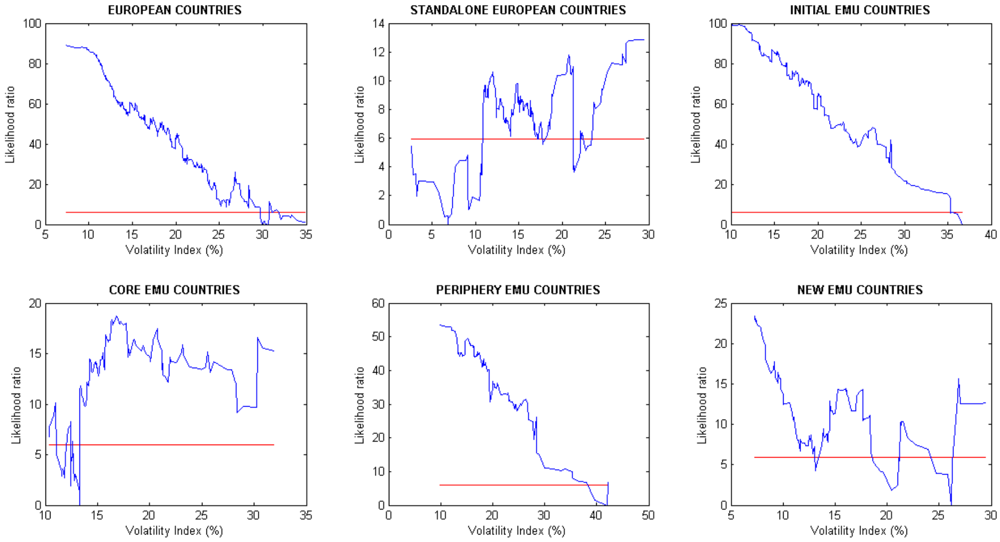
In this study, our primary objective was to determine how the effects of political risk affect 10-year government bond spreads relative to Germany. (De Grauwe and Ji (2013)) have argued that countries within the euro area are more sensitive to investors' change in perceptions than countries with independent monetary policies. We have argued empirically that the answer depends on the level of political risk and the level of stock market volatility. We found that while the levels of political risk thresholds are almost the same in the various groups, the levels of volatility thresholds are relatively low in the core euro area group and the standalone group compared to the peripheral euro area group and the new euro area group. This indicates that the volatility of stock markets due to rising financial uncertainty when political risks are high may affect the relationship between political risk and bond spreads.

Using the dynamic panel threshold analysis, we investigated the non-linearities in the relationship between political risk, bond spreads, and stock market volatility. We showed the destabilizing effects that the combination of rising political risk and volatility can have on the impact of political risk on bond spreads over time. Also, we showed that putting in place measures that ensure the reduction in the high volatility of stock markets can significantly decrease the impact of political risk on bond spreads in affected euro area countries. To sum up, we found evidence for a robust and significant volatility threshold beyond which a rise in political risk increases bond spreads. Hence, stock market volatility is an important source of non-linearity between political risk and bond spreads since they capture periods of financial and economic crises. Furthermore, rising political risk does not seem to cause an extreme increase in bond spreads when stock market volatility is low. In contrast, the rise in volatility beyond certain threshold levels may cause the impact of political risk on bond spreads to rise significantly regardless of the levels of political risk. In addition, it seems that the combination of high levels of political risk and volatility such as experienced during crisis times in peripheral euro area countries may imply that there are crashes in stock markets, which magnified the sensibility of investors to political risk. Thus, an increase in political risk leads to the surge in bond spread. Finally, the rise in political risk during periods of bad financial and economic conditions that caused the volatility to sour in peripheral euro area countries and new euro area countries have mainly been the sources of concerns. Also, contractionary fiscal policy added to the weak states of financial institutions which account for a large portion of growth in peripheral euro area and new euro area countries further fuels the volatility of the various European stock markets.

In addition, through this approach, we identified a set of political factors which would be beneficial for policymakers to focus on, during these bad economic periods' characterized by weak growth and persistent high volatility. The potential consequences of the rising political risks and high volatility in some European countries could be linked to the rise in factors such as: protests over labor conditions, fragmented and polarized debates between political parties on major issues, and popular dissatisfactions in politicians at making good of campaign promises. Additional research might be interesting to determine the impact of these political risks on bond spreads in some other regions as in Americas and Asia to compared them with Europe.

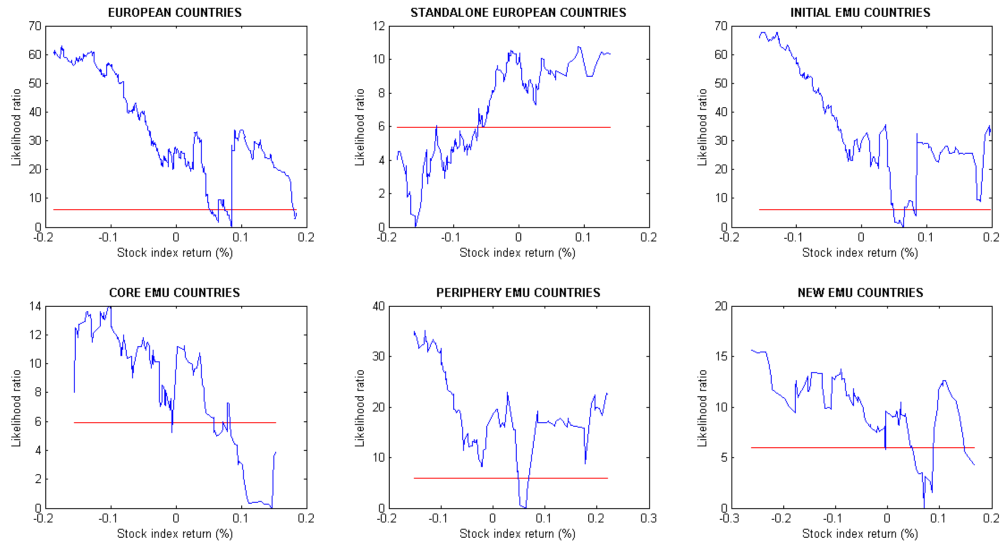
3.7 Appendix

Figure 20. The likelihood ratio of volatility threshold and political risk.



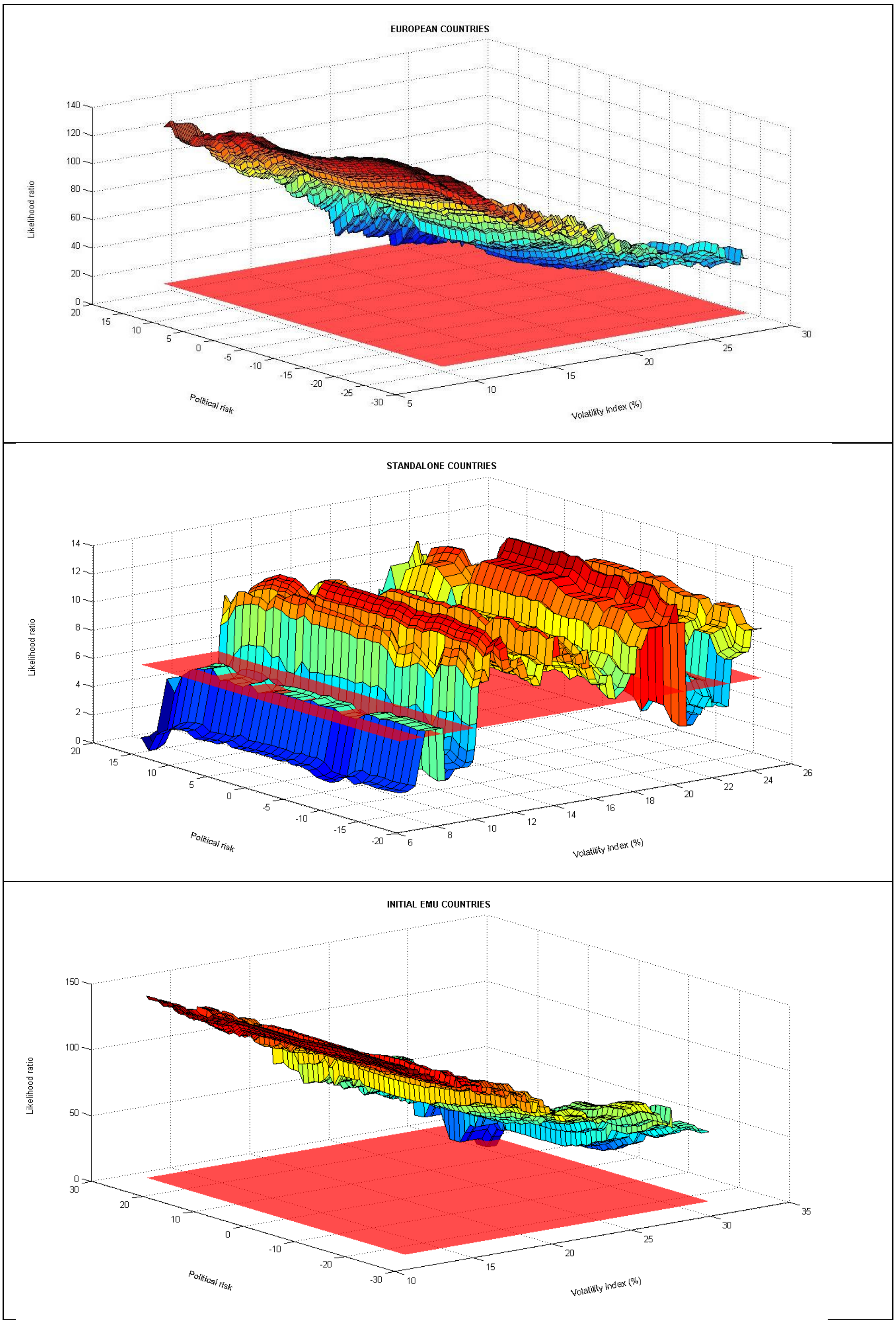
Note: The likelihood ratio is indicated in blue line and the red line represents the 5% confidence level. It shows that the estimated volatility thresholds are significant at 5% level in all panel groups given that the blue line cross the red line at least once.

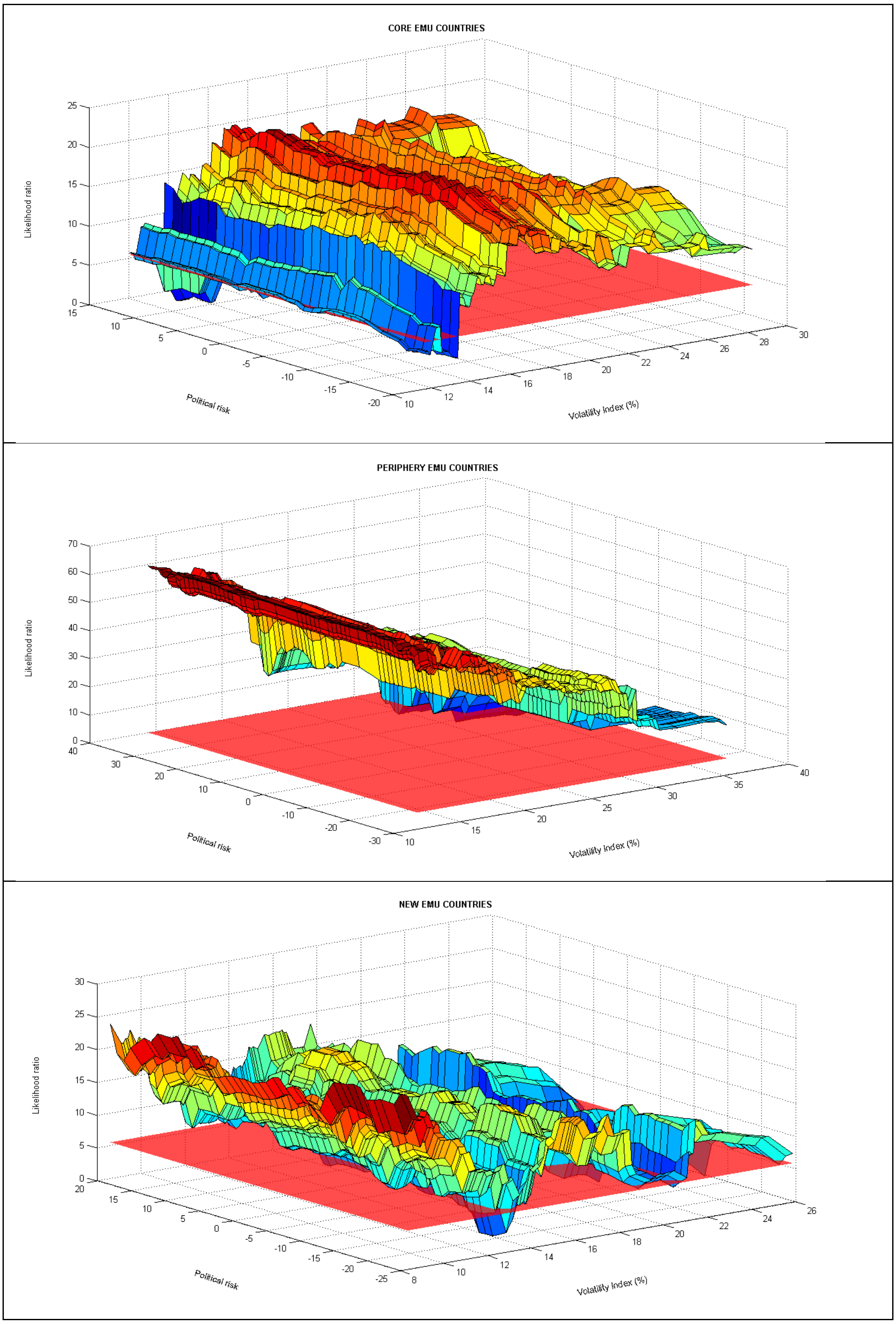
Figure 21. The likelihood ratio of index return threshold and political risk.



Note: The likelihood ratio is indicated in blue line and the red line represents the 5% confidence level. It shows that the estimated volatility thresholds are significant at 5% level in all panel groups given that the blue line cross the red line at least once.

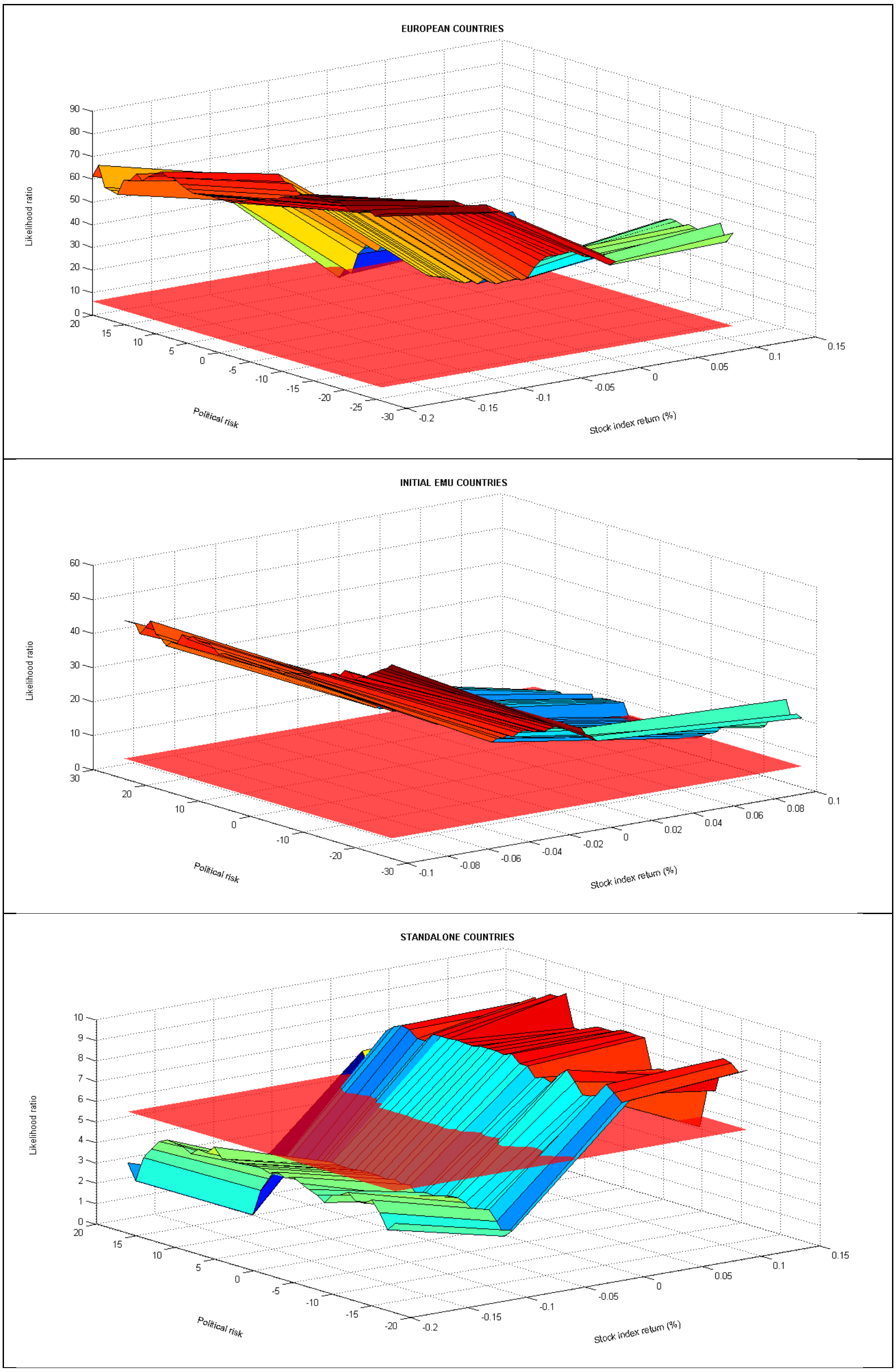
Figure 22. The likelihood ratio of volatility threshold and political risk.

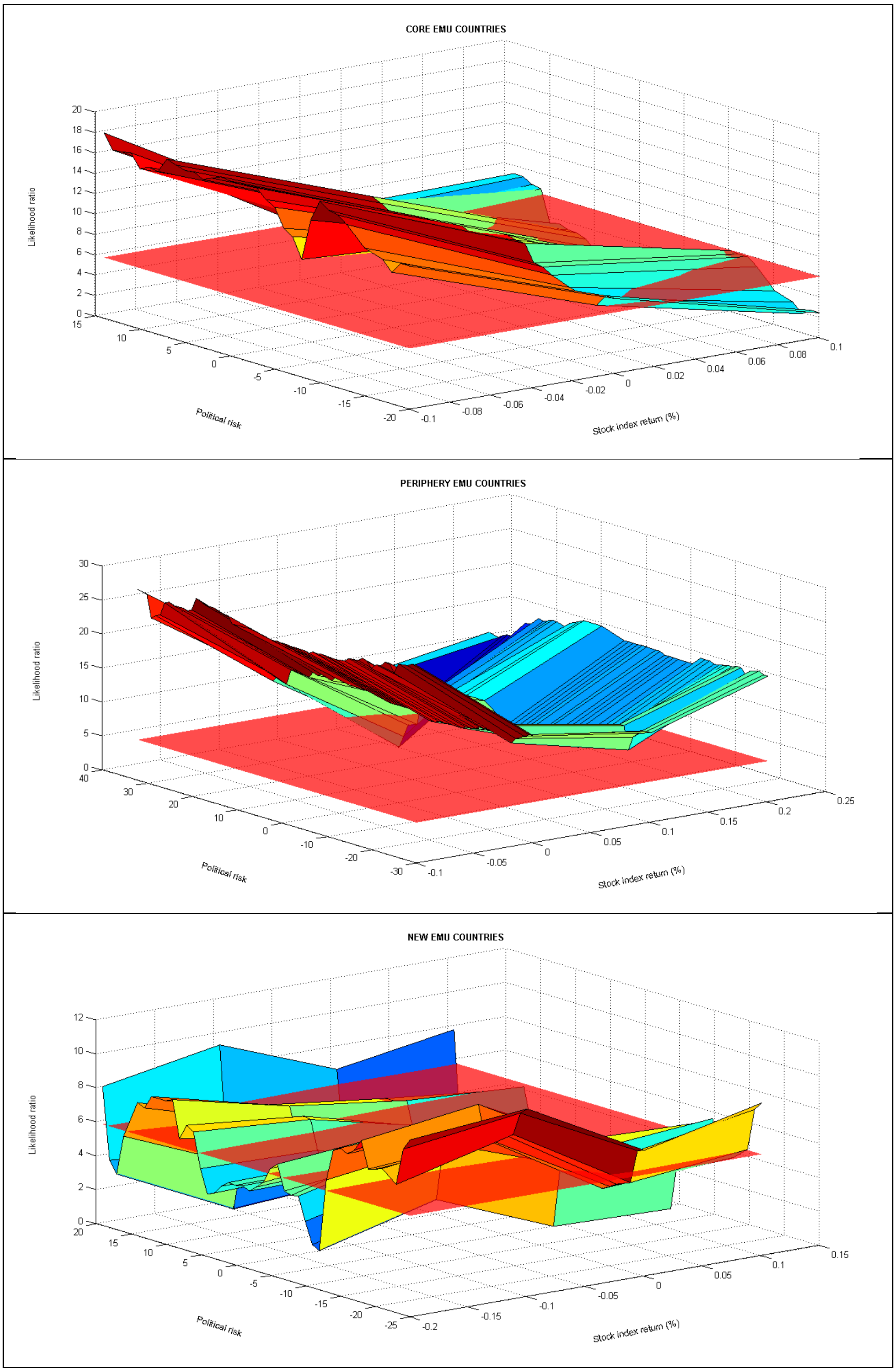




Note: The likelihood ratio is indicated in multi-color 3D surface and the red surface represents the 5% confidence level. It shows that the estimated volatility thresholds are significant at 5% level in all panel groups given that the multi-color 3D surface cross the red surface at least once.

Figure 23. The likelihood ratio of index return threshold and political risk.





Note: The likelihood ratio is indicated in multi-color 3D surface and the red surface represents the 5% confidence level. It shows that the estimated index return thresholds are significant at 5% level in all panel groups given that the multi-color 3D surface cross the red surface at least once.

CONCLUSION

In this dissertation, we investigated the potential contributions of fiscal, financial, and political risks in the rise in bond spreads in European economies. This dissertation provides an empirical research dealing with the European crisis. As explained in the introduction, we provided a general description of the various fundamental causes that can explain the sudden rise in bond spreads in European countries following the global crisis. We mostly expressed the importance of prior deteriorations of various macroeconomic fundaments beside fiscal variables that left these countries quite vulnerable. Thus, we argued in the following chapters that the sudden surge in bond spreads could be due to non-linear factors. The dissertation has been articulated in three chapters.

Chapter 1 tackled the non-linear impact that government debt ratios can have on bond spreads during normal and bad economic conditions. The motivation for this analysis came from the fact that current literature assessing the role of government debt ratios on bond spreads captures the periods of crisis by defining a dummy that takes the value of 1 after the global financial crisis in 2008 and 0 otherwise. However, we advocated using the real GDP growth rate to define periods of normal and bad economic conditions. We defined a framework that captures economic stress when real GDP growth rates fall below the average of real GDP growth rate before 2008. We further test the dummy using the entire sample period. This simple approach allowed us to distinguish between countries that have been severely affected by the global financial crisis with the subsequent European sovereign debt crisis, and countries that were just mildly affected. Also, it allowed us to separate the impact of government debts when these countries are experiencing normal and bad economic conditions. The results of the fixed effect panel regression demonstrated that the non-linear effects of public debts can exhibit magnifying effects that can help to explain the surge in bond spreads.

Chapter 2 attempted to highlight that government debt ratio and/or volatility index beyond certain thresholds can cause government debt to significantly contributes to the rise in bond spreads. Using a dynamic panel threshold technique, we performed three different threshold analyses to better capture different sets of conditions. In the first model, we considered the condition when government debt ratios are above the endogenously determined government debt thresholds. This view followed those who advocate for austerity measures since rising government indebtedness is said to be the prime responsible for increasing bond spreads. In the second model, we considered the condition when the impact of government debt ratios on bond spreads depends on an endogenously computed volatility threshold. This mostly followed the view of those who advocate for government interventions and help to stabilize the financial system through bailout operations. In this approach, the positive and significant impact of government debt ratios on bond spreads were mostly caused by the instability of financial markets and negative consequences on the real economy. Taking measures to mitigate for example the instability of financial institutions would inevitably cause the bond spreads to reduce. In the third model, we considered a combination of the two above models. In this approach, we considered government debt and volatility as threshold variables leading to four regimes (LL, HL, LH, HH). Our results suggested that both threshold variables may cause government debt to play an important role in the rise in bond spreads. However, the negative and significant coefficients obtained particularly in HH (High government debt, High volatility) regime indicate that these results deserve further research. Hence, we decided to consider the impact of political variables.

The last chapter adds to the literature that assesses the impact of political risks based on the levels of political risk and stock market volatility. The vulnerability of peripheral euro area economies and new euro area economies to political backlash during difficult financial markets conditions and economic recessions compared to core euro area economies and standalone economies underscores the importance of a stable financial system. In this chapter, we identified three country-specific political variables (lack of public trust in national parliament, in government, and in political parties) and identified the first principal component as political risk indicator. We applied the dynamic panel threshold method to analyze how the impact of political risk affects bond spreads for various European panel groups. The results obtained indicated that the effects of political risk on bond spreads are positive and significant in almost all regimes for the various groups. In addition, we found that the combination of rising political risk and volatility beyond certain threshold levels are mostly to blame for the surge in bond spreads in peripheral euro area countries and new euro area countries. However, the low volatility thresholds in core euro area countries and standalone countries as compared to peripheral euro area countries are responsible for the small effects of political risk on bond spreads. Hence, the level of volatility seems to be the determining factor when comparing the impact of rising political risk on bond spreads for the initial euro area group and the standalone group given that both groups have high level of political risk.

Overall, this dissertation thesis has demonstrated the importance of considering the non-linearities in the relationships between fiscal, financial, political risk variables to better understand the rising and/or sudden surge of bond spreads in various European countries.

Further research

The subjects treated in the three chapters offer the possibility of expanding the research areas. Given that my research project should focus on the euro area, it would be interesting to further validate our results by exploring the impact of other economic unions around the world such as the North American Union (NAU) with Canada, Mexico, and the United States; the Economic and Monetary Community of Central Africa (CEMAC) with Cameroun, Central African Republic, Chad, Republic of Congo, Equatorial Guinea, and Gabon during high market volatility conditions. In addition, it could be interesting to explore other variables that can be used as thresholds to fully investigate crisis times. Also, it would be interesting to construct a continuous-time Markov process rather than the current discrete-time Markov process to be able to capture the various stages when moving from normal times to crisis times and vice versa.

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