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Sovereign Risk Premia, the EU, and Currency Mismatches

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# Abstract (EN)

This research utilizes Afonso et al. (2012) 2SLS-FE estimators to uncover the impact of EU, ERM, and EMU membership on sovereign bond yield spreads. It does this for a sample of 25 EU countries, in a period from 1999 to 2022. The research further disentangles two potential channels through which these effects function and assesses them: the signaling channel and the currency mismatch channel. The research finds that EU membership is associated with higher spreads, whilst ERM and EMU membership are associated with lower spreads. Additionally, it is found that the currency mismatch channel has a limited role to play, and that there must be an additional channel outside of the signaling channel through which the effects come about. The region of Central and Eastern Europe is found to behave similarly to other European countries.



# Zusammenfassung (DE)

Diese Masterarbeit nutzt die Afonso et al. (2012) 2SLS-FE estimators, um die Effekten der EU, ERM, und EMU Mitgliedschaft auf die Renditeabstand bei staatlichen Anleihen aufzudecken. Dies erfolgt für ein Sample von 25 EU-Ländern im Zeitraum von 1999 bis 2022. Die Forschung differenziert weiter zwischen zwei potenziellen Kanälen, durch die diese Effekte wirken, und bewertet diese: den Signaling Channel und den Currency Mismatch Channel. Die Untersuchung ergibt, dass die EU-Mitgliedschaft mit einem höheren Renditeabstand verbunden ist, und die ERM- und EMU-Mitgliedschaft mit niedrigeren Renditeabstand assoziiert sind. Darüber hinaus wird festgestellt, dass der Currency Mismatch Channel eine begrenzte Rolle spielt und dass es einen zusätzlichen Kanal außerhalb des Signaling Channels geben muss, durch den die Effekte entstehen. Die Region Mittel- und Osteuropa verhält sich dabei ähnlich wie andere europäische Länder.

# Contents

# 1 Introduction

Since the 1950s, European economic integration has been a continuous and ongoing process. The European Union was officially formed in 1993, with the stipulated goal of overseeing a further economic and social integration of the continent. To this end, a common currency area, the European Monetary Union, was realized in 1999. The common market was theorized to increase the economic power of all members through the process of integration. Thirty years after the formation of the European project, however, the economic implications of joining the European Union and introducing the euro remain ambiguous[1].

The economic downsides of integration were clearly shown during the global financial crisis of 2008-2009, and the following sovereign debt crisis. During these crises EU integration came under mounting pressure, as the sovereign bond yield spreads of the EMU-periphery soared. This increase in bond yields included a premium, specific to Southern Europe and Ireland (Cuaresma & Fernández, 2024). The necessitated increase in risk premia paid by the countries of Southern Europe hampered the ability for the governments of these countries to raise funds to provide fiscal stimulus. In other words, the astronomic sovereign bond yield spreads posed a real risk for long-term economic growth.

As high sovereign bond yield spreads threaten long-term economic growth, much empirical research has been conducted to establish the determinants of sovereign bond yields. Sovereign bond yields are the price governments pay for accruing debt. As they are formed in the market, they are influenced by a variety of determinants. These determinants can be broadly categorized as **(i)** macroeconomic fundamentals, **(ii)** institutional qualities, and **(iii)** global factors. As it pertains to EU integration, it may itself be a determinant of sovereign borrowing costs. Markets react to changes within the economic landscape of a country, and it would logically follow that bond markets react to entrance to the European Union, the European Exchange Rate Mechanism (ERM), and the European Monetary Union (EMU). The hypothesized sign of these stages of European integration seems clear: European integration boosts investor confidence through signaling more sound economic policy in the future. Through this signaling of good future economic policy, it lowers the bond yields. Nevertheless, this view ignores the larger implications these three different stages have on the economic climate within the country. One such implication is the increase in foreign-currency denominated government debt, namely debt denominated in euros, for countries joining the EU but not the EMU[2]. This would increase the risk of a *currency mismatch*, which should increase the risk of default and thus the risk premium paid on government bonds.

In this thesis I investigate the effect that European integration has on sovereign risk premia. More specifically, this thesis seeks to establish the effect that membership in the EU, ERM, and EMU has on sovereign bond yield spreads. Whilst the effects themselves are important, it is also paramount that the channels through which the effects work is investigated. The findings regarding the channels may lend itself to certain policy

[1] Badinger (2005) and Lejour et al. (2001) are examples of papers that find clear economic gains from EU integration. Andersen et al. (2019) show that the economic gains may be more ambiguous.
[2] See Rosenberg & Tirpák (2008) and Brkić (2021).

implications to ensure low sovereign spreads during further European integration. The channels that are investigated are the *signaling channel* and the *currency mismatch channel*. To uncover the relative size and importance of the channels, two specifications are used. A country fixed-effect 2SLS, and a two way fixed-effect 2SLS specification are used to investigate the impact of European integration on sovereign borrowing costs. Both of these specifications will include interaction variables that showcase the importance of the *currency mismatch* channel in explaining sovereign spreads. Both specifications employ a large amount of control variables as established in the literature, and dummies indicating membership in the three different EU institutions outlined above. The estimation procedure is a Two-Step Least Squares method akin to Afonso et al. (2012). This estimation method utilizes the first three lags of the independent variables, and the second and third lags of the dependent variable as instruments. This estimation method is chosen specifically to counteract the inherent endogeneity present within the analysis.

A panel including twenty five present-day EU countries is used with data spanning from the last quarter of 1999 until the last quarter of 2022. Annual data is converted into quarterly data using linear interpolation, and monthly data is converted to quarterly.
The main findings of the empirical research show that: **(i)** EU membership is associated with higher long-term sovereign bond yield spreads outside of the currency mismatch channel. **(ii)** The currency mismatch channel is limited in strength, and the share of foreign currency-denominated debt is largely irrelevant in explaining spreads in the sample overall. **(iii)** ERM and EMU membership is associated with lower long-term sovereign bond yield spreads. **(iv)** There must be a channel outside of the signaling channel through which these results come about.

The thesis is structured in the following way. Section two will give an overview of the empirical literature of sovereign borrowing costs determinants and currency mismatches. Through this, it will establish the methodology and the variables commonly used within the literature to assess determinants of sovereign borrowing costs. Section three provides a theoretical discussion of the variables used within the analysis. It provides a theoretical background for their importance in explaining borrowing costs, and their hypothesized coefficient sign. Section four provides a more detailed overview of the dataset, the variables, and the methodology that will be used for the analysis. In section five diagnostic tests are run, and the results are shown and interpreted. Additionally, robustness checks will be done to ensure the validity of the results. Section six briefly summarizes the research, whereafter limitations are discussed and potential avenues for further research are explored.

# 2 Literature Review

Existing empirical studies that attempt to investigate the different determinants surrounding sovereign borrowing costs must first define what sovereign borrowing costs are. Most of the literature uses one of two variables to measure it. The first of these definitions is the most common one, namely *Sovereign Bond Yield Spreads* (Capelle-Blancard et al., 2019; Crifo et al., 2017; Gray, 2009; Afonso et al., 2012). This measure is related to the second variable that is commonly used, namely *Sovereign Bond Yields*[3]. Sovereign bond yields are defined as the annual yield to maturity on government bonds. In essence, it is the cost that governments pay on accruing debt. Bond yield spreads, then, are this yield minus a risk-free benchmark yield of the same maturity. As Cady & Pellechio (2006) stated, the spread specification is nested within the yield specification. The spread specification merely constraints the estimate of the yield specification to unity. The main advantage of using spreads over yields, then, is that the bond yield is being compared to a risk-free benchmark, allowing for a more accurate estimation of the coefficient by controlling for global yield trends.

As it pertains to the independent variables, the determinants can be broadly categorized into three sub-divisions. These are **(i)** Macroeconomic Fundamentals, **(ii)** Institutional Qualities, and **(iii)** Global Factors. Macroeconomic fundamentals include all economic indicators that are used to assess a sovereign's creditworthiness. Common variables used within this sub-division are: *GDP Growth* (Cuaresma et al., 2024; Beirne et al., 2021), a measure of *Inflation* (Thornton & Vasilakis, 2020; Constantini et al., 2014; Oliveira et al., 2012), the *Primary Balance* (Beirne et al., 2021; Crifo et al., 2017; Cady & Pellechio, 2006), the *Current Account* (Cuaresma et al., 2024; Capelle-Blancard et al., 2019), a *Reserves to Imports Ratio* (Pineau et al., 2022; Presbitero et al., 2015), and *Government Debt to GDP* (Poghosyan, 2014; Afonso et al., 2012). Furthermore, *Sovereign Credit Ratings* are an important driver of bond spreads (Capelle-Blancard et al., 2019; Afonso et al., 2012; Eichengreen & Mody, 1998), with some evidence that they may function as a replacement for other macroeconomic indicators (Cady & Pellechio, 2006). An additional variable used is the *Real Effective Exchange Rate* (Afonso et al., 2012; Arghyrou & Kontonikas, 2012) to account for competitiveness differences between countries.

Regarding variables related to institutional qualities, a variety of measures are used. A strain of the literature has been interested in the effect of *Environmental, Social, and Governance* variables on sovereign borrowing costs[4]. In particular, they have found that governance variables are of importance when assessing drivers of sovereign risk (Capelle-Blancard et al., 2019). Other branches of the literature have investigated how the participation in international organizations and their programs affects bond spreads. Gehring and Lang (2020) find that joining IMF programs leads to a restoration of creditworthiness due to giving off a positive signal to financial markets. Gray (2009) finds that EU negotiations, accession, and membership lower bond spreads. Cady & Pellechio (2006) find that

[3] See Berine et al. (2021), Gevorkyan & Kvangraven (2016), Poghosyan (2014), Cady & Pellechio (2006) for papers utilizing sovereign bond yields.
[4] See Capelle-Blancard et al. (2019) and Crifo et al. (2017) for examples.

participating in one of the IMF-supported programs reduces launch yields upon arrival. Tebaldi et al. (2018) conclude that the *Polity IV*[5] score has a significant impact on sovereign spreads.

In addition to macroeconomic conditions and institutional qualities, most of the literature is in agreement that global factors influence the sovereign risk premium. Barrios et al. (2009) finds that sovereign spreads in the EU are impacted by the conditions in global financial markets. The findings of Hartelius et al. (2008) indicate that global factors are important when assessing sovereign spreads, specifically global volatility. The literature often resorts to using the *VIX index* by the Chicago Board Options Exchange as a measure of this global volatility (Silvapulle et al., 2016; Afonso et al., 2012; Jubinski & Lipton, 2012; Hilscher & Nosbusch, 2010), and generally finds a significant positive correlation between it and sovereign spreads.

Concerning methodology, the literature on sovereign borrowing cost determinants can be broadly subdivided into two strands (Poghosyan, 2014): single-country studies and panel data studies. As this thesis concerns panel data, it is essential to establish the methodology used within this strand of the literature. Gray (2009) uses two methods, Prais-Winsten transformations and a fixed-effects model, to control for the inherent serial correlation when including lagged dependent variables as an independent variable. Capelle-Blancard et al. (2019) use a more sophisticated method to control for this by using Kiviet's (1995) fixed-effects estimator that is corrected for serial correlation when including the lagged dependent variable as a regressor. To this same end, Tebaldi et al. (2018) use a GMM estimator that is consistent and efficient under endogeneity with a smaller time dimension than country dimension. Another approach is offered by Afonso et al. (2012). They control for endogeneity through a 2SLS-FE method, where the lags of the independent variables and the dependent variable are used as instruments.

Having established variables and some methodologies that are used within the empirical literature on sovereign borrowing costs, it remains paramount to investigate the evidence that is found for the effect of foreign currency-denominated debt on sovereign risk. Additionally, empirical evidence for the existence of this phenomenon in the EU must be further investigated.

Bernoth & Herwatz (2021) find that the impact of FX rate movements on sovereign risk is non-negligible using SVAR models. Furthermore, they find that the direction and size of this impact depends on the economy's net foreign currency exposure. They find that for sovereigns with a large negative foreign currency exposure, a depreciation of the currency against the USD increases sovereign risk. This finding is in line with the predictions of Krugman's (1999) theoretical model that indicates that debt denominated in foreign currencies can be an economic vulnerability due to the risk they pose when the domestic currency depreciates. This increased cost of depreciation may increase the risk of financial crises, and hence the sovereign risk premia. Prat (2007) finds that currency mismatches significantly raise the default risk perception, which should translate to the sovereign risk premia.

[5] Polity IV has since been updated to Polity V, but the underlying measure remains similar.

Evidence has been found in the literature for an increase in the euroization of debt following EU membership. Rosenberg and Tirpák (2008) find that EU membership boosts foreign currency borrowing through three indirect channels: **(i)** increased access to foreign funding, **(ii)** increased hedging opportunities due to trade openness, and **(iii)** a lower expected probability of devaluation of the currency for lenders. Brkić (2021) shows that the currency composition of government debt in non-euro EU countries is heterogeneous across member-states, though a substantial part remains denominated in foreign currency in Central and Eastern European countries. Additionally, the paper finds that this does not constitute a risk for all countries, as their exchange rate is held stable.

The literature provides ample takeaways that are vital to this research. First, sovereign bond yield spreads appear to be the best measure to use when assessing sovereign borrowing costs. It is thus vital to use this measure when conducting this research. Second, the variables used within the model must cover the three dimensions of determinants of spreads. These are macroeconomic fundamentals, institutional quality, and global factors. Third, as this research will be conducted using panel data with macroeconomic variables, it is pivotal to assess problems of endogeneity and serial correlation. A variety of methods are used within the literature, and as stated by Gray (2009) no method is without its drawbacks. It is thus of utmost importance that the findings generated by this research pass strict robustness checks. Fourth, there appears to be merit to the theory that an increase in foreign currency-denominated debt has a positive effect on sovereign risk premia. Fifth, foreign currency-denominated debt has been found to increase as a result of joining the European Union but not the European Monetary Union. Sixth, this increase in foreign currency-denominated debt appears to be heterogeneous across the EU. This increase appears to be most substantial in Central and Eastern European countries. Lastly, previous empirical findings suggest that joining international organizations, such as the EU, gives off a signaling effect that decreases sovereign risk premia.

This research, then, aims to contribute to the existing literature in a number of ways, keeping in mind the takeaways mentioned above. The main contribution of this research is the disentanglement of the effect that EU membership has on sovereign spreads. EU membership is hypothesized to influence borrowing costs through two main channels: the *signaling channel* and the *currency mismatch channel*. These channels work in counteracting ways. Namely, the effect that operates through the *signaling channel* is theorized to have a negative effect on sovereign spreads. EU membership signals sound future economic policy, and through this, negatively affects sovereign spreads. The effect through the *currency mismatch channel*, on the other hand, is theorized to positively impact sovereign borrowing costs. As a country becomes a member of the EU, and not the ERM and EMU, it is theorized to increase the foreign currency-denominated share of general government debt which increases default risk and thus increases borrowing costs. By analyzing the effect that EU membership has on sovereign spreads, this thesis aims to uncover whether membership in the EU may pose a risk for sustained economic growth. Namely, if EU membership without ERM and EMU membership increases sovereign spreads, this may hamper the economic gains associated with joining the EU. Furthermore, through disentangling this effect into these two channels, this thesis seeks to uncover the mechanisms behind the effect that is found in order to provide policy-makers with concrete policy goals to further increase the

economic gains associated with EU membership. On top of this, this thesis also aims to touch on the heterogeneous nature in which EU membership affects sovereign borrowing costs. Specifically, it contributes to the literature by analyzing the effects for the regions of Central and Eastern Europe separately. This appears especially pertinent as these are the EU countries that may be most likely to struggle with financing government expenditures with increased borrowing costs.

# 3 Theoretical Background

Having provided an overview of the literature, it remains vital that the theoretical mechanism behind the variables and their impact on borrowing costs is investigated. Through this, the hypothesized coefficient sign of these variables can be determined.

Barrios et al. (2009) state that there are three main types of determinants that may influence borrowing cost differentials in the eurozone: **(i)** credit risk, **(ii)** liquidity risk, and **(iii)** risk aversion. They define credit risk as consisting of default risk, credit spread risk, and downgrade risk. The default risk refers to the probability that the issuer of the bond defaults, and many of the macroeconomic fundamentals fall within this category. The credit spread risk consists of all risk based on the probability that the market value of the bond declines more than that of other sovereign bonds. The downgrade risk refers to the risk associated with a downgrade by one of the three main credit rating agencies (Fabozzi, 2007). Liquidity risk refers to the market depth and breadth. In essence, it captures the risk associated with the amount of bonds in the market, and how this affects the bond's price performance. Risk aversion captures global perceptions of risk, also known as global risk-on and risk-off modes.

Utilizing this framework, it is possible to explain the mechanisms through which the variables included in the analysis would influence sovereign borrowing costs. In the next subsection, this thesis will go over the different variables used in the research and discuss why and how they are theorized to impact sovereign borrowing costs. It will do this by first discussing the variables of interest, whereafter all the variables used in the analysis are covered.

## 3.1 Variables of Interest

The variables of interest are the dummy variables indicating membership of the EU, ERM, and EMU respectively. These variables are hypothesized to influence sovereign borrowing costs through two main channels: **(i)** the signaling channel, and **(ii)** the currency mismatch channel.

The signaling channel is hypothesized to work as follows: joining EU institutions indicates a certain commitment towards sound economic policy. This commitment in turn influences the beliefs of investors by signaling that the government will make good policy decisions. This is hypothesized to decrease the credit risk. The credit risk is determined for large part by the macroeconomic policies pursued by the government[6]. Essentially, the membership of the EU, ERM, and EMU signals that sovereigns will not pursue economic policy that may hamper the future ability to repay debt. This changes the expectations of investors, and thus lowers the risk associated with their government bonds. This signaling effect of joining the aforementioned EU institutions should thus lower the sovereign bond yield spreads. Nevertheless, the size of the effects is hypothesized to differ between these institutions. The EU provides a signal of good economic policy. However, the ERM and EMU should have a larger effect. Participation in the ERM and EMU necessitates prudent

[6] I.e., that the Government Debt to GDP will not increase above sustainable levels.

budgetary and structural policies, due to the inherent inability to devalue the currency. The ERM and the EMU function in very much the same way, as the ERM ensures a stable exchange rate of the national currency to the euro (European Commission, n.d.). Sound economic policy is thus even more necessitated, in line with the Maastricht convergence criteria set out by the EU. In summary, membership of the EU institutions are thus all hypothesized to have a negative effect on sovereign bond yield spreads through the signaling channel. Yet, this effect is expected to be more negative for the ERM and EMU countries than for the EU only countries.

The second channel works the opposite way. Membership in the European Union should increase government debt denominated in foreign currencies, namely debt denominated in euros[7]. An increase in foreign currency-denominated government debt creates economic vulnerabilities for states. As mentioned in the literature review, this is mainly due to the increased cost of depreciation of the currency, which in turn leads to more default risk. This should thus have a positive effect on sovereign bond yield spreads, as an increased credit risk necessitates higher bond yields. Nevertheless, this mechanism hinges on government debt being in a foreign currency, the euro. Adopting the euro as the national currency by joining the EMU should thus completely eliminate this positive effect on spreads. Additionally, joining the ERM should at least partly eliminate this effect, as the currencies are essentially pegged to one another. The hypothesized effect of this currency mismatch channel is thus the following: Joining the EU should increase spreads through an increase in foreign currency-denominated government debt. The positive effect disappears as a country joins the EMU.

The key takeaways from the theoretical considerations as it pertains to the results are thus the following:

**(i)** Joining the EU may either increase or decrease sovereign bond yield spreads, depending on which of the two channels is stronger.

**(i.i)** The foreign currency share of government debt *increases* when joining the EU, which should *increase* borrowing costs.

**(ii)** Joining the ERM should decrease bond spreads, as the signaling channel increases in strength, whilst the currency mismatch channel is (partly) eliminated.

**(iii)** Joining the EMU should have the largest negative effect on sovereign bond yield spreads, as the currency mismatch channel becomes irrelevant.

[7] Evidence can be found for this in Rosenberg and Tirpák (2008), and Brkić (2021).

### 3.2 Control Variables

#### 3.2.1 Macroeconomic Fundamentals

As widely established within the literature, *Sovereign Credit Ratings* have a large impact on sovereign bond yield spreads. They are used by many investors as an indication for the creditworthiness of their investments, and may have an effect on borrowing costs outside of the macroeconomic fundamentals. This is alluded to by Barrios et al. (2009), as they include downgrade risk separately from default risk and credit spread risk. An increase in a sovereign credit rating corresponds to a better creditworthiness. This should thus decrease the sovereign spreads.

*Reserves to Imports*[8] are a vital measure for a sovereign's liquidity. In essence, it measures how many reserves a country has for the value of its imports. Its relation to sovereign risk is clear: as the reserves dwindle compared to the value of imports, it may become optimal to devalue the currency or reschedule debt. This thus increases the default risk, especially in the presence of foreign currency-denominated government debt. An increase in the reserves compared to the imports should thus *decrease* the sovereign spreads. Nevertheless, it is important to note that this ratio may not be very significant for European countries compared to low-income countries[9].

The *Primary Balance* refers to the difference between government revenue and its non-interest expenditure. It captures the expected increase or decrease in future government debt, which influences the default risk (Attinasi et al., 2010). As government revenues exceed expenditures, government debt goes down, and the ability to repay debt in the future goes up. This thus decreases the future default risk, and through this, the sovereign risk premia. An increase in the primary balance is thus expected to decrease the sovereign spreads.

A related but different aspect of debt is the general *Government Debt*. The effect of government debt on sovereign risk premia is a bit unclear, as opposed to the primary balance. Namely, government debt may also increase economic growth below a certain threshold (Chen et al., 2017). This would decrease sovereign spreads, as economic growth may indicate a better ability to repay and thus lower default risk. Notwithstanding that a higher debt stock may thus increase default risk as the government budget constraint is tightened, it may also lower default risk through economic growth.

*GDP Growth* is essential to keep in mind when assessing a sovereign's ability to repay debt. As GDP growth increases, the tax base increases which aids the government in repaying its debt. This increase lowers the default risk by increasing the tax base and revenue, which in turn should lower the sovereign spreads.

The *Real Effective Exchange Rate* is a measure that is theorized to impact sovereign spreads as it is an indicator for a country's purchasing power and competitiveness. It captures the competitiveness of the countries in the market. More competitiveness leads to an increased ability-to-repay the debt through future tax revenues. As the effective exchange rate increases, this decreases competitiveness and thus increases default risk, which should increase sovereign spreads.

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[8] Referred to as the *Liquidity Ratio.*

[9] This is because European countries can be assumed to have much more unlimited access to capital markets than emerging markets do. This lessens the need for high reserves (IMF, 2011).

The *Current Account* of the balance of payments is also expected to influence borrowing costs. The current account is seen as an indicator for competitiveness and the ability to raise funds for debt servicing (Capelle-Blancard et al., 2019). As the current account increases, i.e., net foreign assets increase, this indicates a higher competitiveness and thus a better ability to repay debt. This decreases credit risk, and is thus expected to decrease sovereign spreads.

*Inflation* remains vital to control for when assessing sovereign bond yield spreads. An increase in inflation leads to an increase in macroeconomic destabilization, which should increase bond spreads. Nevertheless, inflation may also lower sovereign spreads by decreasing the real value of outstanding debt in foreign currencies (Nickel et al., 2009). When controlling for the amount of foreign currency-denominated government debt, however, it is expected that the effect of inflation on bond spreads is positive.

### 3.2.2 Institutional Qualities

The *Polity Score* measures the degree to which the institutions within a country are democratic. As previously stated in the literature review, the literature finds that ESG variables are important drivers of sovereign spreads, particularly governance variables. An increase in the polity score is associated with a higher degree of political freedom, which can be used as an, albeit imperfect, proxy for the governance variables used within many ESG analyses. In line with the literature, it is hypothesized that an increased polity score leads to a decrease in sovereign spreads due to good governance. Nevertheless, the analysis of this coefficient has two main caveats that need to be kept in mind: **(i)** Not all parts of governance may be relevant for sovereign spreads. Aspects of the polity score that may be correlated with the ability to repay debt[10] seem most relevant. The polity score, however, captures a slew of variables that may have no influence on default risk whatsoever. This creates noise when trying to assess the impact of institutional qualities on sovereign spreads. Nevertheless, this problem appears limited, as institutional qualities are not the main focus of this thesis. **(ii)** As can be seen in Table 1, there is little variation in the variable within the sample. This lack of difference in score between countries may lead to an imprecise estimate of the coefficient. Yet, as polity score is used as a control variable within the analysis, the importance of this estimation problem appears limited. Nevertheless, caution must be used when interpreting the coefficient of the Polity Score on sovereign spreads, as it may not be the true coefficient.

[10] Relevant for sovereign spreads are those aspects of governance that influence default risk and liquidity risk. The ability to repay debt influences default risk, and may be influenced by aspects of governance such as corruption or nepotism.

### 3.2.3 Global Factors

As it pertains to global factors, the most essential variable to capture is a proxy for global risk aversion. Global volatility is used within the literature as this proxy. It is found to impact sovereign spreads (Hartelius et al., 2008). Global risk aversion leads to changes in the behavior of agents on the bond market. Particularly, low-default risk countries may see an increase in demand, whereas more risky bonds see a sharp decrease due to a change in global risk attitudes. Furthermore, the impact of the variables of interest on sovereign borrowing costs may change during periods of high global volatility. It is thus essential to control for global volatility, in order to derive a sound estimate of the coefficients. The sign of this variable is hypothesized to be positive as it can be expected that during times of high global volatility spreads may increase, and it is hypothesized to be significant.

# 4 Empirical Approach

The next section of this thesis will provide an overview of the empirical approach used within this research. It will do this by delineating the particularities of the dataset first, followed by a more detailed account of all the variables used within the analysis. Additionally, the methodological approach will be discussed and the formal model shown.

## 4.1 Data

The dataset used consists of 25 countries, all of which are currently within the European Union. A detailed overview of the countries used within the analysis is given in the appendix. Notable exceptions from the dataset are the countries of Estonia and Luxembourg. These countries did not have all available data necessary to conduct the analysis, and have thus been dropped from the dataset. This should hurt the analysis less than including them, as extrapolation of data can hurt the validity of the results through the creation of data and the sample should be sufficiently large to draw conclusions.

The aforementioned countries are observed from the last quarter of 1999 until the last quarter of 2022. Notwithstanding the importance of a large time dimension, this timeframe is chosen for practical and theoretical reasons. Practically, the data availability for some variables is lacking before this timespan, particularly in Eastern and Central Europe. As data availability is nonrandom, i.e., it is not situated more within a particular region. This may lead to biased results. Theoretically, contemporaneous relationships may not hold in the past. Sovereign borrowing costs may respond very differently now than they did in the past. The study of historical relationships is outside the scope of this thesis and, in line with the literature, a shorter time dimension seems more appropriate to accurately describe the effects of joining the EU, ERM, and EMU on sovereign borrowing costs respectively.

Data for the dependent variable, sovereign bond yield spreads, is available at a monthly frequency and data for the joining of the EU, ERM, and EMU have a specific date attached to them. Nevertheless, many of the control variables are only available at an annual frequency. The difference in frequency requires some thought. On one hand, the conversion of the dependent variable to an annual frequency removes a lot of the variation that is used within the analysis. This low-frequency may obscure the real relationships of the variables, leading to omitted-variable bias (Tebaldi et al., 2018). On the other hand, the interpolation of annual data to monthly data creates an excessive amount of data, and may lead to results that are not in line with the true relationship. Taking into account both of these concerns, this research will find a middle ground by using quarterly data. The annual data is interpolated to a quarterly frequency, whilst the monthly data is taken as quarterly. This solution is not perfect, as data is still created and not all of the variation within the dependent variable is used. Nevertheless, this appears to be the best solution to this problem. This approach seems in line with the literature[11].

[11] See e.g. Gray (2009).

### 4.2 Variables

In the next subsection, a detailed overview is given of all the variables that are used within the analysis. Table 1 provides the summary statistics of the variables. Table 2 provides a more concise overview of the variables used, their data sources, and the expected sign as discussed in the previous section.

**Table 1**

Summary statistics of the variables.

| Variables | Observations | Mean | St. Dev |
|---|---|---|---|
| Sovereign bond yield spreads | 2220 | 0.466 | 2.22 |
| Foreign Currency Share | 2277 | 15.8 | 24.6 |
| Sovereign Credit Ratings | 2325 | 16.4 | 3.86 |
| Liquidity Ratio | 2265 | 32.3 | 25.9 |
| Primary Balance | 2139 | -0.368 | 3.22 |
| Government Debt | 2321 | 63.4 | 34 |
| Polity Score | 1848 | 9.66 | 0.696 |
| GDP Growth | 2325 | 2.4 | 3.33 |
| Real Effective Exchange Rate | 2139 | 4.57 | 0.0878 |
| VIX Index | 2325 | 20.2 | 8.35 |
| Current Account | 2325 | -0.933 | 5.29 |
| Inflation | 2325 | 2.78 | 3.68 |

As can be seen in Table 1, most variables are available over the entire sample period and for all countries. A notable exception of this is the *Polity Score* variable, which has more missing observations than other variables. This should not be a massive problem for the analysis, however, as the variable is not the main focus of this research. Nevertheless, as will be discussed in section 6.2, this limits the ability to interpret the impact of institutional qualities on sovereign spreads within the analysis.

**Table 2**

Description of variables and their sources.

| Variable | Description | Expected Sign | Source |
|---|---|---|---|
| ***Dependent Variable*** | | | |
| Sovereign bond yield spreads | Nominal 10 year government bond yield vis-à-vis a risk-free benchmark (US 10 year) | | ECB, Eurostat |
| ***Independent Variables*** | | | |
| EU | Dummy that takes value 1 when a country is part of the European Union | (?) | European Union |
| ERM | Dummy that takes value 1 when a country is part of the European Exchange Rate Mechanism | (-) | European Union |
| EMU | Dummy that takes value 1 when a country is part of the European Monetary Union | (-) | European Union |
| Foreign Currency Share | The share of general government debt (% GDP) that is denominated in a currency other than the national currency | (+) | ECB |
| Sovereign Credit Ratings | Arithmetic mean of numerical conversion of sovereign credit ratings as provided by Moody's, Fitch, and Standard and Poor's (S&P) | (-) | Moody's, Fitch, S&P |
| Liquidity Ratio | Total reserves in months of imports | (-) | IMF IFS |
| Primary Balance | The difference between government revenue and its non-interest expenditure in % GDP | (-) | IMF |
| Government Debt | General government gross debt in % GDP. All liabilities that require payments, including interest-payments | (+) | IMF WEO |
| Polity Score | Measure of government ranging from -10 (total autocracy) to +10 (total democracy) | (-) | Polity V |
| GDP Growth | Real GDP Growth. Annual % change of real GDP | (-) | IMF WEO |
| Real Effective Exchange Rate | Natural logarithm of the real effective exchange rate based on the Consumer Price Index | (+) | IMF IFS |
| VIX Index | Natural logarithm of the VIX Index, used as a proxy for global risk aversion in the market | (+) | Chicago Board Options Exchange |
| Current Account | The balance of the current account. Exports minus imports in the Balance of Payments in % GDP | (-) | IMF WEO |
| Inflation | Annual % change in the average Consumer Price Index | (+) | IMF WEO |

### 4.2.1 Dependent Variable

A variety of variables are used, given what was found to be common practice in the literature review. The dependent variable used to measure borrowing costs is *Sovereign Bond Yield Spreads* vis-à-vis a risk-free benchmark. More specifically, central government bond yields on the secondary market, gross of tax, with a residual maturity of around ten years are used. The risk-free benchmark chosen within this analysis is the US Treasury Rate with the same maturity. The yield spreads are calculated in line with the literature, namely by subtracting the US yield from the yield in question. The data for the yields are gathered from the Austrian National Bank (ÖNB), which lists the European Central Bank and Macrobond as their data sources. This data was additionally verified by comparing it to data from Eurostat. As mentioned in the previous section, the data is available at a monthly frequency which is converted to a quarterly frequency.

### 4.2.2 Variables of Interest

The variables of interest, namely the membership of the EU, ERM, and EMU are gathered from official EU and national government documents. A detailed timeline of the join dates can be found in Figure A.1 in the appendix. The other variable of interest for this research is the amount of general government debt that is denoted in a foreign currency (*FX Share*). This is defined as the percentage of general government debt that is denoted in currencies other than the national currency. The source of this data is the ECB and it is available at an annual frequency. Using a percentage share of total general government debt allows for a direct comparison between countries given the differing size of their respective economies. General government debt is used, as opposed to debt more generally, as its effect on government bond yields seems more pertinent. As stated previously, the hypothesized effect of *FX Share* on bond yield spreads is positive.

### 4.2.3 Control Variables

Regarding the Macroeconomic Fundamentals sub-division of variables, *Sovereign Credit Ratings* have been found to be highly significant for sovereign bond yield spreads[12]. It is thus paramount to include them in this analysis. Ratings are gathered from the three main rating agencies: Moody's, Fitch, and Standard & Poor's. The ratings from these agencies must first be converted into a number scale to allow for their inclusion into the model. To this end, this thesis follows the methods employed by Teixeira et al. (2018). In this paper, the ratings are converted into a number scale from 1 to 21, where 1 is the worst rating and 21 the highest. Other papers employ the same strategy with a different scale (Afonso et al., 2011; Erdem & Varli, 2014). Having converted the ratings into numerical values, the arithmetic mean is taken between the different ratings for a given year. This takes into account potential

[12] See Section 2 for sources and an explanation.

heterogeneity in ratings between agencies for that year. This is not done quarterly, as rating updates are rather infrequent and certain agencies may have certain biases. If done quarterly, it may thus be the case that ratings jump up and down a lot due to some agencies revising their ratings whilst others do not. The yearly average is thus taken, and given to all quarters within that year to construct the ratings at a quarterly frequency.

A common measure for sovereign liquidity is the *Reserves to Imports Ratio*. This ratio is measured as the total government reserves in months of imports. It is gathered from the IMF International Financial Statistics and is available at an annual frequency.

The *Primary Balance* is measured as the difference between government revenue and its non-interest expenditure in percent of GDP. The government primary balance is gathered from the Public Finances in Modern History database as provided by the IMF. The data is at an annual frequency.

The *Government Debt* variable is defined as general government gross debt in percent of GDP. It consists of all general government liabilities that require payment in the future. This definition includes interest payments. General government debt is chosen over central government debt, as it is a broader and more accurate representation of the debt owed by all levels of government. This definition seems more fitting, as it is overall government debt that should be taken into account when assessing sovereign risk and thus borrowing costs. The data is annual and gathered from the IMF World Economic Outlook. Additionally, a squared term is included to account for the potential nonlinear relationship between government debt and sovereign spreads as alluded to in section 3.

The *Current Account* variable is a measure of the balance in the current account as provided by the balance of payments. More specifically, it is defined as the exports minus imports in a percentage of GDP. It is gathered from the IMF World Economic Outlook and is available at an annual frequency.

Real *GDP Growth* consists of the annual percentage change of real GDP. Real GDP is preferable to nominal GDP, as it takes into account the distortive effects of inflation on the GDP measure. It is an annual variable that is gathered from the IMF World Economic Outlook.

*Inflation* is measured as the annual percentage change in the average Consumer Price Index. It is collected at an annual frequency from the IMF World Economic Outlook.

The *Real Effective Exchange Rate* is measured by comparing the change in the country's price index (CPI) to a weighted average of changes in its competitors' price indices, using the weighting matrix for the current year (ÖNB, n.d.). In essence, it measures how competitive the prices are for a given country. It is obtained from the IMF International Financial Statistics, and has been further cross-referenced with data as provided by Eurostat and the ECB. It is available at an annual frequency. In line with Afonso et al. (2012) the natural logarithm of this variable is used.

As it pertains to the Institutional Qualities sub-division, only the *Polity Score* is used as provided by the Polity V Project. This seems limiting, as it has been found that many different ESG variables may have an impact on sovereign bond yields. Nevertheless, it is found within the literature that the governance variables are by far the most important determinant of sovereign borrowing costs. Whilst it would be ideal to construct an index akin to Capelle-Blancard et al. (2019), this lies outside the scope of this thesis. The Polity Score is

thus used as a proxy for the governance aspect of the ESG set of variables. It is an index which ranges from -10, most autocratic, to +10, most democratic. An important distinction has to be made between the polity and polity2 score, the latter of which is used in this research. This is because the polity score includes three special values which lie outside of the normal range. The polity2 score, on the other hand, is bound between -10 and +10 and is intended for use within panel data and time series analysis. It is collected at an annual frequency.

For the Global Factors category, the natural logarithm[13] of the *VIX Index* is used. As stated in the literature review, the VIX index is widely used as a proxy for global risk aversion in the market. It is an index that measures expected market volatility for the next thirty days. It is collected from the Chicago Board Options Exchange and is available at a daily frequency. To convert it to a quarterly measure in line with the rest of the data, the closest value to the end of quarter date is used. As it is a global measure, it will be the same for all countries within the dataset for a given quarter.

### 4.3 Methodology

Having established the sources and definitions of the variables, it is pertinent that an appropriate methodology is used to arrive at the results. As stated in the literature review, this methodology must take into account problems of endogeneity and serial correlation inherent in macroeconomic analyses. To this end, the methodology of Afonso et al. (2012) is followed with some differences. The first proposed specification to assess the determinants of long-term sovereign bond yield spreads is as follows:

$$BYS_{i,t} = \beta_1 * BYS_{i,t-1} + \beta_2 * vix_t + \beta_3 * EU_{i,t} + \beta_4 * ERM_{i,t} + \beta_5 * EMU_{i,t} + \beta_6 * FX.Share_{i,t} + \beta_7 * FX.Share_{i,t} * EU_{i,t} + \beta_8 * FX.Share_{i,t} * ERM_{i,t} + \beta_9 * FX.Share_{i,t} * EMU_{i,t} + \gamma * X_{i,t} + \alpha_i + u_{i,t} \quad (1)$$

Where X is a vector consisting of all control variables as previously mentioned.

The estimation of equation (1) is done through a Two-Stage Least Squares (2SLS) method with entity fixed-effects. The instruments used in the first step estimation are the second and third lag of the dependent variable, and the first three lagged values of the independent variables. The 2SLS method accounts for the endogeneity between spreads and the explanatory variables (Afonso et al., 2012). The entity-fixed effects with Newey-West standard errors clustered at the country level account for the potential serial correlation in the error term[14]. The lags chosen for the Newey-West standard errors follow Stock & Watson (2020)'s rule of thumb. In short, whilst rounding towards zero, the number of lags is the integer of the time periods to the power of one third, multiplied by three fourths. In this

[13] As with the Real Effective Exchange Rate, this is in line with Afonso et al. (2012) who explicitly uses the natural logarithm of both of these variables.

[14] The usage of Newey-West standard errors is further defended in section 5.1. Diagnostic tests are run to prove the existence of serial correlation in the error term and heteroskedasticity.

sample this means that the maximum number of lags for the Newey-West standard errors is three. This methodology thus: **(i)** accounts for endogeneity through the 2SLS estimation method, **(ii)** accounts for serial correlation in the error term and heteroskedasticity through Newey-West standard errors, **(iii)** accounts for country-specific fixed effects, **(iv)** accounts for the interaction between the foreign currency share of government debt and the EU, ERM, and EMU dummies.

The first lag of the dependent variable is included as an explanatory variable to account for the persistence inherent in spreads (Gerlach et al., 2010). Not including the first lag as an explanatory variable may thus lead to omitted variable bias. Nevertheless, utilizing the first lag of the dependent variable as a regressor may generate a bias as well due to correlation with the fixed effects (Afonso et al., 2012; Hallerberg & Wolff, 2008; Nickell, 1981). As stated in Afonso et al. (2012), however, this bias decreases as the time dimension increases, and is negligible when $T > 20$. As the time-dimension in the dataset is 93, this bias should thus not be of concern[15].

Additionally, this specification controls for the foreign currency share of general government debt, as well as its interactions with the institutional dummies. Inclusion of the interaction terms allows for a disentanglement of the signaling effect from the foreign-currency effect. The interpretation of the coefficients is the following:

1. $\beta_3; \beta_4; \beta_5$:The effect of institutional membership on sovereign spreads given that the foreign currency share is equal to zero

2. $\beta_6$: The effect of the foreign currency share of government debt on sovereign spreads provided that the country is not a member of any of the institutions

3. $\beta_7; \beta_8; \beta_9$: The effect of the foreign currency share of government debt on sovereign spreads provided that the country is a member of the institutions (or equivalently the impact of membership of the institution for a given level of foreign currency denominated government debt)

The first group of coefficients, then, showcase the effects outside of the foreign currency effect. If the premise is accepted that there are two main channels through which institutional membership affects sovereign spreads, this vector of coefficients thus contains the signaling effect outlined previously.

The third vector of coefficients outlined above contains the effect that the foreign currency share of government debt has on sovereign spreads given membership in the EU institutions. If the foreign currency share of government debt is set to increase when joining the EU and not the ERM or EMU, it is expected that sovereign spreads increase as a result.

[15] The size of the time dimension as compared with the cross-section is also why the GMM method is not considered. This method relies on a large cross-section with a smaller time dimension.

Furthermore, the equation is also estimated with two-way fixed effects. This is because the VIX index is used as a cross-section invariant variable, in essence it is treated as the time fixed effect in this specification. However, it may not capture all of the time trends in sovereign spreads over time. Therefore, an additional specification is estimated using the same 2SLS approach:

$$BYS_{i,t} = \beta_1 * BYS_{i,t-1} + \beta_2 * EU_{i,t} + \beta_3 * ERM_{i,t} + \beta_4 * EMU_{i,t} + \beta_5 * FX.Share_{i,t} + \beta_6 * FX.Share_{i,t} * EU_{i,t} + \beta_7 * FX.Share_{i,t} * ERM_{i,t} + \beta_8 * FX.Share_{i,t} * EMU_{i,t} + \gamma * X_{i,t} + \alpha_i + \delta_t + u_{i,t} \quad (2)$$

This equation does not include the VIX index, but instead uses a two-way fixed effects estimation procedure. The main drawback of this method is that it does not account for global volatility directly, as this is captured in the time fixed effect. Nevertheless, this estimation method leads to potentially less biased results due to the inclusion of the time fixed effect.

# 5 Research Findings

This section of the thesis will discuss the estimation results of the two different model specifications as highlighted in section four. First, the results of the country fixed-effects specification are summarized and analyzed, whereafter the two-fixed-effects results are reported and discussed. Furthermore, different explanations for the results are explored for both specifications. Before the results can be interpreted, however, some brief diagnostic tests need to be run to ensure model validity. The diagnostic tests will check for serial correlation in the error term, heteroskedasticity, and endogeneity. These diagnostic tests will give a reasoning behind **(i)** utilizing Newey-West standard errors, and **(ii)** using the 2SLS estimation method as used by Afonso et al. (2012).

## 5.1 Diagnostic Tests

Diagnostic tests are vital to ensure model validity. As highlighted in section 4, the model was chosen in such a way as to deal with serial correlation in the error term, heteroskedasticity, and endogeneity. Whilst these assumptions are plausible for the data, diagnostic tests are run to ensure that the assumptions hold. This section will go over these three different aspects of the model and test whether the assumptions hold up under scrutiny.

### 5.1.1 Serial Correlation in the Error Term

In the presence of serial correlation in the error term, OLS estimates will lose efficiency. In practical terms, depending on whether the serial correlation in the error term is positive or negative, this leads to an increase in type I or type II errors in our estimation. It is therefore vital to test for serial correlation in the error term, as it may hurt the validity of the results. The Durbin-Watson test is used for the identification of autocorrelation. The results of the Durbin-Watson test can be seen below in Table 3:

**Table 3**
Durbin-Watson test for autocorrelation.

| Model | Test Statistic | p-value | Autocorrelation |
|---|---|---|---|
| Country-FE | 1.8783 | 0.003063 (***) | Positive |
| Two-way-FE | 1.8115 | 0.00003287 (***) | Positive |

The *** refers to the significance level that is reached. In this table, *** indicates that all test-statistics are significant at the 1% significance level.

The table shows that there is a positive serial correlation in the error term for both model specifications. This indicates that there is a need to take autocorrelation in the error term into account, as this increases the likelihood of a Type-I error. As previously stated,

Newey-West standard errors control for this autocorrelation. It is thus pertinent that they are used when drawing conclusions from our estimates to ensure validity of the results.

### 5.1.2 Heteroskedasticity

Heteroskedasticity means that the variance of the residuals is not constant over the independent variables. If heteroskedasticity is prevalent, the estimated variances of the regression coefficients produced by OLS become biased. In other words, the standard errors produced using OLS estimation can no longer be used and must be corrected. Two tests are often used to check for heteroskedasticity: the Breusch-Pagan test and the White test. The Breusch-Pagan test specifically tests for a linear form of heteroskedasticity, whereas the White test also includes non-linear forms. To this end, the Breusch-Pagan test will be performed, and if the results indicate homoskedasticity, the White test will be performed[16]. The results of the Breusch-Pagan test for heteroskedasticity can be seen in Table 4.

**Table 4**
Studentized Breusch-Pagan test for heteroskedasticity.

| Model | Test Statistic | p-value |
|---|---|---|
| Country-FE | 498.33 | 0.00 (***) |
| Two-way-FE | 502.73 | 0.00 (***) |

The *** refers to the significance level that is reached. In this table, *** indicates that all test-statistics are significant at the 1% significance level. The degrees of freedom are 51 and 54 respectively.

The results of the Breusch-Pagan test showcase a strong likelihood of heteroskedasticity. In order to draw the appropriate conclusions from the estimates of all models, it is thus apparent that a heteroskedasticity-robust standard error must be used. The Newey-West standard errors control for both heteroskedasticity and serial correlation. The use of these standard errors is thus justified when interpreting the results of the regressions.

### 5.1.3 Endogeneity

Endogeneity refers to a correlation between an independent variable and the error term. Endogenous regressors can lead to biased estimates, and dealing with this problem is a central point of the modeling process. In the case of endogenous regressors, a 2SLS approach

[16] As the White test tests for linear and non-linear forms of heteroskedasticity, it is assumed that if the Breusch-Pagan test finds heteroskedasticity, the White test results are bound to find heteroskedasticity as well.

can be used as a remedy. Nevertheless, it remains important that the instruments used satisfy the **(i)** exclusion restriction and are **(ii)** sufficiently relevant. The instruments used in the model specifications are the first, second, and third lags of the dependent variables and the second and third lag of the dependent variable.

Tests were performed to check for the endogeneity of the *Credit Score* and *Polity Score* variables, as these are the variables included that have the highest likelihood to have some degree of exogeneity[17]. The results of these tests indicate that whilst there is endogeneity present in the *Credit Score* variable, there is not in the *Polity Score* variable. The lags of the *Polity Score* variable will thus not be used as instruments. As endogeneity is inherent when conducting macro analyses due to the nature of the variables, this provides a justification for using a 2SLS approach as showcased by Afonso et al. (2012). Nevertheless, it remains unclear what the instruments should be. As stated previously, the instruments must satisfy the exclusion restriction and be sufficiently relevant.

In terms of relevance, it seems clear that utilizing lags as instruments satisfies this condition . Namely, the variables used are macro variables that are expected to be highly correlated with their lagged values. As it pertains to relevance, this thesis will follow Afonso et al. (2012) in identifying the first three lagged values for the independent variables and the second and third lag of the dependent variable as instruments. These lags should be sufficiently relevant to include as instruments in the specification.

As it relates to the exclusion restriction, this remains trickier. As stated by Wang et al. (2019), when the exclusion restriction is violated in lagged IV, the lagged IV performs worse than the OLS in terms of bias, the RMSE, and the likelihood of a Type I error. This thesis argues, however, that the exclusion restriction holds in the model specified in section four. Sovereign yields are a function of the expectations of the market for the risks associated with a specific government bond. These risks are based on the future ability-to-repay the debt. When forming expectations on the future ability-to-repay, it seems self-evident that the latest information is used. To illustrate, when assessing whether the debt stock in a country is unsustainable in the future, the debt stock from two periods ago seems wholly irrelevant. This line of argument can be followed for all variables included in the model. Notwithstanding the inability to test the restriction, theoretically it appears as if the lags as instruments satisfy the exclusion restriction due to the forward looking nature of the market for government bonds.

## 5.2 Main Results

The economic analysis starts by estimating the results of the 2SLS-FE estimation of the specification with country fixed-effects. The results can be seen in Table 5, column (1) below. In the country fixed-effects model specification, I find that the coefficients of the EU, ERM, and EMU dummies are insignificant. As explained in section 4.3, this indicates that the effect of institutional membership on sovereign spreads is limited (granted that the foreign currency share of government debt is zero). In essence, this provides evidence that the

[17] This is posited because they are scores given by independent agencies. Whilst these scores should reflect other variables that may be correlated with the dependent variable (endogeneity), there may be some exogenous nature to them as they are assigned by independent actors.

'signaling effect' of membership is more limited than previously anticipated. Furthermore, it is also found that none of the interaction variables of foreign currency share and institutional membership, as well as foreign currency share itself, are significant. Essentially, the results of this estimation indicate a limited impact of membership of EU institutional membership on sovereign borrowing costs, whether it be through the signaling channel or the foreign currency channel. This is in contrast to the theoretical underpinnings set out in this thesis that would predict a more pronounced impact on sovereign spreads for both channels. A possible explanation for this is that the VIX index does not adequately capture the effects of the European Sovereign Debt Crisis (SDC) on sovereign spreads. As the SDC was a localized European crisis, and the VIX index is a global measure, it may not accurately capture the relationship between the membership of these institutions and sovereign bond yield spreads.

The impact of the other variables broadly follows the hypothetical signs that were established in Table 2. As it pertains to the macroeconomic fundamentals, it is found that the *Primary Balance*, *Sovereign Credit Ratings,* and *Government Debt* are significant. The first two have the expected sign, whereas the latter does not. This can be explained by the quadratic term that is also included in the analysis. As stated previously, government debt might not have a linear effect on borrowing costs, as too little or too much government debt may indicate bad economic policy and thus increase borrowing costs. The coefficient for government debt must thus be interpreted with caution. The insignificance that is found for the other variables may be explained by the inclusion of *Sovereign Credit Ratings*. As Cady & Pellechio (2006) stated, credit ratings may function as a replacement of other macroeconomic indicators. Inclusion of the ratings may thus render the other macroeconomic fundamentals insignificant. Additionally, as it pertains to the *Liquidity Ratio*, the insignificance may be due to the diminished importance of the reserves to import ratio for the countries sampled[18]. For the institutional qualities, measured by the *Polity Score* variable, insignificance is found with a different sign than hypothesized. As mentioned previously, this variable may not be extremely relevant due to the lack of variation within the sample. Regarding global factors, the *VIX Index* is significant and with the hypothesized sign. Finally, the first lag of the spreads is found to be highly significant in explaining current spreads, further showcasing the need to include the first lag as an explanatory variable in the regression.

[18] See section 3.2.1 for an explanation.

**Table 5**

Results from the 2SLS estimations.

| Variable | (1) | (2) |
|---|---|---|
| lag(BYS) | 0.84019*** (0.088720) | 0.83144*** (0.10912) |
| EU | 1.6397 (1.0453) | 1.9219** (0.94641) |
| ERM | -0.87249 (0.76435) | -1.1389* (0.64311) |
| EMU | -1.4227 (0.92638) | -1.2031* (0.66088) |
| Foreign Currency Share | 0.018752 (0.025339) | 0.017879 (0.022607) |
| EU * Foreign Currency Share | -0.032056 (0.022076) | -0.035562* (0.018621) |
| ERM * Foreign Currency Share | -0.089643 (0.16981) | -0.016800 (0.13422) |
| EMU * Foreign Currency Share | 0.10375 (0.13945) | 0.0058306 (0.10099) |
| Sovereign Credit Ratings | -0.12149** (0.057157) | -0.085290 (0.052120) |
| Liquidity Ratio | 0.002752 (0.0043994) | 0.003400 (0.0031183) |
| Primary Balance | -0.054954*** (0.021667) | -0.035904** (0.01508) |
| Government Debt | -0.0134797* (0.005203) | -0.010297** (0.0048626) |
| Government Debt^2 | 0.0000428 (0.000030) | 0.000049310 (0.000035452) |
| Polity Score | 0.207384 (0.143903) | 0.253844** (0.11547) |
| GDP Growth | 0.023673 (0.020298) | -0.023575 (0.029451) |
| log(Real Effective Exchange Rate) | 1.57311** (0.78047) | 1.0004* (0.57744) |
| log(VIX Index) | 0.671104*** (0.18812) | - |
| Current Account | -0.04400 (0.0264294)* | -0.025932 (0.021069) |
| Inflation | -0.01068 (0.029133) | -0.0032031 (0.030495) |
| Adjusted R^2 | 0.8620205 | 0.8221769 |
| Includes time-fixed effects | No | Yes |

The regression models are estimated over the time period 1999.Q4 - 2022.Q4 (T=93). The panel includes 25 countries as specified in the appendix. 2SLS estimates are reported. The asterisks ***, **, *, indicate significance at the 1, 5, 10% level respectively.

Having established the results of the model without the time-fixed effect, this research seeks to improve on the specification. As previously stated, it does this by removing the VIX index from the regression equation and instead adding a time-fixed effect. This should allow for capturing all the time-fixed effects, not only the ones that are captured by the VIX index. Equation (2) is thus estimated. The inclusion of the time-fixed effects leads to substantially different results as can be seen in column (2) in Table 5. In this specification, the coefficients for the EU, ERM, and EMU dummies are all significant at the 10% significance level, and

the EU coefficient at the 5% level. These results indicate that the effect of institutional membership outside of the foreign currency channel has a significant impact on sovereign spreads. Particularly noteworthy is the sign of the coefficients. The EU coefficient is positive, whereas the ERM and EMU coefficients are negative. As these coefficients function outside of the foreign currency channel, it was expected that all the coefficients would be negative. Namely, if we accept the premise that there are only two main channels through which EU institutional membership affects sovereign spreads[19], the signaling channel would necessitate negative coefficients across the three different institutions. Sovereign borrowing costs should decrease due to signaling sound economic policy. As this is not found to be the case, the results indicate that the premise is flawed; there must be another channel through which EU membership, without ERM or EMU membership, positively affects sovereign spreads regardless of the level of foreign currency-denominated government debt. Regarding the interaction variables of foreign currency share and the EU institutions, the interaction with the EU dummy is found to be significant at the 10% level and negative. In terms of the size of the coefficient, however, the impact is quite limited. The spreads decrease by roughly 0.0035 for a 1% increase in the foreign currency-denominated share of general government debt[20]. The interaction between foreign currency share and the other institutions is found to be insignificant. All in all, these estimation results indicate a limited impact of the foreign currency channel, a pronounced signaling effect of joining the ERM and EMU due to their negative coefficients, and the presence of another channel that explains the positive effect of EU membership on sovereign spreads.

The impact of the other variables is broadly in line with the first model specification with two key differences. First, the *Polity Score* variable is found to be significant but with the wrong sign. Second, the *Sovereign Credit Ratings* become insignificant. The coefficient for the polity score variable is puzzling, but again may be explained by the lack of variation within the sample. The change in significance for the credit ratings may reflect a better estimation due to the inclusion of time fixed-effects. As can be seen in the appendix in Figure A.2, the average sovereign credit rating over the sample is highly correlated with the global financial crisis and the sovereign debt crisis. Particularly the sovereign debt crisis may have driven the change in the variable over the two specifications, as the *VIX Index* is a global measure and the sovereign debt crisis was a localized European crisis. It may thus not have controlled for the effect of the sovereign debt crisis on credit ratings and spreads, thus leading to a biased estimate of the sovereign credit ratings variable.

Overall, the results from the two way fixed-effects specification seem more plausible, as the model specification more accurately captures the time effects that may influence the explanatory variables and the dependent variable. The main results of this specification can be briefly summarized as follows:

[19] The channels being the signaling channel and the currency mismatch channel.
[20] Equivalently, for a given share of foreign currency-denominated general government debt, joining the EU leads to a 0.0035 reduction in sovereign spreads.

**(i)** Joining the EU is associated with higher sovereign bond yield spreads when disregarding the currency mismatch channel.

**(ii)** The foreign currency share of government debt seems to be (mostly) irrelevant in explaining sovereign spreads overall.

**(iii)** Joining the ERM and EMU is associated with lower sovereign bond yield spreads

**(iv)** The signaling effect may be driving result (iii), but cannot be driving result (i)

**(v)** There must be another channel through which EU membership increases sovereign borrowing costs outside of the foreign currency channel.

Notwithstanding the large number of possible explanations that can be driving result (i), the most convincing one may be the economic uncertainty that follows as a result of joining the EU. As a country joins the EU, it becomes part of the common market for the first time and its industries may face more economic competition than they have previously faced. The extent to which national industries can survive in the European market may thus be unsure to investors, which necessitates an increase in the sovereign risk premium. This uncertainty is absent with regards to joining the ERM and the EMU, as the country has already become part of the European common market and its industries have already withstood the increased competition that follows. This 'uncertainty channel' may be the driving force behind result (i). More research is needed to investigate this potential channel. Nevertheless, this falls outside the scope of this research and will not be further investigated.

## 5.3 Robustness

To ensure the validity of the results found within the model specification with the time-fixed effect, multiple robustness checks are performed on it. Equation (2) is estimated whilst including a variety of interaction terms and added dummies. The results of these robustness checks can be found in Table A.1 in the appendix.

First, the results may differ between Central and Eastern Europe (CEE) and the rest of the EU. Borrowing costs may respond differently to institutional changes for these countries. To this end, a dummy indicating a CEE country is added and interacted with the EU, ERM, and EMU dummies to investigate whether the results are robust when accounting for potential regional differences in market responses. Of note is that adding the interaction terms does not alter the main findings. Namely, joining the EU leads to an increase in borrowing costs, whereas joining the EMU is associated with lower borrowing costs. Whilst the ERM coefficient is found to be insignificant, the sign stays the same. Furthermore, the interaction terms between CEE and the institutional dummies are insignificant, though they indicate that there may be stronger responses to membership of European institutions for these countries than for others as their signs are the same as the EU, ERM, and EMU dummies. Furthermore,

this finding signals, like the main findings, that the currency mismatch channel has a limited impact on sovereign spreads.

Second, the results may differ when comparing sovereign bond yield spreads vis-a-vis German bonds as opposed to American bonds. The idea of using sovereign bond yield spreads is to account for the difference between its interest payments and a risk-free benchmark. Assuming that both the American and German bonds can be viewed as risk-free benchmarks, the results ought not to change substantially when utilizing German bonds instead. To ensure robustness, Germany is thus removed from the sample and the bond yield spreads are calculated as being vis-a-vis the German benchmark instead. In short, it is clear that the main results are robust to a slightly different definition of the dependent variable. The EU coefficient remains positive, and the ERM and EMU coefficients remain negative. Furthermore, we can see that the interaction of the foreign currency share of general government debt with the institutional dummies is insignificant. Therefore, the currency mismatch channel is still hypothesized to be of limited importance. As these results are in line with what was found in the main specifications of the dependent variable, the results are thus not driven by using American bonds as the risk-free benchmark as opposed to German ones.

To conclude, the results seem robust to **(i)** adding a dummy and interaction terms for Central and Eastern European countries and **(ii)** redefining the dependent variable as vis-a-vis German bonds instead. After all these robustness checks, the main results as summarized in the previous section remain valid.

# 6 Conclusion and Limitations

## 6.1 Conclusion

This thesis has sought to uncover the effect of membership of the EU, ERM, and EMU institutions on sovereign borrowing costs. It has done this by first delineating two hypothesized channels through which membership in these institutions may influence sovereign risk premia. These channels are: **(i)** the signaling channel, and **(ii)** the currency mismatch channel. The signaling channel refers to the signaling of good economic policy to investors by joining international institutions, which would lower borrowing costs. The currency mismatch channel refers to the increase in the share of general government debt denominated in a foreign currency after joining the EU. This channel was hypothesized to increase borrowing costs when joining the EU but not the EMU due to the increase in government debt denominated in euros.

In order to investigate the effect of institutional membership on sovereign borrowing costs, two different 2SLS specifications were estimated over a sample of 25 current EU members from 1999 until 2022. One specification includes a cross-section invariant variable, the *VIX Index*, and country fixed-effects, whilst the other includes time and country fixed-effects. Both of these specifications utilized the first three lags of the explanatory variables, and the second and third lag of the dependent variable as instruments. The first lag of sovereign bond yield spreads was added as an explanatory variable due to its power in explaining contemporary spreads. A variety of controls were added in order to accurately capture the effect of the different EU institutions on long term sovereign bond yield spreads vis-a-vis American bonds. These controls broadly fall into three categories: **(i)** Macroeconomic Fundamentals, **(ii)** Institutional Qualities, and **(iii)** Global Factors.

The estimation results indicate that EU membership, without ERM and EMU membership, is associated with higher borrowing costs when disregarding the currency mismatch channel. ERM and EMU membership on the other hand is associated with lower borrowing costs. This result was found to pass two different robustness checks. The currency mismatch channel was found to be limited in strength, and was not the main driver behind these results. The signaling channel could be an explanation for the results for ERM and EMU membership, but is unable to explain the results for EU membership on borrowing costs. It can thus be concluded that there must be another channel through which EU membership increases sovereign borrowing costs. This driver could be the uncertainty associated with joining the EU, but this cannot be proven through the results of this research.

## 6.2 Limitations and Future Research

There are limitations to the research that was conducted. One of these concerns interpolation issues. Most of the variables used were only available at an annual frequency. These variables were interpolated to a quarterly frequency, whereas the higher frequency variables were converted to be quarterly. This may hinder the validity of the results, as not all of the true variation within the determinants could be exploited. Notwithstanding the

difficulty of collecting macro variables at a higher frequency than annually, conducting a similar analysis with more high frequency data may lead to more accurate results. Nevertheless, due to the high autocorrelation within macro variables, the chance of the results being rendered entirely invalid would seem low.

Another limitation of this research pertains to the selection of the variables. As stated abundantly in this thesis, financial markets are forward looking. However, all of the variables used are not expectations , but instead are the real values at the time that the sovereign bond yield spreads are measured. This limitation is more problematic, as financial markets would use expectations when forming their beliefs about a government bond and its default risk. Due to data limitations, however, this research has not accounted for this. The inclusion of expected values of the variables would more accurately uncover the determinants of sovereign spreads than real-time values of the variables.

The last aspect of this research to keep in mind when interpreting the results, is that this research has mainly targeted macroeconomic fundamentals in its controls, as opposed to institutional qualities and global factors. A rough estimate of institutional qualities was used, which limits the ability to conclude much about the impact of different aspects of governance on sovereign spreads. The data for this measure was also more limited than for the other variables used within the analysis. It is thus paramount to be careful when interpreting these results when assessing the impact of institutional qualities on sovereign spreads. This was not the main focus of this research, but a more comprehensive model may lend itself to better conclusions about governance on sovereign borrowing costs.

Future research in the field of sovereign borrowing costs generally, then, may keep these limitations of this research in mind and improve on them. Furthermore, this analysis was unable to find the channel through which its main result was found. A potential avenue for future research on the topic of EU integration and borrowing costs specifically would be to try and find the mechanism through which EU membership seems to increase sovereign spreads. Particularly, the ‘uncertainty channel’ could be further explored as a potential driver, though there may be many more channels that could be investigated. In light of the potential for high spreads to reduce long-term economic growth, it is vital that future research seeks to uncover the channel through which this effect comes about. This is particularly relevant, as policy decisions may be able to counteract the increase in borrowing costs that follows EU membership without ERM or EMU membership. Of particular importance is the impact of EU membership on sovereign spreads for new countries in Central and Eastern Europe. It was found that these countries do not exhibit negative effects of EU membership on sovereign spreads, indicating that they also see an increase in spreads when joining the EU. As these countries may be more prone to struggle refinancing their debt, high bond spreads hurt their economic growth more. It thus remains pertinent that effective policy measures are taken to ensure a smooth path towards further European integration. These policy measures could include a faster path towards ERM or EMU membership. Additionally, after the channel through which the positive EU effect was found is identified, more precise policy measures may be taken.

# A Appendix

## A.A Sample

The countries used within the final dataset are: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Germany, Finland, France, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.
Countries classified as Central and Eastern European are: Bulgaria, Croatia, Czechia, Hungary, Poland, Romania, Slovakia, and Slovenia.

## A.B Figures and Tables

Figure A.1

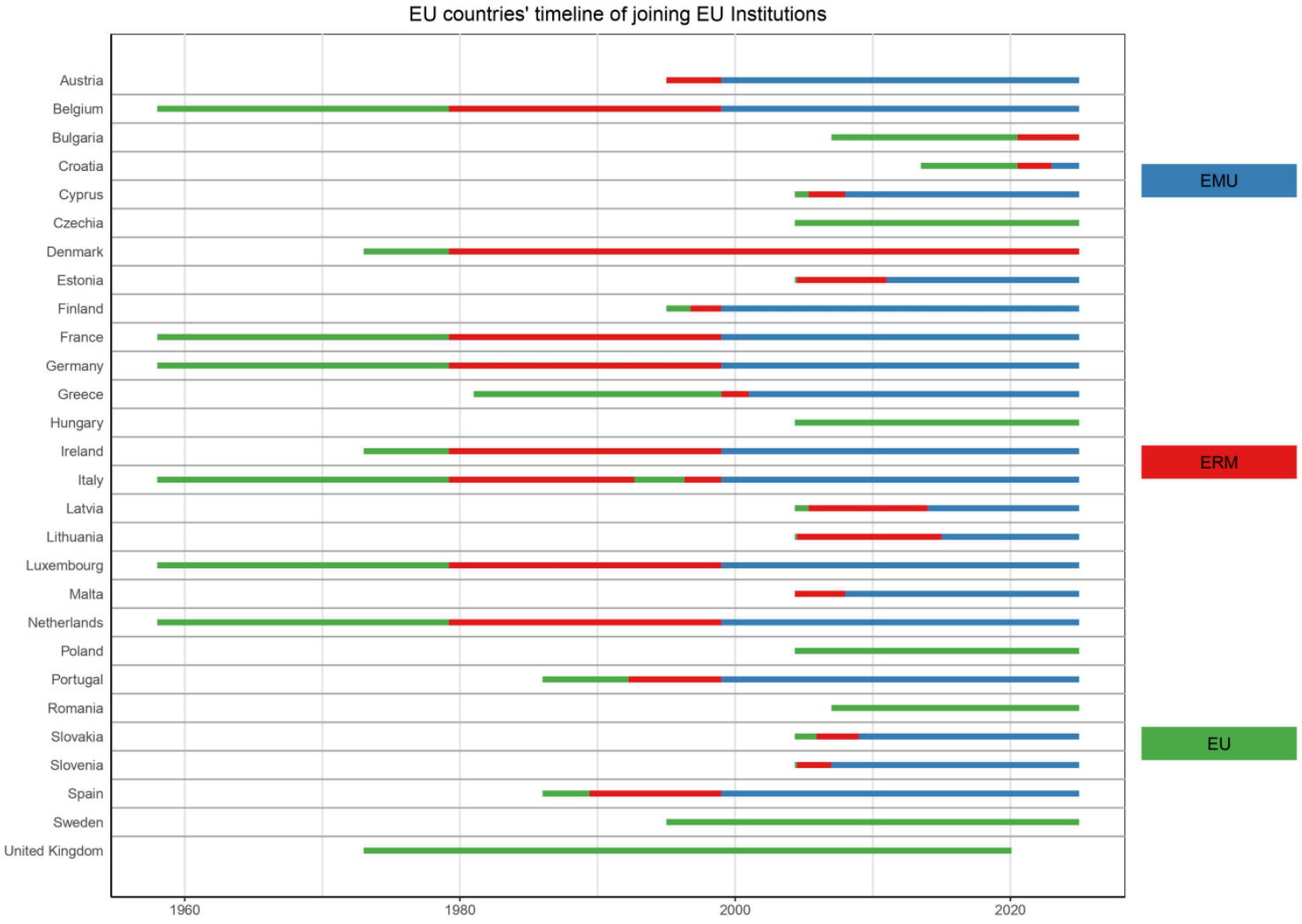

Figure A.2

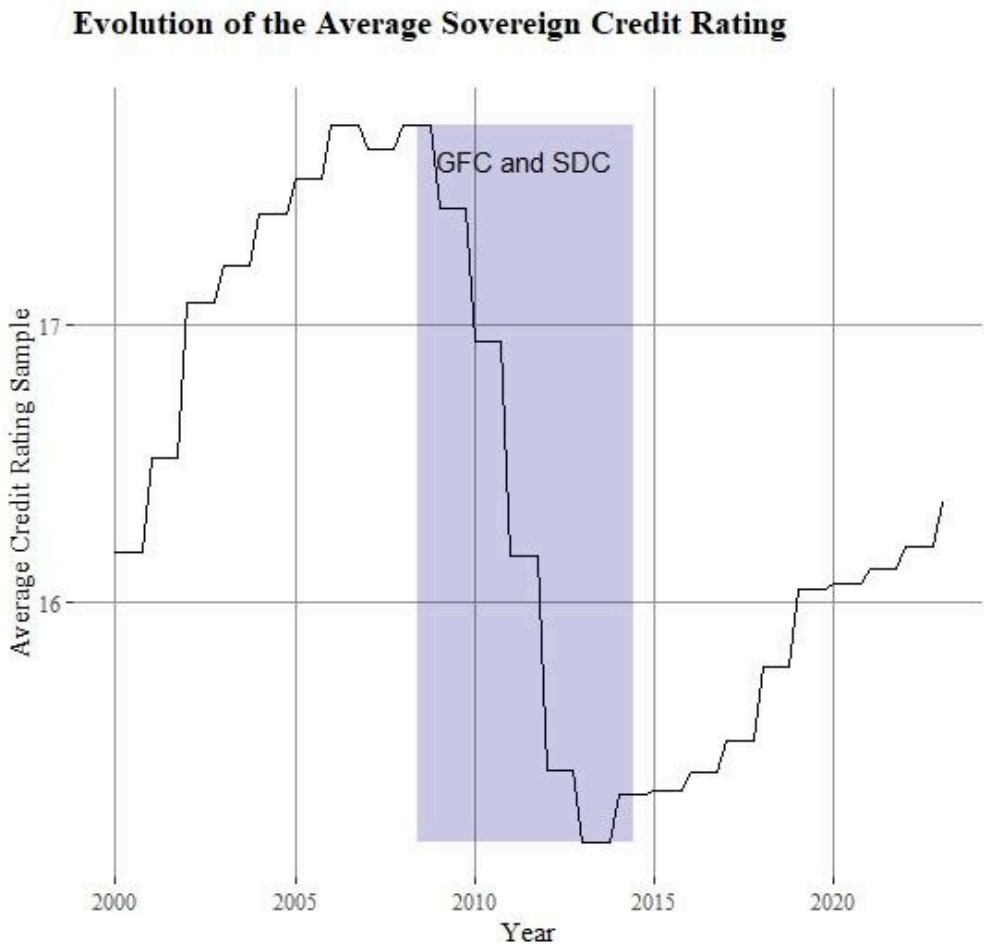
Evolution of the Average Sovereign Credit Rating
GFC and SDC
Average Credit Rating Sample
17
16
2000
2005
2010
2015
2020
Year

**Table A.1**

Robustness Checks Results

| Variable | CEE Dummy | Vis-a-vis German Bonds |
|---|---|---|
| lag(BYS) | 0.837179*** (0.095633) | 0.8348349*** (0.0968183) |
| EU | 0.615682** (0.2940732) | 0.289522** (0.1351163) |
| ERM | -0.645019*** (0.2234580) | -0.274579* (0.1603154) |
| EMU | -0.726863*** (0.2383189) | -0.434827** (0.1800969) |
| Foreign Currency Share | 0.001039 (0.0050198) | 0.002378 (0.0048654) |
| EU * Foreign Currency Share | -0.002352 (0.0022056) | -0.002613 (0.0021699) |
| ERM * Foreign Currency Share | -0.007549 (0.0090429) | -0.010654 (0.0089863) |
| EMU * Foreign Currency Share | 0.008400 (0.0078081) | 0.007733 (0.0078483) |
| EU * CEE | -0.376072 (0.3072521) | - |
| ERM * CEE | 0.496268 (0.3003438) | - |
| EMU * CEE | 0.313871 (0.2948541) | - |
| Sovereign Credit Ratings | -0.082009** (0.0321666) | -0.081202** (0.033413) |
| Liquidity Ratio | -0.001316 (0.0014380) | -0.001798 (0.0014872) |
| Primary Balance | -0.025665* (0.0147560) | -0.028208* (0.0147484) |
| Government Debt | -0.007642 (0.0046549) | -0.009904** (0.0047664) |
| Government Debt^2 | 0.000033 (0.0000330) | 0.000050 (0.0000341) |
| Polity Score | 0.103645** (0.0414990) | 0.106466** (0.0424589) |
| GDP Growth | -0.019185 (0.0174914) | -0.016156 (0.0175864) |
| log(Real Effective Exchange Rate) | 1.098144*** (0.3755328) | 1.044577*** (0.3679757) |
| Current Account | -0.024630*** (0.0083543) | -0.024089*** (0.0082346) |
| Inflation | 0.015624 (0.0187471) | 0.017769 (0.0195126) |

The two way fixed-effects models are estimated over the time period 1999.Q4 - 2022.Q4 (T=93). The panel includes 25 countries as specified in the appendix (Germany is removed from the sample for the second column). CEE countries are defined in the appendix. 2SLS estimates are reported. The asterisks ***, **, *, indicate significance at the 1, 5, 10% level for the coefficients respectively. Newey-West standard errors are reported in brackets.

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