When to Hold 'Em, When to Fold 'Em:

Analyzing Multiple Equilibria Models of Sovereign Default

Regan Brady

Presented to the Department of Economics
In partial fulfillment of the requirements
For a Bachelor of Arts degree with Honors

Harvard College
Cambridge, Massachusetts
March 10, 2022

Abstract:

In a monetary union, countries issue debt in the common currency of the union, which is not guaranteed by the country itself. Thus, there exists a default risk for countries in a monetary union that does not exist in standalone nations with an independent central bank which can guarantee solvency in a crisis. This fundamental feature (or flaw) of a monetary union has been argued to lead to increased fragility and susceptibility to self-fulfilling solvency crises. Building on prior research, this paper attempts to validate this theory empirically through comparing bond spreads, which are used as both an indicator of investor concern and a proxy for default risk, of countries in a monetary union and those that are "standalone," or have an independent banking system. In doing so, this paper provides a more nuanced understanding of multiple-equilibria models of sovereign default through testing additional components of sovereign bond spreads, notably those related to investor risk tolerance. The empirical results indicate that countries in a monetary union are vulnerable to self-fulfilling crises of confidence at periods of heightened market instability, and that countries in monetary unions are "punished" by markets for having high net foreign debt more so than standalone nations, both of which ultimately support the fragility hypothesis.

Acknowledgements:

This thesis would not have been possible without the support of many individuals this year and throughout my time at Harvard. First and foremost, I would like to extend my most sincere gratitude to my thesis seminar instructor Martin Koenen, who was always ready to offer words of encouragement, help me with my Stata code, or read a last-minute draft. I would also like to thank my advisor, Professor Larry Summers, for pushing me to question my assumptions and dig deeper into my analyses. I also very much appreciate the Harvard undergraduate Economics Department for their academic support, along with all of the economics instructors who prepared me so well to write a macroeconomics thesis.

I would like to extend my heartfelt appreciation to my friends: Barbara and Elly, whose brilliance never ceases to amaze me, for quarantining with me and power houring together; Aidan, for being the sounding board for all of my ideas and a constant source of moral support; Lisa and the other residents of Eliot GZ for providing me with encouragement and sweets; Daniel, for keeping me motivated as my thesis evolved from an idea in September; Michelle for answering my econometrics questions and being my OG Econ friend; and of course, the friendship and positivity of many others.

Finally, thank you to my family for their continued love and support over the course of the past four years that I have spent at Harvard, and the one that I spent at home: my mom, for instilling in me a love for learning and sharing in my successes and my failures; my dad, for believing in me even when I don't believe in myself; and my sister Ryan, for helping me to proofread my writing at all hours of the night. I couldn't have done it without you!

Table of Contents

I. Introduction

In a monetary union—a group of countries sharing a currency—such as the European Union, member countries issue debt in the common currency of the union, which is not ultimately guaranteed by the individual country. Thus, there exists a default risk for countries in a monetary union that does not exist for standalone nations[1], which can always ensure solvency in a liquidity crisis through their independent central banks. This fundamental feature (or flaw) of monetary unions has been argued to lead to increased susceptibility to self-fulfilling solvency crises (De Grauwe 2012). That is, if markets expect a given country to default, market expectations can push a country from one equilibrium to another, ultimately forcing a default. Paul De Grauwe and Yuemei Ji attempt to validate this "fragility hypothesis" empirically through an analysis of bond spreads, which are used as a proxy for sovereign default risk, for members and nonmembers of monetary unions. De Grauwe and Ji (2013) use a non-linear regression model to assess the relative importance of three factors in determining the spread between the sovereign and baseline bonds:[2] economic fundamentals, time dummies, and residuals. De Grauwe and Ji find that the debt-to-GDP ratio in a country was not a significant component in predicting spreads before the financial crisis, but it became an explanatory variable in predicting the spreads after the crisis. They argue that the changing significance of debt-to-GDP ratios represents financial markets imposing more "discipline" on countries in the Eurozone compared to standalone countries after the sovereign debt crisis, by overpricing risk and inflating spreads. This paper extends and builds upon the De Grauwe and Ji analysis of bond spreads to further shed light on the fragility hypothesis.

[1] Nations that are not in a monetary union.
[2] The German Bund, for Euro Area countries, and the US Treasury for standalone countries.

In extending De Grauwe's empirical analysis, I have two goals situated within the broader context of the multiple-equilibria model. First, I aim to understand the benefit component of their model: how movements between the multiple equilibria unfold and if they are driven by investor sentiments to the extent that De Grauwe's analysis suggests. Studying a substantially longer time period, I analyze how the relationship between economic fundamentals and bond spreads has changed over time, particularly over the past decade, within the Eurozone and standalone nations. To increase the robustness of the empirical analysis, I improve the sovereign bond spread model's explanatory power by considering additional explanatory factors and utilizing multiple model specifications informed by a literature review of factors that affect bond spreads.

Second, I aim to examine the cost component of the model that De Grauwe and Ji (2013) overlook in their paper: what factors should be included when considering the cost of default. In De Grauwe and Ji (2013), the conception of what makes up the "cost of a default" is largely abstract and simplified to be considered a lump-sum cost, though a broad analysis of the literature suggests that there exist multiple factors (beyond solely economic fundamentals) that, by raising or lowering the cost of defaulting, affect a government's decision to default. While quantifying the role of exogenous and hidden costs of default—such as measures of political reputational costs of austerity— through the lens of a government in crisis is beyond the scope of this paper, I examine how other non-fundamental, but salient, factors may be priced into default risk. In using bond spreads as a proxy for sovereign default risk, I analyze residuals of various model specifications to explore these hidden costs that are country-specific in nature, such as history of default and perceptions of corruption. In building upon previous research through extending the time studied, including more countries in the analysis, adding additional control

variables, and increasing the validity of the model specifications, this paper finds that sovereign spreads are largely explained by economic fundamentals and also by market sentiments. In addition, the relationship between fundamentals and spreads is different for countries in the Euro Area compared to standalone nations, with spreads of the countries in the monetary union increasing more strongly in response to adverse fundamentals. Ultimately, this work contributes an increasingly complex and nuanced analysis of the multiple-equilibria model of sovereign default while considering the stability and institutional structure of monetary unions and suggests that there are fundamental instabilities that exist for nations within a monetary union.

Section 2 summarizes the background of the Eurozone, introduces the fragility theory of the Eurozone and accompanying multiple equilibria model of sovereign default, surveys the literature on this topic, and introduces additional factors which will be included in my models. Section 3, the empirical analysis, summarizes the data used, describes the econometric testing methodology, and highlights additional model specifications. Section 4 presents and discusses the results. Section 5 contextualizes the results and offers a discussion of the broader policy implications.

II. Background

A. An Incomplete Union?

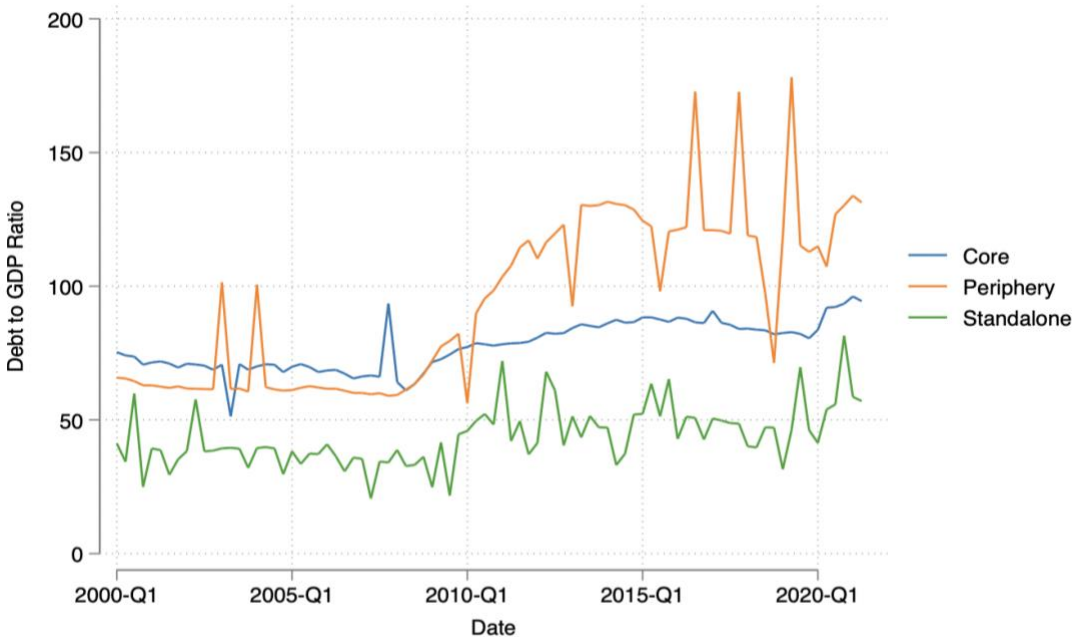
The foundation of the European Union as it exists today was established in 1992 through the Maastricht Treaty, or the "Treaty on European Union" ("Five Things.." 2020). The original twelve signatories—Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and the United Kingdom—were joined by sixteen others over the following three decades. Along with introducing the concept of a European citizenship, establishing a security and foreign affairs policy common across all European states, and promoting cooperation between states on issues related to justice, this treaty also served as the foundation for the Euro Area and for greater economic integration across European states. The banking system was developed, composed of the European Central Bank (ECB) along with the central banks of each of the member states, and the Euro was established as a common currency that could be used across member states. Together, these institutions were responsible for maintaining price stability and gradually aligning economic policies, until there was one common monetary policy, set and implemented by the ECB. As part of the European Union's (EU's) founding treaties, fiscal policies, such as budgeting and taxing, were left up to each individual member state ("Safeguarding…Crisis" 2019).

To obtain membership within the currency union, member states were required to meet a set of economic convergence criteria. These criteria, which stand today, include mandates for inflation control, debt and deficit ceilings, interest rate guidelines, and exchange rate stability. While the Maastricht criteria caps a country's debt to GDP ratio at 60%, this benchmark has often been interpreted as a suggestion by member states. In Figure 1, I compare debt to GDP ratios over

time for the core Eurozone countries, the periphery Eurozone countries, and large economies outside the Eurozone.[3] While most countries have experienced an increase in debt levels over time, countries in the periphery have proven to have very volatile debt to GDP ratios, experiencing periods where the ratio was collectively almost three times twice as large as the 60% benchmark. Such an increase in debt levels is traditionally thought of as indicating future potential financial trouble and solvency issues.

Figure 1: Euro Area (Core & Periphery) and Standalone Countries'

Debt to GDP Ratios 2000-2020



Note: Figure depicts debt to GDP ratio (in %) from 2000 to 2020 at quarterly intervals, separately for Eurozone Core countries, Eurozone Periphery countries, and Standalone countries.[4] The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

[3],[4] Core Euro subgroup countries include: Austria, Belgium, Finland, France, Italy, Netherlands. Periphery Euro subgroup countries include: Greece, Ireland, Portugal, and Spain. Euro Area countries include: Austria, Belgium, Cyprus, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. Standalone countries include: Australia, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Czechia, Denmark, Hungary, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Norway, Poland, Romania, Sweden, and Switzerland.

The Eurozone is often celebrated as a groundbreaking achievement in the way of political institutions. Never before had a group of countries unified in this way to grant authority over domestic affairs to a supranational agency. Adopting a common monetary policy without a fiscal or budgetary union was, and still is, seen as a risky move, one resulting in what some see as an incomplete institution vulnerable to shock and crisis. De Grauwe's 2012 paper, "Governance of a Fragile Eurozone," explores the institutional structure of the Eurozone in an attempt to determine the best mechanism for developing and completing a stable monetary union. The basic theory of instability stems from the fact that, in a currency union, states must give up the fundamental aspects of control over their currencies that they retained as sovereign states (DeGrauwe 2012). Specifically, weakness and instability arise within the context of debt issuance, as countries can no longer rely on a central bank to ensure that debt obligations will be met and have no such safeguard in place to fulfill bondholder obligations. If the European Monetary Union were akin to another large currency area, like the United States, "member states would tackle economic or financial shocks together," with an empowered "central government or jointly run institutions to deal with stressed financial entities, secure bank deposits, and provide fiscal relief to member states in a particularly deep recession" (Berger et. al. 2018). In issuing debt in the Euro, countries have no fundamental control over the currency as the ECB remains the only institution which issues Euros. This fundamental "paradox" serves as the foundation for the theory of a self-fulfilling debt crisis and the accompanying threat of instability.

One figure De Grauwe leverages to illustrate his basic argument is one which compares the debt to GDP ratios and 10-year bond rates of Spain and the UK, using data through 2011, which shows how—despite having a lower debt burden than the UK—Spanish bond rates were close to

200 bps higher than those of the UK. This difference is attributed to Spain's membership in a monetary union, making it a riskier investment than UK bonds, which are issued in British pounds and backed by the independent and sovereign Bank of England. In Figure 2, I extend the analyses to include data through 2020. Panel A showcases the striking increases in the debt to GDP ratio of the two countries while Panel B depicts the falling bond yields. In the period from 2010 to 2015, when both countries were experiencing similar growth in debt levels, the Spanish bond yields surged, while the UK bonds did not. This reflects the pressure of the debt crisis and falling investor confidence in Spanish bonds, which De Grauwe would argue is directly attributable to its membership in the Euro Area.

Figure 2A: Spain and UK Debt to GDP Ratios 2000-2020

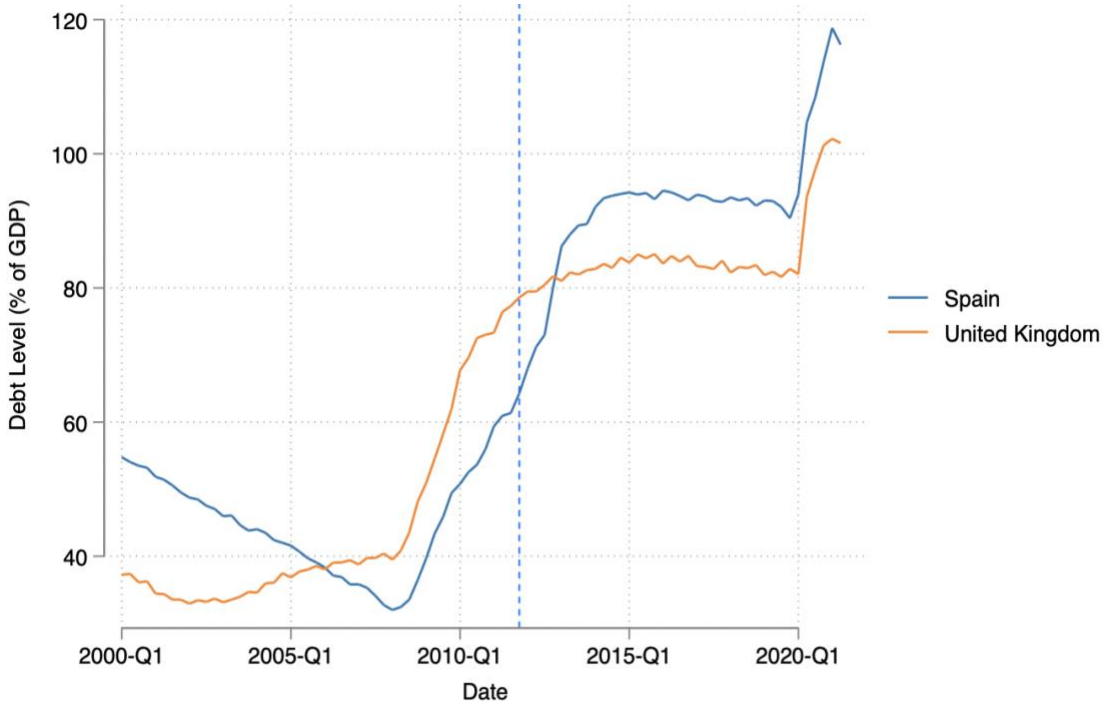


Figure 2B: Spain and UK 10 Year Bond Rates 2000-2020

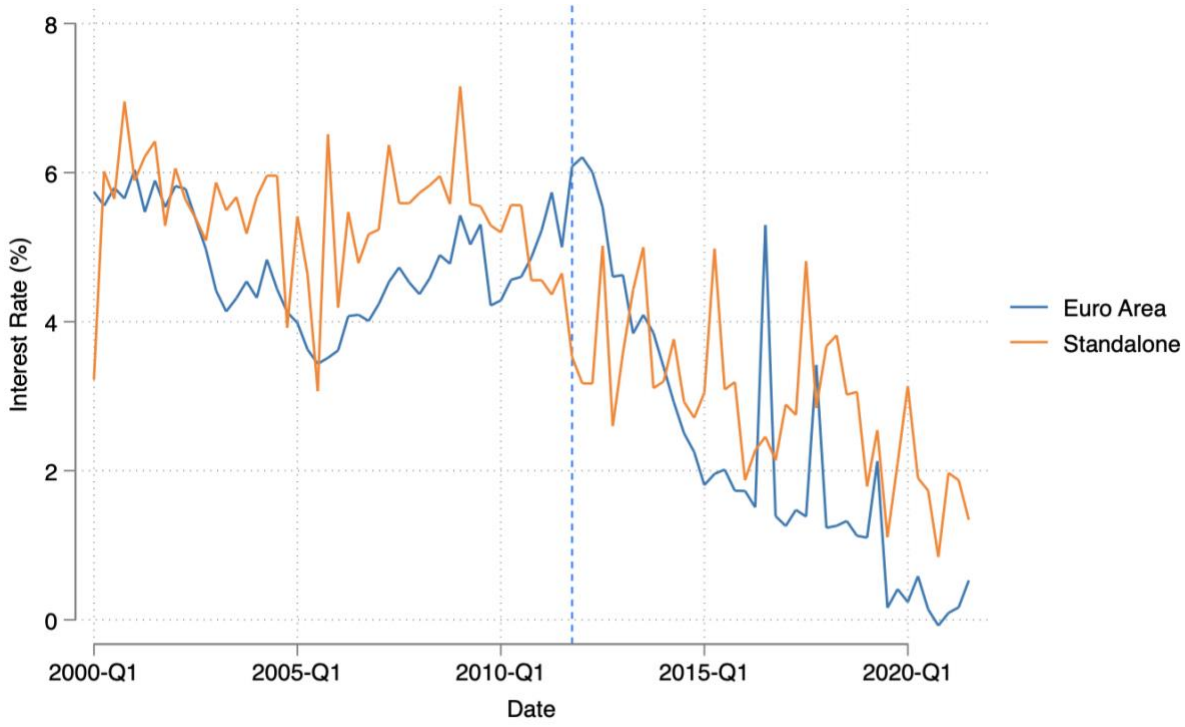
Note: Figure shows time series of the debt to GDP ratio (Panel A) and the 10-Year Bond Rates for Spain and the United Kingdom (Panel B). The dashed blue line indicates the end of the time series for corresponding analysis in De Grauwe and Ji (2013). The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

An important distinction must be made between two different causes of economic crises. The precursor to many debt crises, including those De Grauwe describes, is the financial instability and lack of solvency of any individual member state. This is the first type of economic crisis situation: issues with a member state's economy are problematic in themselves, resulting in adverse economic effects within the country. Second, deteriorating fundamentals, by raising doubts about a country's economic situation and solvency (due to large deficits or other signs of fiscal weakness) can trigger a crisis of confidence amongst investors—the type of crisis that De Grauwe focuses on in his multiple equilibria model, first presented in his 2012 paper, which will be discussed in greater detail in part C of this section.

B. European Sovereign Debt Crisis

This paper not only explores bond spreads, but also places the findings in the broader context of the European monetary system's institutional structure. In order to fully understand the structural and institutional features of this system, it is necessary to understand the context in which it was created and the considerations weighed throughout its development.

Figure 3: Euro Area vs. Standalone Interest Rates 2000-2020



Note: Figure shows time series of the mean interest rate for Euro Area and Standalone countries. The dashed blue line indicates the end of the time series for corresponding analysis in De Grauwe and Ji (2013). Included in the mean interest rate for Euro Area countries, at the time of entry into currency union, are: Austria, Belgium, Cyprus, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. Standalone countries include: Australia, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Czechia, Denmark, Hungary, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Norway, Poland, Romania, Sweden, and Switzerland. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

Figure 3 shows the relative trajectories of the mean interest rates between country groups, comparing countries within the Euro Area and standalone countries not part of a currency union. Euro Area countries have had lower interest rates than the group of standalone countries, apart from the years of the debt crisis. Since 1999, markets became more integrated and sovereign bonds were traded more interchangeably across the Euro Area countries, showcased by the diminishing bond yield spread across the Euro Area in the early 2000's ("Safeguarding…Crisis" 2019). Doubts about the stability of the currency, and by extension, the union, were few.

The creation of the institutional structure European monetary system as it exists today was a process that unfolded over the course of the sovereign debt crisis, a landmark event that tested the strength of the monetary union. The European sovereign debt crisis that began in 2008 with the collapse of Iceland's banking system and subsequently affected Portugal, Italy, Ireland, Greece, and Spain, sending ripples across the Eurozone that continued for years afterwards. In retrospect, there are a few key factors that have been pinpointed as having paved the way for, and exacerbating, the crisis. Large intra-area capital flows (mostly bank loans) led to high levels of private debt, and foreign credit was used to "finance consumption, an oversupply of housing and, in some countries, irresponsible fiscal policies" rather than for productive investment (Wijffelaars 2015). As a result, the peripheral states experienced a loss of economic and wage competitiveness and ran large deficits.

The Greek government elected in 2009 entered its term with much higher-than-expected budget deficits—in 2009, Greece's budget deficit exceeded 15% of its GDP, triggering fears of default and leading to widening 10-year bond spreads (Amadeo 2020). Investors who had been

previously insensitive to economic news began selling vast quantities of Greek debt, along with debt from countries throughout the Euro Area. This highlights the spillover effects driven by investor perceptions of potential default and/or by real deteriorating fundamentals that result from a sovereign debt crisis. As confidence deteriorated, the bond investors' demand for euro countries' sovereign debt fell, forcing interest rates to rise, which exacerbated debt levels and destroyed national budgets ("Safeguarding…Crisis" 2019). In 2010, Greece was unable to finance its debts and threatened to default, which, by extension, threatened the viability of the Eurozone. The fear of default spread to other countries in the Eurozone, leading to a period of heightened bond spreads as investors became increasingly aware of and attuned to default risks. In exchange for austerity measures and fiscal reform, the EU lent Greece enough to service its debts and avoid default, and Greece became a cautionary tale for similarly indebted countries. The contagious panic exacerbated the already-present economic crisis in the affected nations and is an example of the second type of crisis mentioned earlier: a crisis fueled by sentiment and loss of confidence, the implications of which will be modeled in section C.

C. Multiple Equilibria Default Model

De Grauwe's fragility theory of the Eurozone (2012) reasons that, if investor beliefs of insolvency are sufficiently large, investors will sell government bonds, creating a liquidity outflow, raising the interest rate, and resulting in a self-perpetuating solvency crisis and default. De Grauwe does not argue that all solvency crises are of this self-fulfilling nature, as countries may become insolvent irrespective of investor expectations, but rather that countries in a monetary union are especially vulnerable to these "self-fulfilling movements of distrust" that then "set in motion a devilish interaction between liquidity and solvency crises" (De Grauwe

2012). This is the same problem that often plagues developing countries, whose nascent economies are often forced to issue debt in a foreign currency. The result of this dynamic is demonstrated by a model of default that De Grauwe contends has "multiple equilibria" determined by the expectations of markets and investors of a country's solvency level. High trust in solvency keeps interest rates low and market conditions favorable, whereas low trust raises interest rates, making the debt more costly to roll over and, thus, the fulfillment of debt obligations more difficult.

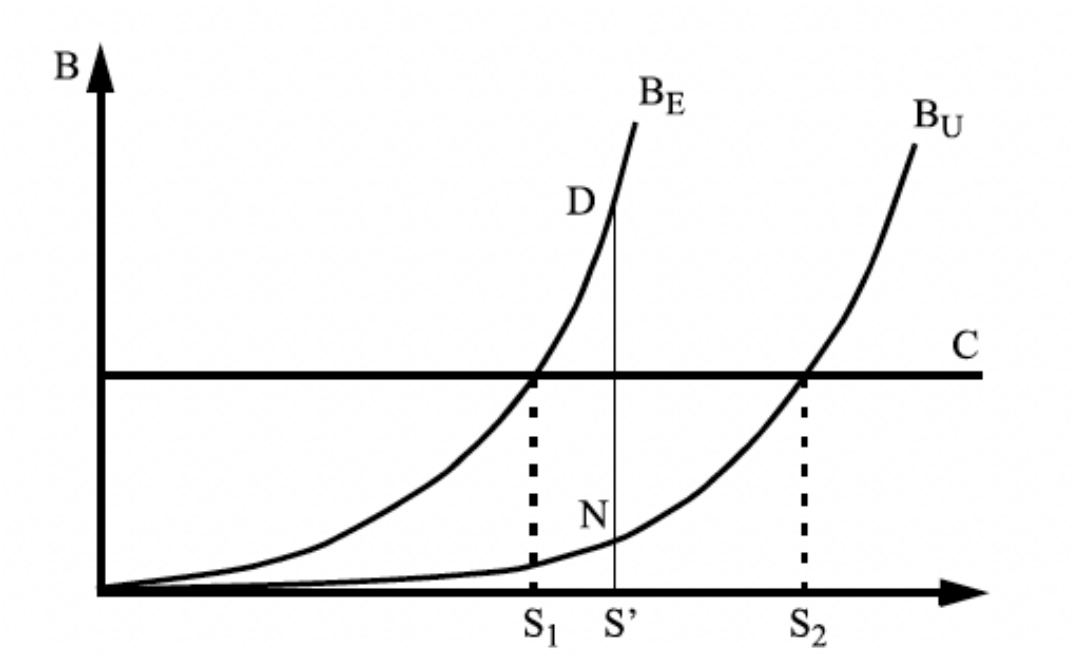
In the model of this phenomenon shown below, the X axis represents the magnitude of a solvency shock, and the Y axis (B) represents the benefits of defaulting, in the form of the money a government saves by defaulting on its debt. Horizontal line C represents the cost of default in the form of a government suffering a loss of reputation that would make it more difficult for the government to borrow in the future, after a default (De Grauwe 2012).[5] Line C is horizontal, as De Grauwe assumes that defaulting at any point will incur the same amount of reputational damage and impediment to future borrowing.[6] The vertical lines of S_1, S', and S_2 represent solvency shocks of different magnitudes, and the B_E and B_U curves represent the benefits of an expected and unexpected default, respectively. In both cases, the benefit of default increases as the solvency shock grows in magnitude, since the costs of austerity (raising and collecting taxes) will be higher and default becomes more favorable. A default unexpected by

[5] De Grauwe makes the simplifying assumption that this is a fixed cost.

[6] If the decision to default is considered as continuous, whereby debt restructuring is considered a "soft default" that leads to similar, but smaller in magnitude "costs," then a more accurate representation of the true "C" (the cost of default or of restructuring debt), could be estimated by quantifying the losses or "haircuts" forced on creditors through the sovereign failing to meet its debt obligations. This would be equivalent to the "benefit of default" which, if the sovereign elects to pursue a default or restructuring, outweighs the costs. Thus, the "cost" would be equivalent, or less than, the quantity of such creditor losses. Cruces et. al (2013) develop a dataset to quantify the costs of countries restructuring in debt crises and the "haircuts" faced by creditors.

investors and the market will always have a higher benefit than a default that is anticipated, since when a default is expected, investors proactively sell bonds, raising interest rates, which subsequently increases the government's budget deficit and calls for heightened austerity in the form of spending cuts and increased taxes. Since such austerity measures are not politically favorable, the benefit of an expected default will be higher than that of an unexpected one for any size solvency shock.

Figure 4: Multiple Equilibria Model



Source: De Grauwe and Ji, 2012

For shocks of size S', there exist two equilibria possibilities: D and N, depending on whether the default is expected or unexpected. In the case of an expected default, defaulting becomes more beneficial since the rise in interest rates would make the debt harder to pay off, and the model would land at point D. For the same size shock, however, if default is unexpected, interest rates

do not change, making the pay-off of debt less expensive than in the expected case, meaning the benefit of the default is lower and the model settles at point N. De Grauwe points to the existence of multiple equilibria in this model as underlining the importance of sentiments in driving default outcomes. He explains that:

> "since there is a lot of uncertainty about the likelihood of a default and since investors have very little scientific foundation to calculate probabilities of a default (there has been none in Western Europe in the last 60 years), expectations are likely to be driven mainly by market sentiments of optimism and pessimism. Small changes ... can lead to large movements from one type of equilibrium to another."

If investor and market sentiment do have a tangible and dramatic effect on bond spreads, as De Grauwe suggests, these sentiments can force the shift from equilibrium points N to D, as a default becomes expected. Further, whether a country is a sovereign or part of a monetary system thus arguably affects levels of investor trust and the subsequent default outcome—in a standalone country, default can be avoided, it is argued, since a central bank can be "forced to provide all the liquidity that is necessary to avoid such an outcome."

D. Sovereign Bond Spreads

There is extensive literature on components of sovereign bond spreads, which noticeably increased in the years during and directly following the European sovereign debt crisis. At the simplest level, bond spreads are the difference in interest rates between a country and a

benchmark, which reflects the default risk of that country[7] and is developed on the basis of economic fundamentals (González-Hermosillo 2008). Sovereign bond spreads are widely agreed upon being influenced by a few fundamental components/factors: the country's debt to GDP ratio or an indicator of "fiscal space," the country's current account position, the country's real effective exchange rate, and the country's rate of economic growth. De Grauwe and Ji conducted an empirical analysis of De Grauwe's 2012 theoretical paper, building upon existing models of bond spreads to test for the importance of investor sentiments in influencing bond spreads and therefore the role of market expectations in forcing default (De Grauwe and Ji 2013).

In addition to the aforementioned fundamentals, De Grauwe and Ji introduced the time dummy variable to measure the time effects that are "unrelated to the fundamentals of the model," to understand the effect of investor sentiments on sovereign spreads. Thus, the significance of the quarterly indicator of time represents the role of market contagion in affecting spreads, and the self-fulfilling market sentiments that arise from the fragility of the monetary union. Beyond fundamentals and the time indicator, there is a residual that exists within their regression, representing the proportion of the bond spread that cannot be explained by fundamentals or a time dummy in the regression. This residual is positive for some countries and negative for others. The authors' empirical findings support their theory, and show that over time, the relationship between fundamentals and bond spreads has differed for standalone countries and countries in a monetary union. Changes in the relationship between fundamentals and spreads over time reflect changing perceptions of risk across country groups, shedding light on the role

[7] Euro Area spreads are calculated to the bund, the German 10-year bond, as it is seen as the safest asset in the Euro Area, much like the US Treasury. Spreads in standalone countries are taken to the US 10-Year Treasury, similarly seen as one of the safest investments.

of self-fulfilling market sentiments in forcing a default and if creditors "punish" countries for being a part of a monetary union by reacting more strongly to changing fundamentals. The analysis concludes that fundamentals cannot account for the entirety of the bond spread, but rather that investor sentiments—in a self-fulfilling manner—exacerbated the crisis and widened the spreads, supporting the fragility hypothesis.

E. Additional Factors in Bond Spreads

I argue that there are a variety of overlooked factors that= contribute to the multiple-equilibria model beyond the economic fundamentals and time dummy components. In this section, I review additional papers to identify and discuss these factors that later guide my controls and specifications for additional empirical analyses. This analysis is broken into two sections based on the multiple equilibria model. First, additional factors that may influence a country's likelihood of default—moving from a non-defaulting equilibrium to a defaulting equilibrium (benefit of default)—are explored. Second, the hidden and visible costs of default are discussed, along with additional considerations for hidden cost components raised and new suggestions for controls presented.

1. Benefit of Default

In order to fully understand the role of market sentiments and investor contagion in forcing a default, it is essential to consider any additional factors that would be theorized to affect bond spreads. This can be considered as a more nuanced exploration of the "benefit curves" of the multiple-equilibria model. De Grauwe and Ji conclude that the movements from the B_E to B_U curves, and points N and D, are caused largely by changes in investor confidence. Martelli and

Aristei (2014) support this conclusion, though implicitly assuming that time dummies represent market sentiments. Their analysis, which uses behavioral variables as proxies for investor sentiment, supports De Grauwe and Ji's conclusion that investor expectations and sentiments (whether proxied via time dummies as in De Grauwe or market sentiment proxies as in this analysis) are significant factors along with fundamentals in determining bond spreads.[8]

Brenda González-Hermosillo (2008) uses an autoregression model to assess how bond spreads are affected during periods of financial crisis,[9] concluding that during periods of market instability, global market risk becomes a driving force in determining bond spreads and the relative importance of the factors included in the model also vary. In this model, when accounting for global market risk, the author finds that investor contagion risk is very small. Additionally, from the result that changes in bond spreads are not limited to a country facing a crisis, but also are seen at the same time in unrelated countries, the author hypothesizes that investors' short-run risk appetites play a role in influencing bond spreads.[10] De Grauwe's paper does not control for market volatility within his analysis, which is why I include indicators of expectation of near-term market volatility (VIX)[11] as a control factor in my regression analysis,

[8] The authors test different behavioral variables and compare these results with fixed panel models and mean-group regressions, finding that behavioral proxies are strongly statistically significant. The proxies they use include three country-specific investor sentiment proxies and three EU-wide investor sentiment indicators representing views on economic conditions and the like.

[9] This model quantifies how each of the following factors affect bond spreads: global market conditions (funding liquidity, market liquidity, as well as credit and volatility risks), contagion effects, and idiosyncratic factors.

[10] The mechanisms linking countries and asset markets to one another may only operate during periods of financial stress. One such channel includes portfolio rebalancing by international investors reacting to a shock, essentially meaning that investors are "re-pricing risk" by reducing risk in a portfolio or demanding a higher risk premium for riskier investments.

[11] Note that VIX is based off of the S&P 500, and thus reflects US equity market volatility. The channel through which market volatility affects spreads is expected to be: an increase in market volatility leads to investors becoming more risk-averse and seeking safer assets. This could shift investments away from equities and towards bonds, but also could alter the choice of sovereign bonds to hold, with investors favoring bonds with less perceived risk.

discussed in greater detail in Section 3.[12] VIX is considered to be a gauge of investor fear and will rise during times of financial stress and fall as investors become complacent to risks.

To control for longer-run changes in investor sentiments unrelated to fundamentals, such as trends in global investor risk tolerance, it is necessary to understand both the extent to which changes in bond spreads across the Eurozone can be attributed to global changes in investor risk tolerance as well as the mechanisms through which risk tolerance affects spreads—a factor De Grauwe and Ji did not include in their analysis. One of the most robust studies exploring the specific topic of risk aversion is Manganelli and Wolswijk (2009), which assesses the key factors that determine bond spreads across euro-area countries.[13] The authors point out that "existing literature is unanimous in finding that spreads of Euro Area government bond markets reflect liquidity and credit risks, and are mainly driven by a common factor [international risk aversion]," which changes borrowing costs across the board. To understand "what drives change in risk aversion and ultimately government bond spreads," the authors first dissect the broader dynamic and reciprocal effects of interest rates on the state of the economy. Their analysis supports the existence of two mechanisms through which bond spreads and global risk appetite are related,[14] both of which operate through a common pathway of affecting short-term interest

Ultimately, additional research is necessary to uncover the effect of short-term market volatility on sovereign bond spreads.

[12] Appropriately controlling for market risk should reduce any sentiment effect, whereby spreads are significantly affected by their previous level.

[13] There are three main factors: liquidity risk, credit risk, and a third factor, international risk aversion.

[14] First, the direct incentive on investment managers is a clear outcome of the interest rate environment. "When interest rates are low, investors have greater incentives to take on risk, in order to improve the expected return on their investment," and vice versa, when interest rates are high (Manganelli and Wolswijk 2009). The global interest rate environment has been declining for quite some time now, suggesting that investor risk tolerance may be at comparatively high levels. The second channel through which the authors hypothesize that risk aversion affects bond spreads is through affecting the state of the broader economy. More specifically, since "risk aversion increases during economic slowdowns and decreases in expansions," tightening monetary policy and depressing economic

rates, which are, in turn, affected by liquidity, cyclical conditions, and investor risk-taking incentives. In both cases, lower interest rates are associated with lower risk aversion and lower bond spreads.[15] In order to control for investor risk aversion, I include US corporate bond spreads as a control variable in my regression analysis since global sovereign bonds and US corporate bonds are two similar financial instruments, for which fundamental risks would be theorized to be largely uncorrelated: corporate default risk should be unrelated to sovereign default risk apart from a common channel of market volatility. However, both bonds are responsive to global cyclical market conditions and volatility, thus the spreads between AAA-rated and BAA-rated US corporate bonds serve as a proxy for global market perceptions of risk, and thereby account for a driving force that may be common to sovereign and corporate bond spreads: changing risk appetites amongst investors.[16]

Finally, I include inflation rate and change in inflation rate as controls in the modeling of bond spreads. Since inflation rates and expectations are priced into interest rates, future inflation risks are a component of absolute sovereign bond yields.[17] In theory, if investors are perfectly inflation-risk agnostic, it would be expected that changes in inflation would not alter spreads. However, inflation rates can arguably be considered as an economic indicator of market

activity will increase risk aversion, and vice versa. Thus, "if investors take on less liquidity or credit risk in the government bond market when interest rates are high, spreads will widen."

[15] Their analysis is inconclusive, and they conclude that "besides short-term interest rates, international risk aversion … continues to play a role in determining euro area government bond spreads, while not ruling out the possibility that an omitted variable is correlated with risk aversion or spread levels.

[16] Corporate bond spreads (spreads between HY and AAA, HY and BAA, and AAA and BAA) are highly positively correlated with one another, along with VIX, representing market volatility. This is a relationship that is expected due to the spreads reacting to volatility in the market, proxied by VIX. However, the correlation with US treasuries is low, and negative in magnitude. This is to be expected, as there should be low to no correlation between corporate-backed and government-backed securities.

[17] The higher the current rate of inflation and the higher the (expected) future rates of inflation, the higher the bond yields will be, in order to compensate investors for assuming inflation risk.

expectations. Similarly, change in inflation rates from one period to the next can also be viewed as a proxy for certain types of market risks. If inflation increases, investors who are risk averse will demand a higher compensation for the additional risk assumed. While the pathways through which investor risk tolerance and sovereign spreads are related are complex and not yet well-understood, including inflation as well as change in inflation controls can help to control for changes in spreads due to investor risk preferences.

2. Cost of Default

Costs of default are not explicitly modeled in the multiple-equilibria model of sovereign default, instead taken to be a fixed "C," which De Grauwe notes is a simplifying assumption. Gros (2012) extends De Grauwe's multiple equilibria framework by arguing that the cost of default has two main components: a lump sum once default is chosen (credit rating effects once a country has defaulted and services public debt in full and on time), and the variable cost that increases with the size of the total losses imposed on creditors (fraction of debt that the government does pay).[18] This model has the same multiple-equilibria default approach, whereby a "feedback loop between higher interest rates and the higher incentive to default can become explosive." This model extends the literature in its presentation of the choice of how much to pay creditors as less binary, based on the costs of raising revenues and the costs that can be imposed by creditors on the country in debt, becoming a tradeoff between "the amount the government is willing to pay and the taxes it has to raise to pay for this residual amount." This is in line with

[18] First is a "lump-sum cost due to the fact that the country does not service its debt fully and is recognized as being in default status, by ratings agencies" or other creditors for example. And second is "a cost that increases with the size of the losses (or haircut) imposed on creditors whose resistance to a haircut increases with the proportional loss inflicted upon them." Understanding that the cost of default has both fixed and variable cost components means that there are some situations in which it would be in the creditor's best interest to forgive debt and forgo a default.

my note in section 2C that " a more accurate representation of the true "C" (the cost of default or of restructuring debt), could be estimated by quantifying the losses or "haircuts" forced on creditors through the sovereign failing to meet its debt obligations.

Kalemli-Özcan, Reinhart, and Rogoff (2016) stresses the importance of understanding the exogenous costs of default, which play into the cost-benefit default analysis, including government interests that are skewed in favor of or against domestic bondholders. Blot et. al 2016 similarly presents this choice of default as a "strategic game between governments and private investors."[19] The authors support the conclusion of De Grauwe and Ji, finding that "recent empirical evidence has shown that the sharp increase in government bond yields cannot be attributed entirely to changes in macroeconomic fundamentals." There are a multitude of exogenous factors that are hidden to third parties, and can influence a government's cost of default, including the political repercussions of default, costs for future trust in government, the internal-external composition of government debt,[20] and sovereign default resulting in a decline in private sector credit[21] (Mallucci 2021, Sandleris 2014). Such costs of default are reflected in

[19] Building upon the previous multiple-equilibria models, the authors introduce uncertainty about the cost of default into the model, which extends the range of possibilities for the eventual outcome. This implies that when information is asymmetric, self-fulfilling expectations of default do not always occur, which the authors validate by examining the cases of Greece and Italy during the sovereign debt crises.

[20] Enrico Mallucci, in "Domestic Debt and Sovereign Defaults," examines how this factor affects the government's borrowing policy, sovereign risk, and welfare in a small open economy. He highlights an externality that distorts debt composition: "domestic debt levels are inefficiently low and default risk is inefficiently high," meaning that the efficient level of domestic purchases of government bonds would be higher than it is in the natural equilibrium (Mallucci 2021).

[21] In a 2014 paper, Sovereign Defaults, Credit to the Private Sector, and Domestic Credit Market Institutions, Guido Sandleris finds that beyond increasing borrowing costs for government entities, sovereign defaults are associated with declines in foreign and domestic credit to the domestic private sector, notably, "even if domestic agents do not hold sovereign debt." His findings represent an advancement in the understanding in the literature of the costs of sovereign defaults beyond those that directly affect the public sector.

the fact that sovereigns are more likely to pursue "a restructuring or renegotiation of its debt," than a full default, as supported by Gros (2012). Thus, for a sovereign to pursue a default or restructuring of debt, the benefit of reduced debt payments must outweigh the costs of "reputation effects, asset seizure, increased regulatory monitoring, reduced access to external finance" (Remolona et. al. 2007).

Though an analysis of such exogenous and hidden costs is beyond the scope of this paper, I do include some of the costs of default that are publicly visible and could contribute to a country's risk premium, thereby affecting spread levels as investors price in additional risk factors. While between the mid-1980's and the year 2000, "excess savings" shocks were the most significant factor in affecting bond yields, since then, "risk premium" shocks have accounted for more of the decline in real bond yields, indicating the growing importance of investor assessment of country-specific risk on bond yields (Daly 2016). Thus, I consider what other factors may affect the market's perceptions of the credit-worthiness of a country and their likelihood of default. The factors that I analyze include history of default and corruption perceptions, as these are both salient to investors and would thus be expected to be priced into the bond spread. The significance of these additional country-specific risk premia may be additionally supported by empirical analyses demonstrating that during the financial crisis, the impact of domestic factors on spreads increased significantly, particularly the cross-country differences in fundamentals (Barrios et al, 2009)—post-crisis, investors became more attuned to country-level differences in risks and country risk-premia played a larger role in the determination of bond spreads.

III. Empirical Analysis

A. Data

The data used in this analysis is panel data sourced from multiple public databases including Eurostat, the World Bank, the IMF, FRED, the OECD, Transparency International, and the BoC-BoE Sovereign Default Database from 1960 to 2021. A panel dataset was created through combining multiple datasets to obtain quarterly data for 42 countries from 2000 to 2021, with some historical variables being derived from values prior to 2000. While quarterly data was used where possible, for some variables, only annual data were available, in which case the yearly value was replicated for each quarter each year. Sovereign bonds include the Eurozone countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. Standalone countries include Australia, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Czechia, Denmark, Hungary, Iceland, Israel, Japan, Korea, Mexico, New Zealand, Norway, Poland, Romania, Sweden, and Switzerland.[22] Other variables used within my regressions include a country's debt to GDP ratio (debt as % of GDP), a country's exchange rate (to 143 trading partners), fiscal space (ratio of tax revenue to total government debt), current account balance to GDP ratio (USD accumulated since 2000/GDP), and GDP growth rate (% per year).

B. Methodology

This paper is an extension of the De Grauwe and Ji 2013 analysis of bond spreads, which used data from Q1-2000 to Q3-2011. In the 2013 paper, both a linear and non-linear econometric

[22] Germany and the United States are excluded from the analysis as they are the benchmarks for the Eurozone and standalone countries respectively.

regression model were used, and the significance of various factors in determining bond spreads were compared across country groups and time periods (pre-crisis and post-crisis). The following linear regression model was used:

$$(1) \qquad I_{it} = \alpha + z \times CA_{it} + \gamma \times Debt_{it} + \mu \times REE_{it} + \delta \times Growth_{it} + \alpha_i + u_{it}$$

As in the De Grauwe paper, I_{it} is the interest rate spread of country i in period t, CA_i is the accumulated current account deficit to GDP ratio of country i in period t, and $Debt_{it}$ is either the government debt to GDP ratio or the fiscal space of country i in period t, REE_{it} is the real effective exchange rate, $Growth_{it}$ is GDP growth rate, a is the constant term, and α_i is country i's fixed effect (De Grauwe 2013).

$$(2) \qquad I_{it} = \alpha + z \times CA_{it} + \gamma_1 \times Debt_{it} + \mu \times REE_{it} + \delta \times Growth_{it} + \gamma_{2x}(Debt_{it})^2 + \alpha_i + u_{it}$$

De Grauwe and Ji elect to use country fixed effects to control for "unobserved time-invariant variables"—which I also use throughout the models in this paper—to control for country-specific differences. By including country fixed effects, time-invariant factors such as political system, structural economic differences, or the efficiency of a country's tax system are all controlled for and can no longer confound the analysis. The non-linear specification, which I replicate, was used to represent the "discontinuous" nature of the decision to default, since "as the debt to GDP ratio increases, investors realize that they come closer to the default decision, making them more sensitive to a given increase in the debt to GDP ratio." In my model, I test both the debt to GDP ratio and fiscal space variables in order to determine which has a higher predictive property. I

also test a range of control variables, being sure to only include those exogenous to the model. As De Grauwe states, there is a temptation to include many explanatory variables such as country-specific bond ratings or risk ratings, yet these are unlikely to be endogenous especially in a crisis situation, as they are a reaction to the unfolding financial instability.

De Grauwe and Ji's analysis centers around comparing various subgroups of the Euro Area spread behavior with a group of "standalone comparison countries." They define this category of countries as those not part of a monetary union, issuing debt in their own currencies, and with a GDP per capita greater than or equal to $ 20,000 and a population greater than or equal to five million. They include 14 "standalone" developed countries in this category: Australia, Canada, Czech Republic, Denmark, Hungary, Japan, South Korea, Norway, Poland, Singapore, Sweden, Switzerland, the UK and the US. I increase the robustness of the analysis through expanding the dataset to include additional standalone countries: Bulgaria, Chile, Colombia, Costa Rica, Croatia, Iceland, Israel, Mexico, New Zealand, and Romania. Additionally, they distinguish between the "core" and "periphery" Eurozone countries, with the "core" of Austria, Belgium, Finland, France, Italy, Netherlands and the "periphery" of Greece, Ireland, Portugal, and Spain.[23]

C. Additional Specifications

In addition to utilizing regression specifications from the De Grauwe paper, I also increase the validity of the model used by incorporating additional control variables based on my survey of

[23] This grouping is widely used in literature on Euro Area countries (De Grauwe and Ji 2013).

the relevant literature, including inflation (% per year), change in inflation (absolute change from previous quarter in % per year), US corporate bond spreads (spread of AAA to BAA rated 10-year corporate bonds), and VIX, which measures market expectation of near-term volatility conveyed by stock index option prices. The initial model with additional controls is as follows:

$$(3) \quad I_{it} = \alpha + z \times CA_{it} + \delta \times Debt_{it} + \gamma_2 \times (Debt_{it})^2 + \mu \times REE_{it} + \delta \times Growth_{it} + \varepsilon \times Inflation_{it} + \zeta \times \Delta Inflation_{it} + \theta \times VIX_t + \eta \times CorpSpreads_t + \alpha_i + u_{it}$$

I also developed a model which included corruption levels as scored by the Corruption Perceptions Index (CPI), as well as a quantification of a country's history of default. The Corruption Perceptions Index is scored from 0 to 100, with 0 being the most corrupt. It would be expected that if a country is perceived to be more corrupt and less credit-worthy, then spreads would be larger to account for the risk premium increase of holding that country's debt. The historical default indicator constructed is from the BoC-BoE Sovereign Default Database, which contains estimates of government obligations in default, in US dollars. These include bonds and other marketable securities, bank loans and official loans between the years 1960 to 2020. To develop the historical quantification of default, I created a variable which is a sum of the total debt obligations that have been in default up to the year in question.[24] The following regression model was used:

$$(4) \quad I_{it} = \alpha + z \times CA_{it} + \delta \times Debt_{it} + \gamma_{2x}(Debt_{it})^2 + \mu \times REE_{it} + \delta \times Growth_{it} + \varepsilon \times Inflation_{it} + \zeta \times \Delta Inflation_{it} + \eta \times CorpSpreads_t + \tau \times CPI_{it} + \theta \times HistDefault_{it} + \alpha_i + u_{it}$$

[24] For example, if a country has a debt balance of $10 M in default for ten years between 1975 and 1985, it would have a default indicator of $50M IN 1980 AND $100 M in 1985.

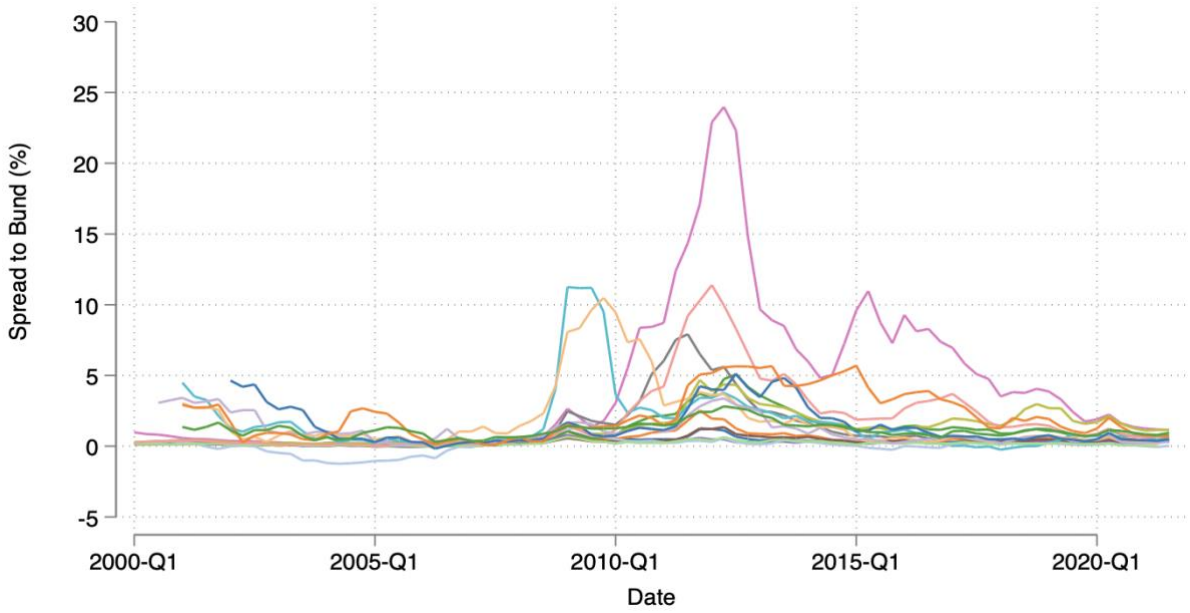
IV. Results

A. Descriptive Analysis

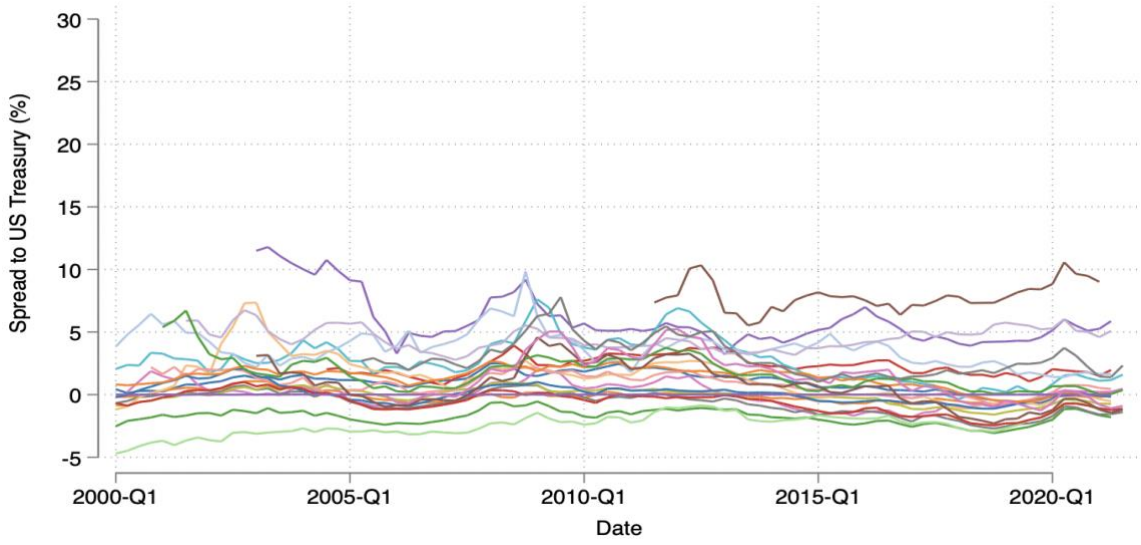
Sovereign bond spreads react to investor uncertainty and doubt. During the sovereign debt crisis between 2008 and 2012, the fear of default rippled across to other countries in the Eurozone, leading to a period of heightened bond spreads as investors were increasingly aware of and attuned to default risks. Euro Area spreads are calculated to the bund, the German 10-year bond, as it is seen as the safest asset in the Euro Area. Spreads in standalone countries are taken to the US 10-Year Treasury, similarly seen as one of the safest investments. Throughout this results section, I have created data visualizations that replicate and extend those in the De Grauwe paper. The following set of figures reflects the distribution of spreads by country group, comparing the differences between 10-year bond spreads in Euro Area countries and in standalone countries. The visuals support the hypothesis that the Euro Area nations are more susceptible to elevated spreads due to the instability that arises from currency unions. Spreads were much higher in the Euro Area countries reflecting the debt crisis and fear of default.

Figure 5: Spreads in Euro Area and Standalone Countries 2000-2020

Panel A: Euro Area Countries: Spread to Bund (%)



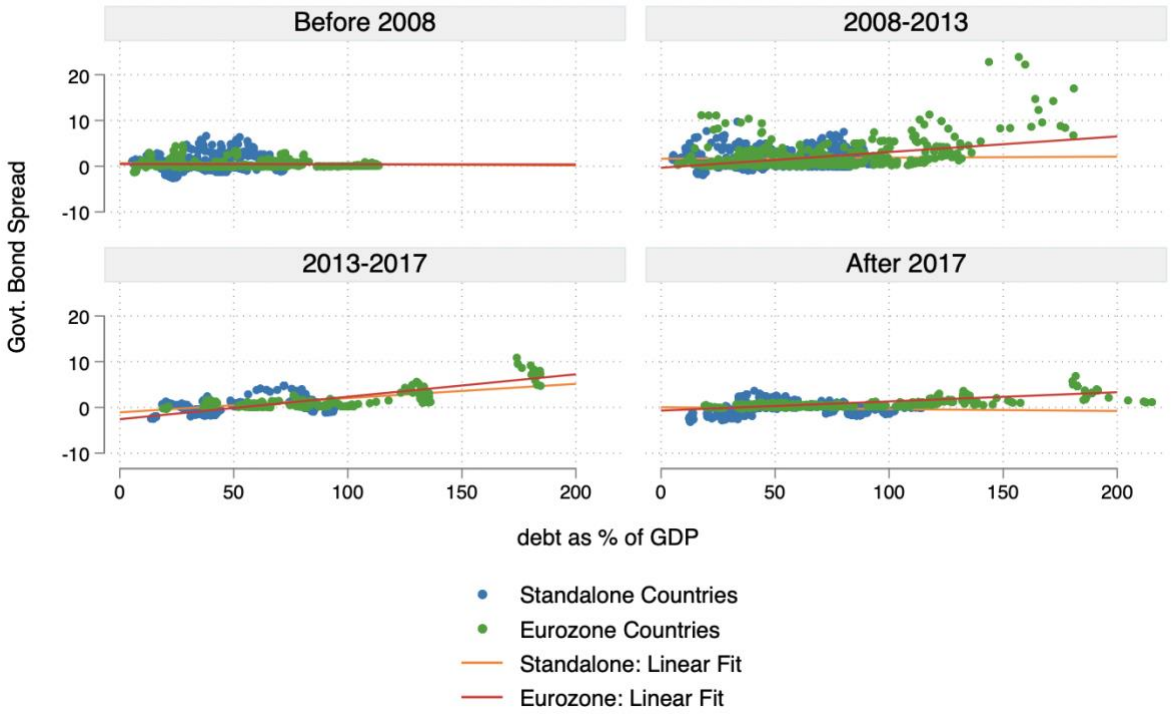
Panel B: Standalone Countries: Spread to US Treasury (%)



Note: Panel A shows sovereign 10-year bond spreads to the German Bund for Euro Area Countries between 2000 and 2020. Panel B shows sovereign 10-year bond spreads to the US Treasury for Standalnie Countries between 2000 and 2020. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

Figure 6: Debt to GDP Ratio (%) and Bond Spreads for Standalone and Euro Area countries

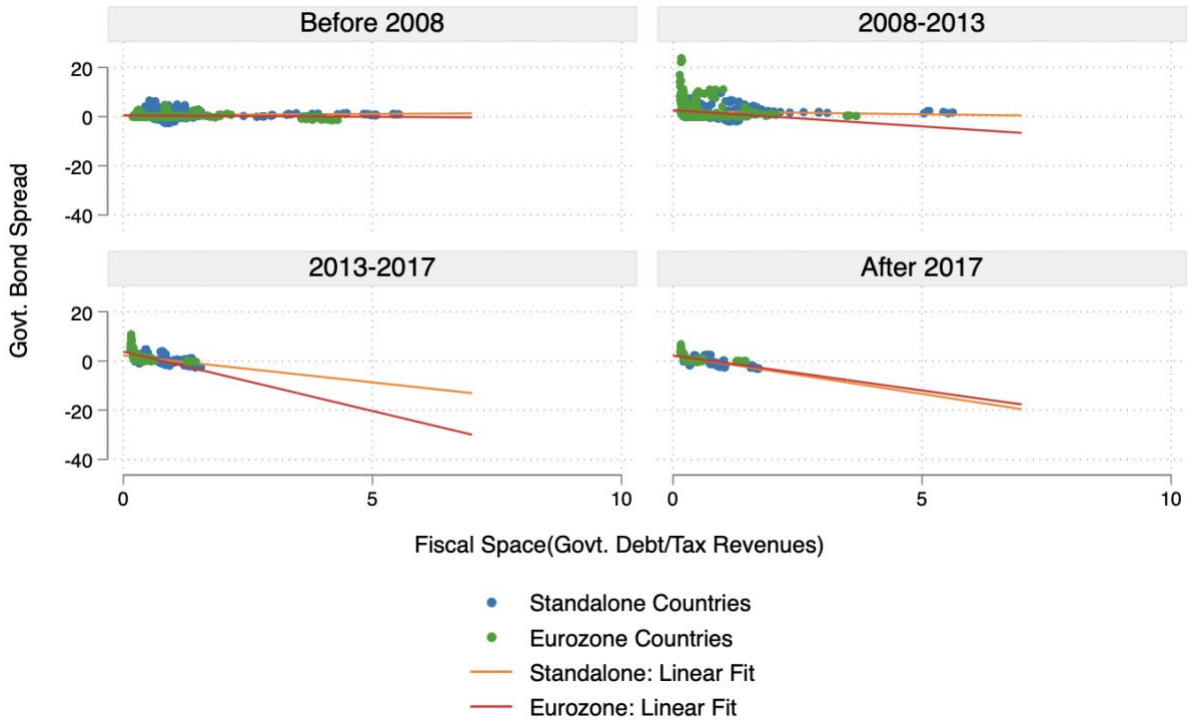
2000-2020



Note: Figure shows scatterplot and linear fit of bond spreads to debt to GDP ratios for Euro Area and Standalone countries broken into four time periods. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

The above figure reflects the relationship between the Debt to GDP ratio and the bond spreads for Euro Area and standalone countries. Before 2008, there was no clear relationship in either country group, but since 2008, the relationship between debt levels and spreads has been higher in Euro countries than for standalone countries, with a relationship in both groups, suggesting that investors have become more risk-aware overall, and have been less risk tolerant with respect to European countries. De Grauwe found a significant break in the relationship before and after 2008 in Euro countries, and no change in the relationship among standalone countries.

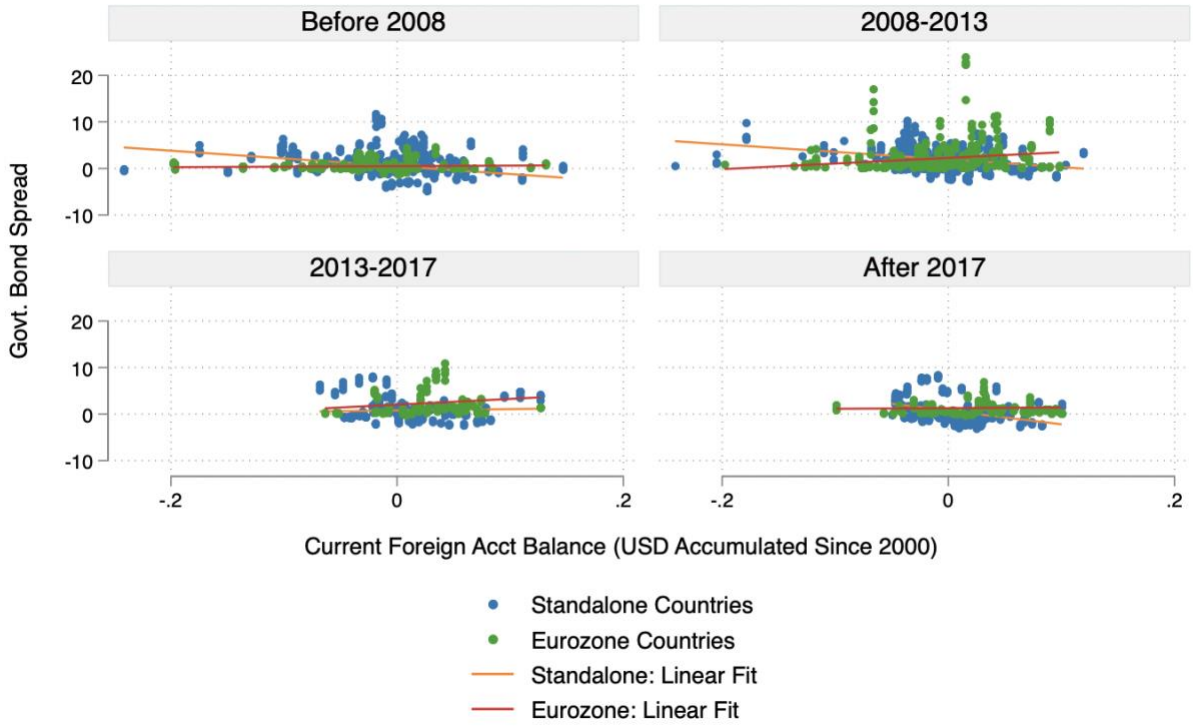
Figure 7: Fiscal Space and Bond Spreads for Standalone and Euro Area countries 2000-2020



Note: Figure shows scatterplot and linear fit of bond spreads to fiscal space (Defined as the ratio of Govt. Debt to Total Tax Revenues) for Euro Area and Standalone countries broken into four time periods. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

The above figure reflects the relationship between the Fiscal Space variable—the ratio of govt. Debt to total tax revenues—and the bond spreads for Euro Area and standalone countries. Before 2008, there was no clear relationship in either country group, but between 2008 and 2013, the relationship between fiscal space and spreads has been stronger in Euro countries than for standalone countries, with greater fiscal space correlating with lower spreads. Since 2017, both country groups experience a similar relationship, suggesting that investors have become more attuned to this metric overall and have stopped pricing in an additional risk premium for Euro Area countries.

Figure 8: Current Foreign Account Balance and Bond Spreads for Standalone and Euro Area countries 2000-2020

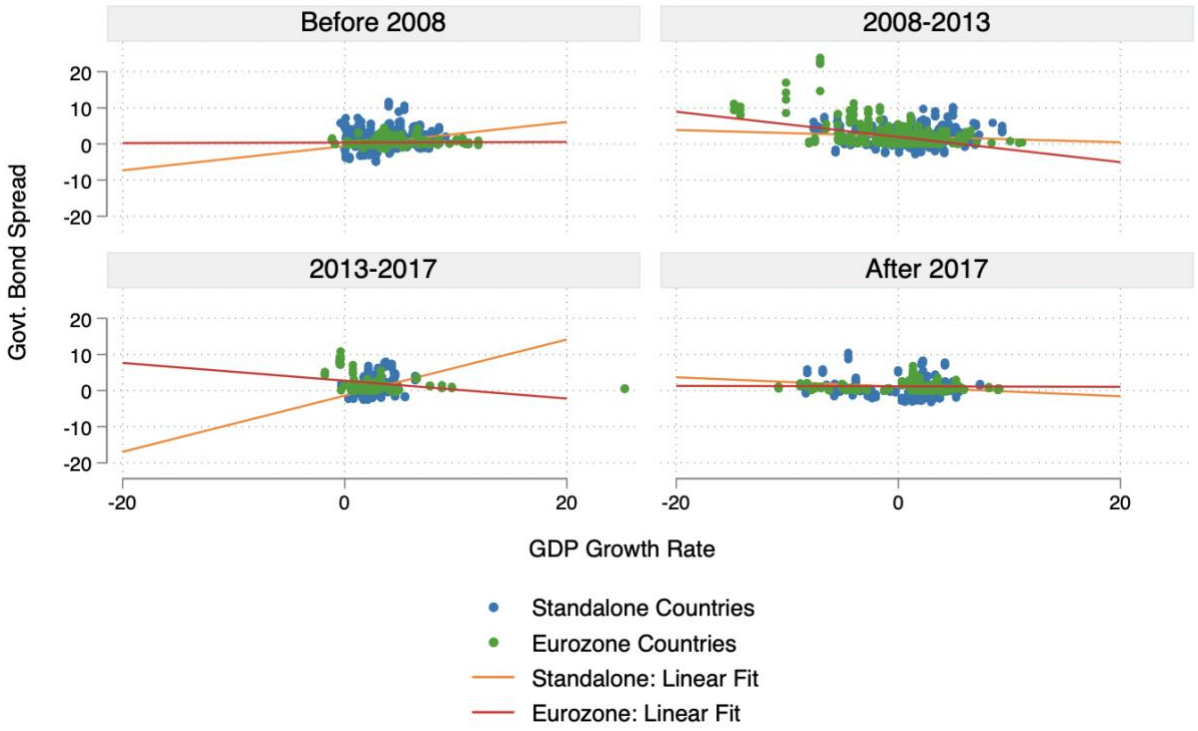


Note: Figure shows scatterplot and linear fit of bond spreads to current foreign account balance (Defined as the amount accumulated since Q1 2000 divided by GDP level) for Euro Area and Standalone countries broken into four time periods. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

Current account deficits are a fundamental indicator that should be interpreted as "increases in the net foreign debt of the country as a whole (private and official residents)" (DeGrauwe 2013). The above figure reflects the relationship between the current account deficit and the bond spreads for Euro Area and standalone countries. In all time periods, the Euro Area countries had a slightly more positive correlation between current account deficits and spreads, with higher deficits related to higher spreads. On the contrary, standalone countries have had a negative

relationship in all time periods, suggesting that this metric is not as important, or not interpreted in the same way for sovereign countries as compared to countries in a monetary union.

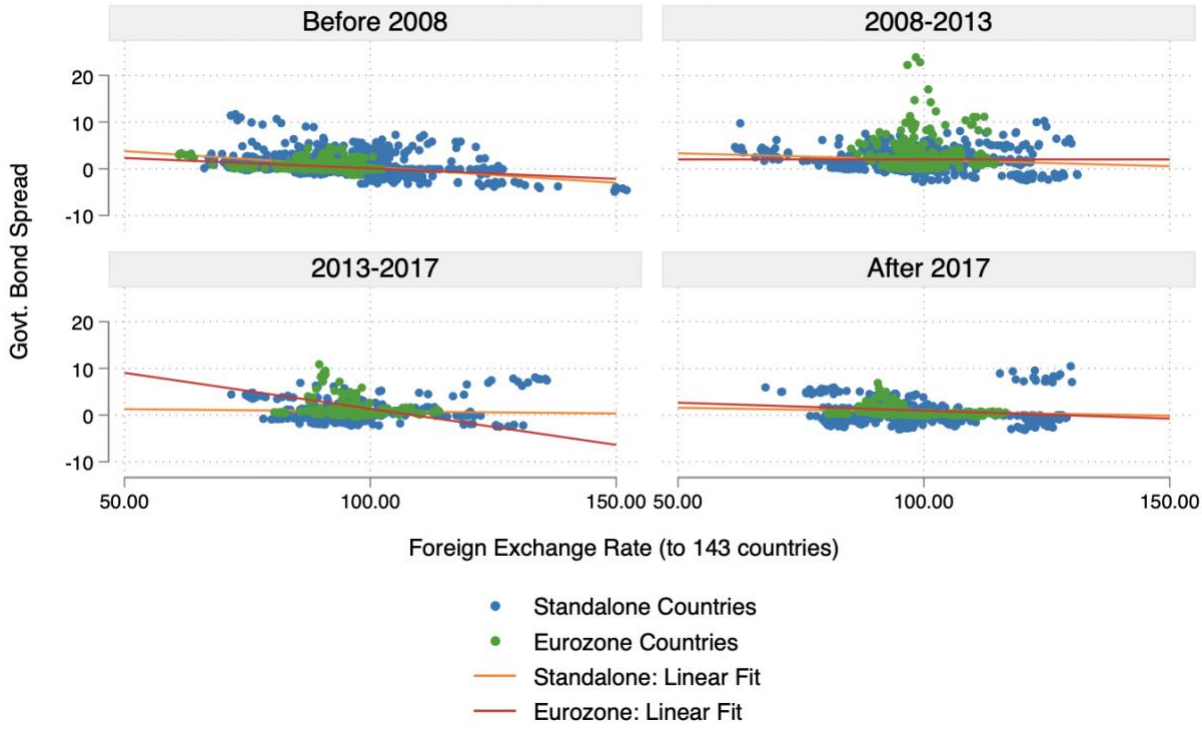
Figure 9: GDP Growth Rate and Bond Spreads for Standalone and Euro Area countries 2000-2020



Note: Figure shows scatterplot and linear fit of bond spreads to GDP Growth Rate (% per year) for Euro Area and Standalone countries broken into four time periods. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

The above figure reflects the relationship between the GDP growth rate and the bond spreads for Euro Area and standalone countries. While some of these coefficient estimates appear to be positive, this is likely driven by confounding factors; once controlling for various other factors (Table XII), the relationship becomes negative throughout, as discussed in more detail below.

Figure 10: Foreign Exchange Rate and Bond Spreads for Standalone and Euro Area countries 2000-2020



Note: Figure shows scatterplot and linear fit of bond spreads to foreign exchange rate (Defined as the mean exchange rate to 143 Trade partners) for Euro Area and Standalone countries broken into four time periods. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

The above figure reflects the relationship between the Foreign Exchange Rate and the bond spreads for Euro Area and standalone countries. The inverse relationship between the exchange rate and spreads has been quite similar in both country groups over time, with the exception of between 2013 and 2017, where the Euro Area countries had a stronger negative relationship than standalone countries. As De Grauwe suggests, the negative sign reflects the idea that "'carry

trade' has been a significant factor, i.e. countries with low (high) interest rates tend to experience currency depreciations (appreciations)."

B. Regression Analysis

The first set of regressions in Tables 1 and 2, involves the Euro Area and standalone countries, and replicates the regressions of the De Grauwe and Ji 2013 paper. Models 1 and 2 use the debt to GDP ratio as an indicator of indebtedness, while Models 3 and 4 use fiscal space instead. The difference between the two is subtle. De Grauwe explains, "when the government debt to GDP ratio increases the burden of the debt service increases leading to an increasing probability of default." On the other hand, fiscal space is the ratio of the government debt to total tax revenues which may be a better measure of debt sustainability, as the capacity for raising taxes directly affects a state's ability to raise necessary funds to service its debts. In both sets of regressions, using fiscal space in place of the debt to GDP ratio improves the fit, as indicated by the increase in the R-squared value, though for the standalone countries, fiscal space was not significant to the model, again perhaps indicating less investor scrutiny for countries issuing debt in their own currencies.

The coefficients are all as would be theoretically expected in the Eurozone models, for an increase in a country's current account balance should be interpreted as an "increase in the net foreign debt of the country as a whole," which can either arise due to private or public sector overspending, both of which would hamper economic activity, lead to a decline in government revenues, and raise the default risk for a government, thus increasing the spread. The GDP

growth coefficients are both negative and a decrease in GDP growth would both signify decreased economic activity and decreased government revenues, as well as increased default risk. The magnitude of the GDP growth coefficient is stronger for Euro Area countries, suggesting that investors are more responsive to changes in fundamentals for countries in a currency union. The effects of the exchange rate are opposite as expected in the Eurozone models, as it would be expected that an increase in the exchange rate, not decrease, could be an indicator of decreasing competitiveness and economic trouble in the future, increasing default risk.

Table 1: Spread in Eurozone: (Q1 2000 - Q2 2021)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Current Acct Balance to GDP	-0.0133	2.970***	10.98***	12.89***
	(1.051)	(1.051)	(1.144)	(1.319)
Exchange Rate	-0.0115*	-0.00147	-0.0568***	-0.0527***
	(0.00602)	(0.00589)	(0.00970)	(0.00978)
GDP Growth (%)	-0.166***	-0.171***	-0.369***	-0.376***
	(0.0114)	(0.0111)	(0.0148)	(0.0150)
Debt to GDP Ratio	0.0321***	-0.0252***		
	(0.00229)	(0.00563)		
Debt to GDP Ratio^2		0.000261***		
		(2.36e-05)		
Fiscal Space			0.193	1.349***
			(0.126)	(0.420)
Fiscal Space^2				-0.239***
				(0.0830)
Constant	0.549	1.829***	7.559***	6.690***
	(0.643)	(0.633)	(0.965)	(1.008)
Country FE	Yes	Yes	Yes	Yes
Observations	1,776	1,776	1,452	1,452
R-squared	0.460	0.495	0.526	0.529

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The above regression output reflects the linear and non-linear specifications of the model of Eurozone bond spreads over the period from 2000 to 2020. The sign and significance of each of the variables do not change between models, which suggests that Current account balance, exchange rate, GDP growth, debt to GDP, and fiscal space all have significant effects on the spread in the Eurozone, seen by the low p-values for these coefficients. The non-linear specification also improves the fit for the Eurozone countries, for both the models using debt to GDP and the models using fiscal space, suggesting that changes in fiscal space have a magnified effect on bond spreads, and that these two variables are highly non-linear.

Table 2: Spread in Standalone Countries (Q1 2000 - Q2 2021)

VARIABLES	(1) Model 1	(2) Model 2	(3) Model 3	(4) Model 4
Current Acct Balance to GDP	-2.753***	-2.537***	-2.697***	-2.034***
	(0.627)	(0.621)	(0.563)	(0.579)
Exchange Rate	-0.0110***	-0.00885***	0.00161	-0.00227
	(0.00266)	(0.00266)	(0.00297)	(0.00308)
GDP Growth (%)	-0.169***	-0.167***	-0.270***	-0.267***
	(0.00922)	(0.00912)	(0.0104)	(0.0103)
Debt to GDP Ratio	-0.0205***	-0.0604***		
	(0.00264)	(0.00676)		
Debt to GDP Ratio^2		0.000410***		
		(6.41e-05)		
Fiscal Space			0.242***	0.884***
			(0.0553)	(0.154)
Fiscal Space^2				-0.120***
				(0.0269)
Constant	3.213***	3.789***	1.457***	1.405***
	(0.283)	(0.294)	(0.292)	(0.290)
Country FE	Yes	Yes	Yes	Yes
Observations	1,829	1,829	1,500	1,500
R-squared	0.733	0.739	0.796	0.799

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The above regression output reflects the linear and non-linear specifications of the model of standalone country bond spreads from 2000 to 2020. This regression indicates that ratio of a country's Current Account Balance to GDP, Exchange Rate, and GDP growth are all significant to determining the spreads at the 5% significance level in all of the regressions except for Models 3 and 4 for standalone countries, in which Current Account Balance is not significant. However, fiscal space does not have a significant effect on bond spreads for the standalone countries. The magnitude of the coefficients for the explanatory variables is also lower for the standalone countries than it is for the eurozone countries, suggesting that spreads in eurozone countries are more susceptible to changing fundamentals. Similarly to the Eurozone countries, model 4, with fiscal space and the non-linear specification, has the highest explanatory power.

The next set of regressions, in Tables 3 and 4, show the results of the country groups across each of the four time periods studied, using either debt to GDP ratio or the fiscal space variable. The regression specification was replicated from the De Grauwe paper and extended through 2020 for a comparison of trends.

Table 3: Structural Break In Euro Area Country Spreads (Q1 2000 - Q2 2021), DeGrauwe Specification; Debt to GDP Ratio

	(1)	(2)	(3)	(4)
	Euro Area	Euro Area	Euro Area	Euro Area
VARIABLES	Before 2008	2008-2013	2013-2017	After 2017
Current Acct Balance to GDP	3.282***	16.09***	17.28***	5.187***
	(0.606)	(2.957)	(2.976)	(1.658)
Exchange Rate	-0.0369***	-0.112***	-0.0444**	0.0973***
	(0.00420)	(0.0384)	(0.0203)	(0.0185)
GDP Growth (%)	-0.0435***	-0.268***	-0.188***	-0.00274
	(0.0120)	(0.0263)	(0.0334)	(0.00866)
Debt to GDP Ratio	0.0146***	0.0454***	-0.0613***	-0.0155**

	(0.00566)	(0.00848)	(0.0184)	(0.00635)
Constant	3.410***	10.60**	12.44***	-6.678***
	(0.555)	(4.162)	(2.473)	(1.876)
Country FE	Yes	Yes	Yes	Yes
Observations	682	492	216	386
R-squared	0.551	0.696	0.970	0.872

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Structural Break In Euro Area Country Spreads (Q1 2000 - Q2 2021), DeGrauwe Specification; Fiscal Space

	(1)	(2)	(3)	(4)
	Euro Area	Euro Area	Euro Area	Euro Area
VARIABLES	Before 2008	2008-2013	2013-2017	After 2017
Current Acct Balance to GDP	1.850**	28.17***	13.64***	37.33***
	(0.757)	(2.757)	(3.116)	(5.244)
Exchange Rate	-0.0274***	-0.218***	-0.0597***	-0.0116
	(0.00509)	(0.0377)	(0.0218)	(0.0222)
GDP Growth (%)	-0.0400***	-0.298***	-0.197***	0.0833*
	(0.0131)	(0.0284)	(0.0364)	(0.0469)
Fiscal Space	-0.985***	0.596*	-2.888	-0.991
	(0.240)	(0.360)	(2.109)	(1.381)
Constant	4.107***	23.69***	9.185***	2.107
	(0.507)	(3.735)	(2.329)	(1.960)
Country FE	Yes	Yes	Yes	Yes
Observations	604	443	204	201
R-squared	0.509	0.692	0.968	0.956

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0

In Tables 3 and 4, the debt to GDP ratio and the fiscal space variables support the expected outcome, with the variables both having a significant effect during the 2008-2013 period of the crisis. During this time period, the worst of the debt crisis, the coefficients are positive, meaning that an increase in debt to GDP ratio increased spreads, as expected, but an increase in the fiscal space of a country also increased spreads, which is not expected. The R-squared values of the regressions that use fiscal space are higher than those which use debt-to-GDP ratio, so this is the variable that will be used to represent the indebtedness levels henceforth.

The coefficient on the current account balance to GDP ratio is interesting to examine in the above regressions, as in both cases, the coefficient is positive, and increases significantly in magnitude after 2008, and remains elevated after the crisis subsides. Since the current account balance should be understood as a country's net foreign debt, arising from public or private sector overspending, a positive coefficient is thus expected. The coefficient increased by a factor of ten between 2000-2008 and 2008-2013, which suggests that investors become more attuned to the debt burden of particular countries, and "punished" them accordingly, with spreads being much more sensitive to changes in current account balance. This trend does not hold for the standalone nations shown in Table 5, discussed in greater detail below. This difference supports the idea that markets overcorrect in pricing risk for Euro Area countries, becoming more acutely attuned to increases in debt levels for countries in the Eurozone, with the effect not being mirrored in standalone nations. The next set of regressions, in tables 5 and 6, replicates the regressions in tables 3 and 4 for the standalone countries.

Table 5: Structural Break In Standalone Country Spreads (Q1 2000 - Q2 2021), DeGrauwe Specification; Debt to GDP Ratio

VARIABLES	(1) Standalone Before 2008	(2) Standalone 2008-2013	(3) Standalone 2013-2017	(4) Standalone After 2017
Current Acct Balance to GDP	-4.222***	-2.932***	6.413***	0.307
	(0.873)	(1.078)	(1.284)	(1.830)
Exchange Rate	-0.0402***	-0.00434	0.0267***	0.0485***
	(0.00416)	(0.00637)	(0.00631)	(0.00893)
GDP Growth (%)	-0.213***	-0.150***	-0.0361	-0.0942***
	(0.0245)	(0.0122)	(0.0253)	(0.00792)
Debt to GDP Ratio	-0.0165***	-0.0219***	0.0383***	0.00844
	(0.00593)	(0.00432)	(0.00906)	(0.00689)
Constant	5.763***	3.303***	-3.817***	-4.688***
	(0.451)	(0.691)	(0.841)	(0.895)
Country FE	Yes	Yes	Yes	Yes
Observations	567	617	330	315
R-squared	0.851	0.892	0.967	0.946

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Structural Break In Standalone Country Spreads (Q1 2000 - Q2 2021), DeGrauwe Specification; Fiscal Space

VARIABLES	(1) Standalone Before 2008	(2) Standalone 2008-2013	(3) Standalone 2013-2017	(4) Standalone After 2017
Current Acct Balance to GDP	-3.248***	-4.585***	4.975***	16.13***
	(0.896)	(0.949)	(1.303)	(3.275)
Exchange Rate	-0.0292***	-0.000187	0.0191***	-0.00309
	(0.00511)	(0.00670)	(0.00664)	(0.0135)
GDP Growth (%)	-0.212***	-0.171***	-0.0113	-0.0244
	(0.0264)	(0.0122)	(0.0265)	(0.0393)
Fiscal Space	0.252**	0.279***	-0.582*	-3.760***
	(0.126)	(0.0893)	(0.329)	(0.512)
Constant	4.059***	1.986***	-0.801	3.045**
	(0.437)	(0.681)	(0.548)	(1.307)
Country FE	Yes	Yes	Yes	Yes
Observations	484	544	296	176
R-squared	0.864	0.894	0.970	0.979

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

While the coefficient on the current account balance to GDP ratio is positive and increases significantly in magnitude after 2008 for the Eurozone countries, in Table 5, this is not the case for the standalone countries, as shown in Table 6. For the standalone nations, the current account balance variable is negative over the period from 2000 to 2013 and does not change in magnitude to the extent that it does in the Euro Area countries, as discussed above.

The next set of regressions, in table 7, incorporates the time dummy variables used in the De Grauwe and Ji 2013 analysis. The time dummies, for quarter fixed effects, represent the influence of the quarter itself on the spreads, and thus reflects investor fears of contagion. In De Grauwe's analysis, he finds that the effect of the time variable in the standalone countries is weak, while in the Eurozone, there is an "increasing positive time effect since 2010-Q2" with "significant and positive time effects from 2010-Q4 to 2011-Q3 in both the core and periphery of the Eurozone." He concludes from the effects from the time dummies that, in the post-crisis period, "the spreads in the peripheral countries of the Eurozone were gripped by surges that were independent from the underlying fundamentals."

The interpretation of the coefficients on the year dummy variable is the effect of the quarter itself on bond spreads irrespective of any of the other variables, essentially representing the portion of the spread that cannot be explained by the fundamentals. It is a measure of investor "fear of contagion" or "market sentiments" as it measures the movement of spreads away from the observable fundamentals. As De Grauwe explains, after the crisis, spreads of the peripheral countries increased dramatically and independently from the observed fundamentals, which

suggests that "the markets were gripped by negative sentiments and tended to exaggerate the default risks."

Table 7 summarizes the important coefficients from this analysis[25] and it is seen that, in the height of the crisis and afterwards, between 2010 and 2012, there is a marked difference in the spreads for core and periphery Euro Area countries. Peripheral countries, (Greece, Spain, Ireland, and Portugal) had much higher coefficients than in previous quarters and much higher coefficients than the standalone countries and even the core Euro Area countries in the same time period. The high and significant coefficients reflect the "contagion" or investor lack of confidence that plagued the peripheral countries most heavily during the debt crisis and provides empirical support for De Grauwe's theory that investor sentiments can thus push countries towards default through a mispricing of risk.

Table 7: Fiscal Space Results with Inclusion of Time Dummy

[25] Please reference Table A-1, in the appendix, for the full regression output with all of the time dummies, divided by country group and use of fiscal space vs. debt-to-GDP ratio.

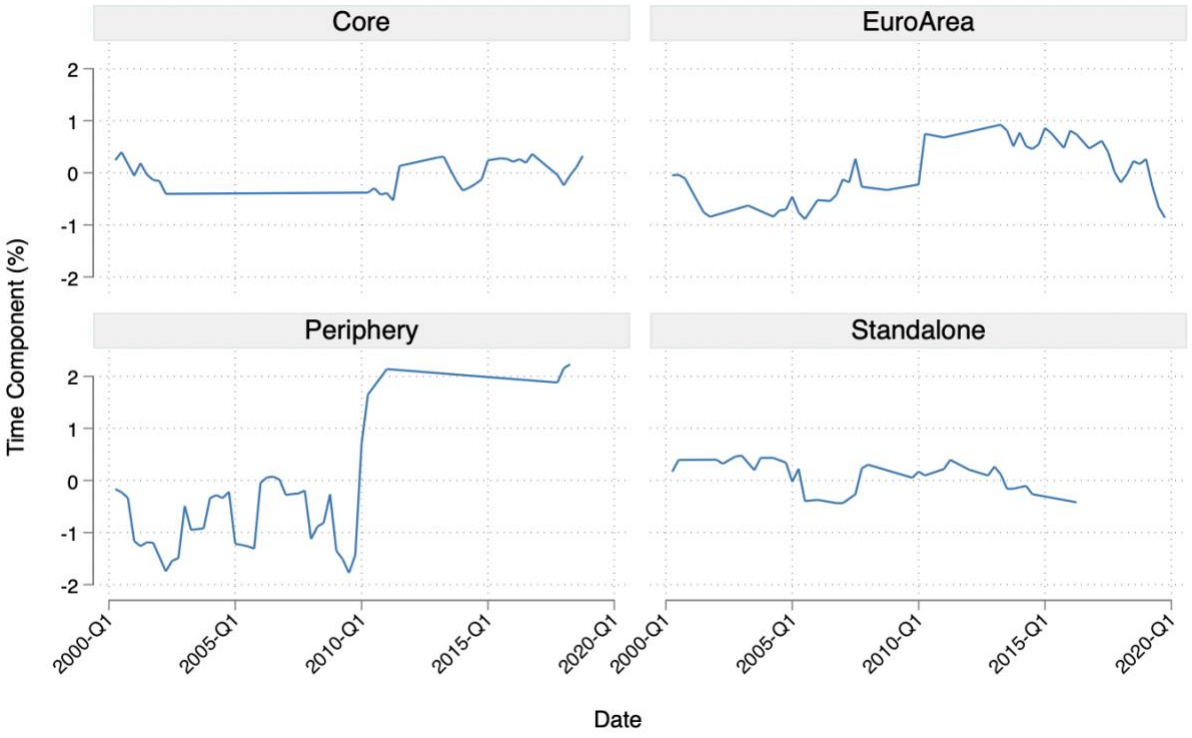
VARIABLES	(1) Standalone	(2) Euro Area	(3) Core	(4) Periphery
Current Acct Balance to GDP	-1.341***	14.40***	-4.503***	8.039
	(0.485)	(1.205)	(1.242)	(5.909)
Exchange Rate	0.0148***	-0.0268*	0.167***	-0.100
	(0.00261)	(0.0158)	(0.0262)	(0.0633)
GDP Growth (%)	-0.134***	-0.396***	0.00321	-0.554***
	(0.0127)	(0.0173)	(0.0280)	(0.0578)
Fiscal Space	0.129	5.272***	3.017*	15.78**
	(0.134)	(0.470)	(1.644)	(6.926)
Fiscal Space^2	-0.00551	-0.867***	0.537	-5.194
	(0.0223)	(0.0875)	(1.116)	(7.013)
2009-Q4	0.552**	3.105***	0.794**	7.752***
	(0.257)	(0.572)	(0.316)	(1.353)
2010-Q1	0.210	2.487***	0.821**	8.955***
	(0.259)	(0.570)	(0.323)	(1.456)
2010-Q2	0.955***	2.773***	1.175***	9.384***
	(0.295)	(0.570)	(0.322)	(1.453)
2010-Q3	1.479***	2.404***	1.127***	8.354***
	(0.263)	(0.568)	(0.314)	(1.439)
2010-Q4	0.0944	1.380**	0.650**	5.227***
	(0.258)	(0.570)	(0.324)	(1.475)
2011-Q1	0.268	1.165**	0.294	3.844***
	(0.290)	(0.506)	(0.328)	(1.363)
2011-Q2	0.124	0.924	0.311	3.890**
	(0.258)	(0.568)	(0.334)	(1.505)
2011-Q3	-0.158	0.810	0.0678	3.838**
	(0.290)	(0.570)	(0.346)	(1.516)
2011-Q4	-0.157	0.508	-0.158	2.948*
	(0.290)	(0.571)	(0.356)	(1.523)
2012-Q1	-0.127	0.774	-0.338	3.682**
	(0.289)	(0.570)	(0.358)	(1.495)
Constant	0.00391	2.576	-16.31***	7.437
	(0.321)	(1.625)	(2.238)	(6.022)
Country FE	Yes	Yes	Yes	Yes
Observations	1,500	1,452	401	442
R-squared	0.910	0.729	0.752	0.902

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

When including time dummies, the difference in significance of fundamentals in determining spreads for each country group becomes more marked. Note the coefficient on Current Account Balance, and that it is negative and strongly statistically significant for standalone countries and positive for Euro Area countries. This suggests that markets responded strongly to a country's net foreign debt in pricing spreads, with the large positive coefficient for Euro Area countries suggesting that an increase in net foreign debt leads to a much greater increase in spreads, whereas for standalone countries, the effect is the opposite, suggesting that investors are not as attuned to default risks. Figure 11, shown below, is a graphical representation of the amount of the spread that is unexplained by the fundamentals included in the regressions in table 7.

Figure 11: Component of Spread Unexplained by Fundamentals/Residual (Percentage Points) by Country Group 2000-2020



Note: Figure depicts component of spreads explained by time dummies between 2000 to 2020, separately for Eurozone Core countries, Eurozone Periphery countries, and Standalone countries. The data sources are: Eurostat; the World Bank; the OECD; and the IMF.

The result indicates that contagion struck the Eurozone with the debt crisis, as a larger portion of the spread can not be explained by economic fundamentals included in the regression. This effect was more pronounced in the "periphery" countries of Greece, Portugal, Spain and Ireland, and less pronounced for the core Eurozone countries. The trend was also not seen in the standalone countries. The graph represents the irrationality that can afflict investors in times of crisis, whereby risk is mispriced and countries are "punished" unduly and thereby pushed closer to the point of default.

The next set of regressions are the ones I develop for each country group, through introducing new factors as detailed in Section 2E. The regression specifications use fiscal space as the indebtedness indicator, as for all of the above regressions, fiscal space had a higher explanatory power than the debt to GDP ratio. Additional variables included in the analysis are: inflation (%), change in inflation from previous quarter (%), US corporate bond spreads as a proxy for global investor risk tolerance, and VIX, to control for volatility in financial markets. These regressions also control for country fixed effects and include the time dummy variables used in the previous set of regressions. Please see Tables A-2 and A-3 for the full iterations of regressions used to fit the model by country group. The model with the highest R-squared value for standalone countries was the one which included US Corporate Bond Spreads, inflation, and the change in inflation, defined as the difference in inflation rate from the previous quarter. A limitation of this regression analysis is the smaller number of observations for the models that include the inflation variables, as there is not inflation data available for all quarters. For the Euro Area countries, the inclusion of the change in inflation variable very slightly decreased the R-squared value. Nonetheless, this analysis suggests that including Corporate Bond Spreads to control for global investor risk tolerance, inflation rates to control for general economic conditions and absolute returns, and the change in inflation to control for changing inflation expectations improves the fit of the model. The final model specification, including the fundamentals, time dummies, country fixed effects, and the new controls of US corporate spreads, inflation, and change in inflation was used for each country group and time period, to determine how the signs and significance of the coefficients changed for each country group over time. The results are shown in Table 8 below.

Table 8: Spreads by Country Group with Controls and Time Dummies

VARIABLES	Before 2008		2008-2013		2013-2017		After 2017	
	Standalone	Euro Area	Standalone	Euro Area	Standalone	Euro Area	Standalone	Euro Area
Current Acct Balance to GDP	1.437	1.554*	-0.0205	21.57***	0.706	14.74***	17.90***	18.84***
	(1.375)	(0.838)	(1.424)	(3.630)	(1.611)	(3.148)	(3.241)	(6.491)
Exchange Rate	0.0651***	0.106***	0.00737	0.533***	0.0134**	-0.241***	-0.0204*	0.485***
	(0.0118)	(0.0121)	(0.0106)	(0.0797)	(0.00618)	(0.0488)	(0.0111)	(0.0701)
GDP Growth (%)	0.364***	0.0165	-0.0607**	-0.395***	0.0971***	-0.199***	0.137**	-0.136**
	(0.0525)	(0.0193)	(0.0250)	(0.0406)	(0.0262)	(0.0362)	(0.0600)	(0.0639)
Fiscal Space	-13.89***	-1.200**	3.656***	8.163***	-5.296***	-1.264	-5.562***	-2.224
	(2.079)	(0.495)	(0.983)	(1.177)	(0.988)	(4.605)	(2.048)	(3.574)
Fiscal Space^2	7.386***	0.0842	-1.361***	-1.367***	2.118***	0.637	0.963	2.106
	(1.074)	(0.0976)	(0.501)	(0.246)	(0.516)	(2.286)	(0.789)	(1.596)
US Corp Spreads	3.890***	-4.487***	0.346	-6.298**	-5.588***	-10.05***	5.056***	-5.695***
	(1.168)	(0.941)	(1.507)	(2.824)	(0.659)	(2.156)	(1.720)	(1.510)
Inflation (%)	0.0937**	0.120***	0.128***	-0.0780	-0.0743*	0.107	0.190***	-0.0821*
	(0.0440)	(0.0232)	(0.0340)	(0.0676)	(0.0405)	(0.0903)	(0.0499)	(0.0476)
Change in Inflation	0.00344	-0.00288	-0.0124	-0.121***	0.00745	-0.0189	-0.0106	0.0224
	(0.0258)	(0.0125)	(0.0205)	(0.0418)	(0.0139)	(0.0441)	(0.0172)	(0.0189)
Constant	-5.447***	-5.010***	-1.424	-48.80***	5.846***	33.52***	0.289	-38.15***
	(1.753)	(1.038)	(1.477)	(7.479)	(0.784)	(6.051)	(1.489)	(6.567)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	193	492	350	421	238	204	104	167
R-squared	0.968	0.698	0.928	0.806	0.986	0.973	0.989	0.974

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

With the inclusion of additional controls along with the time dummy variables, it is possible to understand how the relationship between fundamentals and spreads changed over time, comparing the role of fundamentals for countries within the Euro Area and standalone nations. The most notable coefficient is that of Current Account Balance. Current Account Balance is never significant for countries in standalone nations, but the magnitude and significance changed quite dramatically for Euro Area countries, becoming more significant and larger in magnitude after 2008. This supports the results in Table 7, that markets responded to a country's net foreign

debt in pricing spreads, with the large positive coefficient suggesting that an increase in net foreign debt leads to an increase in spreads. This supports De Grauwe's finding that fundamentals become more important for countries in a currency union, and more important after the sovereign debt crisis.

The final regression specification I used was that which included the corruption perceptions index and various historical quantifiers of default. Tables A-4 and A-5 show the development of the best model specifications, which is determined to include the CPI and the sum of historical debt in default. The current value of debt in default and historical value of debt in default had low significances and high p-values. The high R-squared values and the high p-values for the models with current and historical indicators of default suggest that the model explains the variation within the data to a high degree but is not significant. The inclusion of the CPI (Corruption Perceptions Index) yields an inconclusive, but interesting result as well. As a country becomes less corrupt (CPI increases), spreads move in different directions based on country group, with a negative effect (as expected) in the Euro Area, and a weak but positive effect in standalone countries. Ultimately, the inclusion of these two variables suggest that markets do not respond strongly to corruption perceptions or historical occurrences of default, and spreads are better explained by economic fundamentals and controls included in previous specifications. Table 9 shows the final specification divided by country group and time.

Table 9: Spreads by Country Group and Time with Controls, Time Dummies, and Additional Explanatory Variables

VARIABLES	(1) Standalone Before 2008	(2) Euro Area Before 2008	(3) Standalone 2008-2013	(4) Euro Area 2008-2013	(5) Standalone 2013-2017	(6) Euro Area 2013-2017	(7) Standalone After 2017	(8) Euro Area After 2017
Current Acct Balance	61.11	8.258***	6.382	-22.71**	-21.90***	50.81***	38.80	85.99***
	(12.60)	(2.603)	(3.858)	(9.644)	(5.903)	(13.48)	(28.85)	(27.98)
Exchange Rate	0.0262	0.438***	0.0139	0.999***	0.111*	-0.286	-0.0623	0.0250
	(0.0536)	(0.0428)	(0.0171)	(0.189)	(0.0576)	(0.220)	(0.0384)	(0.137)
GDP Growth	-10.36	0.0251	-0.163***	-0.405***	-0.112	-0.941***	-1.562**	-0.821
	(1.859)	(0.0275)	(0.0297)	(0.0710)	(0.0814)	(0.280)	(0.707)	(0.820)
Fiscal Space	2.920	-23.20***	-3.694**	-37.42***	-17.70**	177.9	24.48*	-179.9***
	(11.95)	(2.830)	(1.623)	(11.61)	(7.988)	(135.7)	(12.33)	(27.34)
Fiscal Space^2	-0.967	10.58***	2.135***	26.68***	7.693*	-347.6	-16.26**	345.6***
	(5.206)	(2.276)	(0.779)	(6.813)	(4.463)	(289.1)	(6.948)	(52.75)
AAABAA	-11.57	-25.87***	7.005***	-5.702	1.878	-4.536	8.079**	-12.87*
	(2.821)	(2.305)	(2.214)	(11.56)	(3.513)	(5.879)	(3.967)	(6.678)
Inflation	0.0356	0.0497	0.0372	0.242	-0.0936	-0.301	0.468***	-0.857***
	(0.0917)	(0.0611)	(0.0327)	(0.164)	(0.0960)	(0.286)	(0.0815)	(0.160)
Change in Inflation	0.0257	0.0478	-0.0711***	-0.226*	0.0115	0.0160	-0.0424*	-0.0351
	(0.0397)	(0.0416)	(0.0222)	(0.127)	(0.0412)	(0.166)	(0.0221)	(0.0458)
Corruption Index	0.168*	-0.147***	0.0354	-0.00350	0.178***	-0.588***	1.884***	-0.0382
	(0.0253)	(0.0216)	(0.0261)	(0.0565)	(0.0562)	(0.170)	(0.577)	(0.0838)
Current Debt in Default	0.0419		0.000299	5.38e-05***	50.12***	0.00132***		-7.59e-06
	(0.0120)		(0.00357)	(5.12e-06)	(15.72)	(0.000370)		(7.48e-06)
Historical Debt in Default	0.140		-0.000746	-7.61e-06**		-0.000495		
	(0.0436)		(0.00435)	(3.43e-06)		(0.000740)		
Constant	-7,256	-5.221*	38.62	-84.26***	-12.14	180.6	-91.41***	36.74***
	(2,270)	(3.101)	(256.6)	(19.05)	(9.698)	(220.3)	(26.84)	(10.42)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28	177	194	100	72	72	58	83
R-squared	1.000	0.901	0.950	0.959	0.918	0.981	0.994	0.997

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

V. Discussion

A. Addressing Instability in a Monetary Union

Moral hazard risks pervade any currency union, for when a country is unable to guarantee its own sovereign debt but believes that the central bank—in this case the ECB—would provide a bailout in the event of a crisis, and excessive spending and fiscal irresponsibility are a temptation. For a nation in a monetary union, the cost of default is limited to political ramifications, and is unlikely to escalate into a full-blown economic crisis, so long as there is a "lender of last resort." As it exists today, there is no such "bailout clause" existing within the institutional makeup of the ECB, no real promise to cover debts in the case of a crisis. The reasoning is explained by economists Hanno Beck and Aloys Prinz, "if the regulatory framework of the monetary union contains a bailout clause, there will be a certain potential for moral hazard, i.e. countries accumulating large amounts of sovereign debt, expecting that they will be bailed out by the union" (Beck 2012). In order to maintain credibility, a no-bailout principle must be plausibly enforceable, otherwise program terms and conditions will not be able to elicit the intended changes within the nations assisted. The ramifications of the decision to not include a no bailout clause have been seen in the behaviors of member states, as economic reforms have not come to fruition as promised, such as privatization programs or pension system reforms (Rövekamp 2020). It has been argued that the fundamental flaw of a monetary union is "the impossibility of upholding at one and the same time an independent monetary policy, national fiscal sovereignty and a no-bailout clause" (Beck 2012).

In the early days of the Greek crisis, the misaligned incentive system came to light and leaders were confronted with a classic moral hazard scenario: if they were to offer a bailout plan too

early, “the Greek people have to understand how serious the situation is… and there will be no change of behavior … as they will simply come back later for more” (Cimenti 2010). As the Greek crisis continued to unfold and it became clearer that the Greek Loan program was insufficient to quell market anxiety, questions arose over what would occur in a full-blown default situation. Investors began to question what would happen if there did prove to be a default– what would happen to Greek-denominated debt obligations? What would be the effects on other sovereign bonds? There were no clear answers, and it was up to the ECB to step in to deescalate the crisis and quell fears. “Default is out of the question. It is as simple as that,” Jean-Claude Trichet, president of the ECB at the time, said during the ECB’s press conference. This phrase reflected the view that a sovereign default would be so costly and deadly for the euro area, that it simply could not happen (“Introductory Statement” 2010). As economist Frank Rövekamp argues, this was the key moment when the credibility of the financial stability arrangement was undermined. In establishing a basis for countries to “assume that they will be rescued by external funds in times of even self-inflicted fiscal crisis” countries will have “much less incentive to enforce fiscal discipline and keep national debt under control” (Rövekamp 2020). While this was recognized at the beginning of the response to the Greek crisis, the conditionality of loan programs and bailouts was seen as a sufficient protection against such behavior, meant to minimize moral hazard by discouraging irresponsible fiscal behavior. Yet, while the Euro Area had adopted budget guidelines in the past, known as the stability and growth pact, these agreements had no teeth, so to speak, with no real ramifications for countries failing to uphold the criteria in times of economic downturn.

B. A Path Forward

There are a variety of proposals that exist for strengthening the European Monetary Union, which fall within a few major groupings: conditionality on access to EMU-wide funds, and the scope of stabilization mechanisms. Any institutional reform program attempting to rectify structural inadequacies by preventing instability and fear of a crisis scenario unfolding again, would be theoretically quite simple. A promise from a lender of last resort to bail out a country in financial distress would be sufficient to prevent this type of spillover instability. If such a claim is credible, the Euro Area would be akin to a standalone nation being able to fulfill its debt obligations through printing currency. Marcello Minenna argues in favor of the lender-of-last-resort reform, explaining that if the ESM introduced a "supranational guarantee on the public debt securities of member countries," then appropriate risk-sharing mechanisms would be in place (2019).[26] This would result in the market viewing each country's bonds as equivalently risky (and not very risky at all), driving convergence in bond spreads across the Euro Area, reducing the risk of spreads exacerbating country-specific recessions. This would address the risk of financial instability leading to contagion and a euro-wide crisis but does not alleviate the risk from moral hazard behavior by member states. Within this institutional framework, moral hazard risks would exist, as countries would face differential pricing of premiums paid from member states to the ESM, with riskier nations facing higher premiums.

[26] His proposal would operate in two sequential stages, in the first of which, the ESM would "guarantee an increasing share of the public debt of each member country," until, eventually, all outstanding debt was backed by the ESM. The second stage of Minenna's proposal is that all sovereign-guaranteed debt would be replaced with ESM-issued debt, in order to fully mutualize debt obligations

The most promising solution, in my view, is one in which both types of economic crises are confronted: crises arising due to inter-country economic downturn and crises stemming from intra-country financial contagion. Arguably, markets at present do not fully believe in the "no bailout" rule. In other insurance schemes, "adding fiscal risk sharing" would increase moral hazard and lower the risks of financial imprudence, as countries are aware that an insurance mechanism is in place" (Berger 2018). However, in the case of the Euro Area, it can be argued that creating more fiscal risk sharing "could make the Euro Area's 'no bailout' rule more credible and thereby make financial markets pay more attention to fiscal misdeeds" (Berger 2018). If countries were to share fiscal risk, in conjunction with a doubling-down on the no-bailout rule, it would encourage countries to self-regulate, with fiscal policies being scrutinized and disciplined before a bailout would become necessary and before investor contagion could force a default. This proposal can potentially rectify both types of economic crises– those caused by fiscal imprudence and those caused by spillover contagion stemming from the potential of a default.

VI. Conclusion

This paper provides an analysis of the multiple-equilibria model of sovereign default and explores the effects of country membership in a currency union. Through an analysis of sovereign bond spreads that includes economic fundamentals, new control variables, a more robust dataset, and additional model specifications, this paper supports the conclusion reached by De Grauwe and Ji (2013), that nations in a currency union are more susceptible to crises of confidence and therefore default risks. The implications are clear: a stable currency union cannot exist so long as there exist multiple equilibria in a model of sovereign default, whereby markets wield the power to force a country into default. In order to create a monetary union that is stable and preserves the original goals of the EMU—maintaining price stability, improving ease of intra-country movement of goods and people, and creating a common monetary policy, set, and implemented by the ECB—it is necessary to eliminate the existence of multiple equilibria in models of sovereign default. This can be done through reducing country economic moral hazard risk or through fundamentally altering the role of the ECB in guaranteeing sovereign debt. Only through remedying the structural and institutional weaknesses of the currency union as it currently exists can "an ever-closer union," be attained.

VII. Appendices

Appendix A: Regression Output

Table 1: Time Dummy in Analysis by Country Group

VARIABLES	(1) Standalone	(2) Euro Area	(3) Core	(4) Periphery	(5) Standalone	(6) Euro Area	(7) Core	(8) Periphery
Current Acct Balance	-1.364***	14.40***	-4.503***	8.039	-2.831***	7.802***	-5.035***	12.09**
	(0.476)	(1.205)	(1.242)	(5.909)	(0.466)	(0.994)	(0.924)	(5.469)
Exchange Rate	0.0149***	-0.0268*	0.167***	-0.100	0.0102***	-0.0341***	0.176***	0.307***
	(0.00249)	(0.0158)	(0.0262)	(0.0633)	(0.00229)	(0.00679)	(0.0191)	(0.0796)
GDP Growth	-0.133***	-0.396***	0.00321	-0.554***	-0.110***	-0.296***	-0.0212	-0.372***
	(0.0125)	(0.0173)	(0.0280)	(0.0578)	(0.0116)	(0.0140)	(0.0212)	(0.0624)
Fiscal Space	0.0972**	5.272***	3.017*	15.78**	0.00211	-0.0287***	-0.0429***	-0.0107
	(0.0439)	(0.470)	(1.644)	(6.926)				
Fiscal Space^2		-0.867***	0.537	-5.194				
		(0.0875)	(1.116)	(7.013)				
Debt to GDP					(0.00204)	(0.00583)	(0.00654)	(0.0164)
						0.000273***	0.000396***	0.000284***
Debt to GDP Squared						(2.17e-05)	(2.89e-05)	(4.39e-05)
161.qtr	0.168	-0.0471	0.243	-0.166	0.227	-0.0487	0.308	0.321
	(0.318)	(0.618)	(0.259)	(0.957)	(0.312)	(0.562)	(0.222)	(0.919)
162.qtr	0.394	-0.0394	0.397	-0.226	0.522*	-0.0981	0.497**	0.478
	(0.318)	(0.619)	(0.264)	(0.960)	(0.312)	(0.547)	(0.225)	(0.924)
163.qtr	0.736**	-0.103	0.487*	-0.334	1.928***	-0.0734	0.689***	0.629
	(0.318)	(0.619)	(0.272)	(0.963)	(0.259)	(0.548)	(0.231)	(0.930)
164.qtr	0.775**	-1.775***	-0.0555	-1.164	0.954***	-1.460***	0.000167	-1.508
	(0.311)	(0.508)	(0.263)	(1.062)	(0.306)	(0.454)	(0.224)	(1.009)
165.qtr	0.871***	-0.547	0.185	-1.261	1.022***	-0.440	0.245	-1.223
	(0.311)	(0.500)	(0.266)	(1.060)	(0.306)	(0.445)	(0.226)	(1.007)
166.qtr	0.991***	-0.761	-0.0320	-1.187	1.174***	-0.368	0.0721	-1.529
	(0.311)	(0.567)	(0.263)	(1.062)	(0.306)	(0.508)	(0.225)	(1.009)
167.qtr	0.744**	-0.843	-0.135	-1.195	0.861***	-0.443	-0.0202	-1.747*
	(0.311)	(0.567)	(0.263)	(1.065)	(0.306)	(0.508)	(0.225)	(1.013)
168.qtr	0.398	-1.080*	-0.157	-1.912*	0.481	-0.649	-0.0999	-2.167**
	(0.311)	(0.559)	(0.274)	(1.080)	(0.306)	(0.501)	(0.232)	(1.024)
169.qtr	0.321	-1.249**	-0.403	-1.744	0.401	-0.820	-0.366	-2.646**
	(0.311)	(0.559)	(0.275)	(1.094)	(0.306)	(0.501)	(0.233)	(1.040)
170.qtr	1.157***	-1.105**	-0.799***	-1.542	1.126***	-0.653	-0.769***	-3.240***
	(0.254)	(0.560)	(0.288)	(1.122)	(0.254)	(0.500)	(0.241)	(1.080)
171.qtr	0.460	-1.270**	-0.949***	-1.491	0.530*	-0.861*	-0.879***	-3.615***
	(0.311)	(0.561)	(0.293)	(1.141)	(0.306)	(0.500)	(0.245)	(1.107)
172.qtr	0.478	-1.807***	-1.302***	-0.488	0.531*	-0.811*	-1.355***	-3.577***
	(0.303)	(0.494)	(0.321)	(1.005)	(0.299)	(0.444)	(0.263)	(1.025)

173.qtr	0.621**	-0.628	-1.425***	-0.949	0.671**	-0.643	-1.664***	-4.725***
	(0.303)	(0.506)	(0.320)	(1.219)	(0.299)	(0.448)	(0.255)	(1.241)
174.qtr	0.199	-2.321***	-1.512***	-2.382**	0.277	-1.496***	-1.614***	-5.796***
	(0.303)	(0.502)	(0.343)	(1.084)	(0.299)	(0.447)	(0.277)	(1.077)
175.qtr	0.434	-1.189**	-1.738***	-0.919	0.606**	-0.929*	-1.799***	-4.965***
	(0.303)	(0.568)	(0.362)	(1.248)	(0.255)	(0.501)	(0.289)	(1.280)
176.qtr	0.784***	-1.895***	-1.919***	-0.338	0.845***	-0.818*	-1.944***	-5.118***
	(0.302)	(0.506)	(0.374)	(1.170)	(0.298)	(0.445)	(0.293)	(1.252)
177.qtr	0.433	-0.841	-1.572***	-0.281	0.489	-0.612	-1.630***	-4.633***
	(0.302)	(0.568)	(0.345)	(1.226)	(0.298)	(0.446)	(0.275)	(1.285)
178.qtr	0.626**	-0.719	-1.621***	-0.339	0.719**	-0.569	-1.683***	-4.742***
	(0.302)	(0.570)	(0.351)	(1.238)	(0.298)	(0.502)	(0.279)	(1.299)
179.qtr	0.342	-0.705	-1.825***	-0.217	0.366	-0.464	-1.848***	-5.118***
	(0.254)	(0.574)	(0.371)	(1.284)	(0.255)	(0.502)	(0.292)	(1.366)
180.qtr	-0.0257	-0.456	-1.969***	-1.216	0.0398	-0.239	-1.963***	-5.539***
	(0.303)	(0.502)	(0.373)	(1.232)	(0.299)	(0.449)	(0.293)	(1.285)
181.qtr	0.225	-0.759	-1.637***	-1.238	0.255	-0.553	-1.675***	-5.252***
	(0.253)	(0.570)	(0.346)	(1.199)	(0.254)	(0.502)	(0.276)	(1.242)
182.qtr	-0.395	-0.888	-1.481***	-1.265	-0.321	-0.644	-1.457***	-5.156***
	(0.297)	(0.569)	(0.327)	(1.184)	(0.293)	(0.502)	(0.263)	(1.222)
183.qtr	-0.792***	-1.019*	-1.327***	-1.308	-0.652**	-0.752	-1.287***	-5.076***
	(0.261)	(0.568)	(0.312)	(1.177)	(0.260)	(0.501)	(0.254)	(1.210)
184.qtr	-0.373	-0.524	-1.363***	-0.0468	-0.338	-0.332	-1.236***	-4.092***
	(0.253)	(0.570)	(0.306)	(1.179)	(0.254)	(0.502)	(0.248)	(1.250)
185.qtr	-0.669**	-1.262**	-1.487***	0.0576	-0.611**	-0.821*	-1.413***	-4.427***
	(0.292)	(0.508)	(0.322)	(1.222)	(0.289)	(0.449)	(0.259)	(1.313)
186.qtr	-0.442*	-0.541	-1.648***	0.0744	-0.358	-0.187	-1.495***	-4.566***
	(0.254)	(0.578)	(0.331)	(1.243)	(0.254)	(0.503)	(0.262)	(1.339)
187.qtr	-0.434	-0.421	-1.639***	0.0170	-0.357	-0.113	-1.467***	-4.552***
	(0.292)	(0.578)	(0.328)	(1.246)	(0.289)	(0.504)	(0.262)	(1.338)
188.qtr	-0.436	-0.126	-1.733***	-0.277	-0.389	0.503	-1.527***	-4.747***
	(0.293)	(0.581)	(0.335)	(1.241)	(0.290)	(0.450)	(0.264)	(1.328)
189.qtr	-0.691***	-0.183	-1.794***	-0.260	-0.642**	0.126	-1.611***	-4.899***
	(0.261)	(0.585)	(0.343)	(1.264)	(0.259)	(0.505)	(0.269)	(1.358)
190.qtr	-0.265	0.271	-1.850***	-0.250	-0.170	0.587	-1.571***	-4.851***
	(0.293)	(0.537)	(0.349)	(1.275)	(0.290)	(0.459)	(0.270)	(1.364)
191.qtr	0.233	-0.266	-2.271***	-0.194	0.334	0.0770	-1.788***	-5.195***
	(0.294)	(0.522)	(0.325)	(1.326)	(0.290)	(0.449)	(0.246)	(1.432)
192.qtr	0.303	-1.524**	-2.142***	-1.124	0.431*	-0.790	-1.965***	-6.313***
	(0.259)	(0.602)	(0.396)	(1.311)	(0.259)	(0.512)	(0.304)	(1.398)
193.qtr	0.528*	-0.918*	-2.100***	-0.887	0.676**	-0.510	-2.127***	-6.605***
	(0.295)	(0.539)	(0.390)	(1.354)	(0.292)	(0.456)	(0.299)	(1.465)
194.qtr	0.499*	-1.329**	-2.121***	-0.813	0.627**	-0.547	-1.827***	-6.166***
	(0.295)	(0.605)	(0.406)	(1.303)	(0.292)	(0.513)	(0.303)	(1.398)
195.qtr	1.436***	-0.329	-1.314***	-0.265	1.491***	0.134	-1.235***	-5.356***
	(0.294)	(0.594)	(0.370)	(1.243)	(0.290)	(0.512)	(0.287)	(1.328)
196.qtr	1.470***	-1.983***	-1.077**	-1.349	1.762***	-1.070**	-1.416***	-7.084***
	(0.284)	(0.608)	(0.444)	(1.315)	(0.279)	(0.527)	(0.354)	(1.357)
197.qtr	0.691**	-1.120**	-1.413***	-1.510	0.937***	-0.927*	-1.743***	-7.674***
	(0.307)	(0.549)	(0.456)	(1.320)	(0.303)	(0.475)	(0.359)	(1.380)
198.qtr	0.629**	-1.964***	-1.529***	-1.774	0.794***	-1.388***	-2.007***	-8.311***
	(0.260)	(0.604)	(0.458)	(1.338)	(0.259)	(0.527)	(0.365)	(1.415)
199.qtr	0.0523	-1.937***	-1.551***	-1.431	0.256	-1.461***	-2.078***	-8.439***

	(0.308)	(0.604)	(0.463)	(1.361)	(0.303)	(0.527)	(0.370)	(1.460)
200.qtr	0.171	-0.223	-1.143***	0.710	0.327	-0.274	-1.535***	-6.159***
	(0.295)	(0.515)	(0.359)	(1.153)	(0.291)	(0.453)	(0.286)	(1.327)
201.qtr	0.0972	0.748	-0.379	1.649	0.354	0.330	-0.807***	-4.578***
	(0.260)	(0.570)	(0.310)	(1.230)	(0.260)	(0.508)	(0.255)	(1.340)
202.qtr	0.929***	1.179**	-0.294	3.153**	1.163***	0.705	-0.713***	-3.560**
	(0.260)	(0.569)	(0.304)	(1.244)	(0.259)	(0.508)	(0.250)	(1.386)
203.qtr	0.507*	1.179**	-0.417	3.707***	0.651**	0.666	-0.845***	-3.623**
	(0.295)	(0.572)	(0.319)	(1.276)	(0.292)	(0.509)	(0.261)	(1.456)
204.qtr	0.219	0.679	-0.388	2.139	0.353	0.121	-0.792***	-5.088***
	(0.294)	(0.571)	(0.314)	(1.337)	(0.291)	(0.509)	(0.257)	(1.466)
205.qtr	0.396	1.318**	-0.530	4.518***	0.507*	0.681	-0.979***	-3.546**
	(0.294)	(0.575)	(0.334)	(1.376)	(0.259)	(0.511)	(0.271)	(1.560)
206.qtr	0.869***	2.288***	0.133	6.252***	0.986***	1.168**	-0.307	-1.798
	(0.294)	(0.573)	(0.325)	(1.358)	(0.291)	(0.465)	(0.265)	(1.544)
207.qtr	0.554**	3.105***	0.794**	7.752***	0.727***	2.332***	0.329	-0.469
	(0.257)	(0.572)	(0.316)	(1.353)	(0.257)	(0.511)	(0.259)	(1.551)
208.qtr	0.206	2.487***	0.821**	8.955***	0.322	2.111***	0.244	2.134
	(0.258)	(0.570)	(0.323)	(1.456)	(0.258)	(0.511)	(0.268)	(1.523)
209.qtr	0.954***	2.773***	1.175***	9.384***	1.104***	2.260***	0.506*	2.220
	(0.295)	(0.570)	(0.322)	(1.453)	(0.292)	(0.512)	(0.267)	(1.543)
210.qtr	1.478***	2.404***	1.127***	8.354***	1.693***	1.862***	0.460*	1.385
	(0.262)	(0.568)	(0.314)	(1.439)	(0.262)	(0.511)	(0.260)	(1.515)
211.qtr	0.0947	1.380**	0.650**	5.227***	0.251	0.836	-0.0588	-2.629
	(0.258)	(0.570)	(0.324)	(1.475)	(0.258)	(0.513)	(0.269)	(1.606)
212.qtr	0.266	1.165**	0.294	3.844***	0.363	0.696	-0.460*	-5.118***
	(0.290)	(0.506)	(0.328)	(1.363)	(0.288)	(0.461)	(0.275)	(1.606)
213.qtr	0.119	0.924	0.311	3.890**	0.212	0.0845	-0.538*	-5.338***
	(0.257)	(0.568)	(0.334)	(1.505)	(0.257)	(0.514)	(0.279)	(1.800)
214.qtr	-0.160	0.810	0.0678	3.838**	-0.0649	-0.0686	-0.750***	-5.556***
	(0.290)	(0.570)	(0.346)	(1.516)	(0.288)	(0.515)	(0.288)	(1.822)
215.qtr	-0.159	0.508	-0.158	2.948*	-0.525**	-0.359	-1.004***	-6.661***
	(0.290)	(0.571)	(0.356)	(1.523)	(0.259)	(0.515)	(0.296)	(1.845)
216.qtr	-0.130	0.774	-0.338	3.682**	-0.287	-0.268	-1.219***	-6.653***
	(0.289)	(0.570)	(0.358)	(1.495)	(0.257)	(0.515)	(0.299)	(1.937)
217.qtr	-0.104	0.511	-0.286	2.784*	-0.0660	-0.562	-1.240***	-7.273***
	(0.260)	(0.568)	(0.350)	(1.470)	(0.258)	(0.515)	(0.293)	(1.894)
218.qtr	-0.263	0.459	-0.214	2.757*	-0.188	-0.608	-1.104***	-6.852***
	(0.253)	(0.566)	(0.332)	(1.440)	(0.254)	(0.514)	(0.280)	(1.831)
219.qtr	-0.570**	0.545	-0.126	3.277**	-0.528*	-0.557	-1.013***	-5.812***
	(0.289)	(0.565)	(0.323)	(1.410)	(0.287)	(0.513)	(0.273)	(1.762)
220.qtr	-0.651**	0.861	0.240	3.885***	-0.611**	-0.296	-0.681***	-4.042**
	(0.288)	(0.561)	(0.292)	(1.381)	(0.286)	(0.510)	(0.249)	(1.652)
221.qtr	0.529**	0.762	0.490*	4.318***	0.662***	-0.383	-0.438*	-3.240**
	(0.255)	(0.561)	(0.286)	(1.366)	(0.255)	(0.509)	(0.244)	(1.610)
222.qtr	-0.612**	0.929*	0.279	4.151***	-0.562**	-0.211	-0.613**	-4.447***
	(0.288)	(0.493)	(0.292)	(1.216)	(0.286)	(0.458)	(0.249)	(1.555)
223.qtr	-1.118***	0.479	0.267	3.148**	-0.983***	-0.670	-0.594**	-4.844***
	(0.253)	(0.561)	(0.291)	(1.378)	(0.254)	(0.510)	(0.248)	(1.656)
224.qtr	-0.508**	0.808	0.213	4.020***	-0.489*	-0.401	-0.699***	-4.144**
	(0.253)	(0.562)	(0.291)	(1.400)	(0.254)	(0.511)	(0.250)	(1.686)
225.qtr	-0.419	0.739	0.263	3.807***	-0.391	-0.478	-0.638**	-4.547***
	(0.288)	(0.561)	(0.289)	(1.402)	(0.286)	(0.511)	(0.249)	(1.704)

226.qtr	-0.532*	1.951***	0.193	4.017***	-0.490*	0.531	-0.644***	-3.174**
	(0.288)	(0.493)	(0.286)	(1.181)	(0.286)	(0.459)	(0.246)	(1.490)
227.qtr	-0.805***	0.467	0.362	3.545**	-0.847***	-0.666	-0.468*	-4.735***
	(0.254)	(0.561)	(0.284)	(1.400)	(0.255)	(0.510)	(0.244)	(1.696)
228.qtr	-1.001***	0.812*	0.866***	4.182***	-0.954***	-0.261	0.00676	-4.211**
	(0.288)	(0.492)	(0.224)	(1.379)	(0.286)	(0.454)	(0.194)	(1.707)
229.qtr	-0.936***	0.613	0.486*	3.610***	-0.869***	-0.533	-0.350	-4.895***
	(0.288)	(0.561)	(0.277)	(1.386)	(0.286)	(0.510)	(0.241)	(1.722)
230.qtr	-0.874***	0.399	0.0589	3.239**	-0.800***	-0.684	-0.754***	-5.798***
	(0.288)	(0.564)	(0.292)	(1.417)	(0.286)	(0.510)	(0.253)	(1.792)
231.qtr	-1.058***	0.0212	-0.0400	1.880	-0.938***	-1.457***	-0.790***	-6.519***
	(0.288)	(0.495)	(0.293)	(1.194)	(0.286)	(0.461)	(0.253)	(1.635)
232.qtr	-1.460***	-0.186	-0.240	2.155	-1.402***	-1.122**	-1.034***	-6.949***
	(0.255)	(0.565)	(0.305)	(1.382)	(0.255)	(0.510)	(0.263)	(1.775)
233.qtr	-1.428***	-0.0198	-0.0488	2.230	-1.375***	-0.969*	-0.839***	-6.716***
	(0.255)	(0.565)	(0.301)	(1.374)	(0.255)	(0.510)	(0.259)	(1.755)
234.qtr	-1.491***	0.224	0.109	3.218**	-1.337***	-0.724	-0.681***	-6.320***
	(0.292)	(0.499)	(0.303)	(1.286)	(0.286)	(0.461)	(0.261)	(1.682)
235.qtr	-1.593***	0.169	0.328	2.410*	-1.448***	-0.746	-0.412	-6.383***
	(0.292)	(0.564)	(0.295)	(1.360)	(0.286)	(0.510)	(0.255)	(1.731)
236.qtr	-2.844***	0.264			-2.081***	-0.991*	-0.415*	-6.393***
	(0.277)	(1.322)			(0.258)	(0.509)	(0.251)	(1.707)
237.qtr	-1.802***	-0.258			-1.334***	-2.716***	-0.378	-7.617***
	(0.508)	(1.322)			(0.286)	(0.463)	(0.250)	(1.595)
238.qtr	-1.567***	-0.660			-1.272***	-1.321***	-0.633**	-6.755***
	(0.508)	(1.322)			(0.286)	(0.508)	(0.248)	(1.639)
239.qtr	-1.595***	-0.861			-1.226***	-1.755***	-0.537**	-6.787***
	(0.508)	(0.531)			(0.286)	(0.455)	(0.243)	(1.601)
Constant	0.00666	2.576	-16.31***	7.437	-1.338***	-3.815***	-0.843**	-10.49***
	(0.320)	(1.625)	(2.238)	(6.022)	(0.274)	(0.532)	(0.343)	(1.439)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1,500	1,452	401	442	1,829	1,776	429	512
R-squared	0.910	0.729	0.752	0.902	0.899	0.735	0.827	0.897

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Fitting Spreads by Country Group with Time Dummies and Controls; Standalone (2000-2020)

VARIABLES	(1) Standalone	(2) Standalone	(3) Standalone	(4) Standalone	(5) Standalone
Current Acct Balance	-1.341***	-1.341***	-1.389***	-0.145	1.017
	(0.485)	(0.485)	(0.492)	(0.736)	(0.739)
Exchange Rate	0.0148***	0.0148***	0.0145***	0.0307***	0.0264***
	(0.00261)	(0.00261)	(0.00264)	(0.00450)	(0.00459)
GDP Growth	-0.134***	-0.134***	-0.131***	-0.108***	-0.0900***
	(0.0127)	(0.0127)	(0.0129)	(0.0186)	(0.0185)
Fiscal Space	0.129	0.129	0.116	-1.654***	-0.660
	(0.134)	(0.134)	(0.138)	(0.604)	(0.604)
Fiscal Space^2	-0.00551	-0.00551	-0.00353	0.893***	0.504*
	(0.0223)	(0.0223)	(0.0228)	(0.282)	(0.280)
AAABAA		-5.889***	-5.970***	-9.033***	-8.819***
		(1.883)	(1.920)	(2.731)	(2.637)
VIX			-0.00143		
			(0.00628)		
Inflation Rate				0.0612***	0.0800***
				(0.0196)	(0.0218)
Change in Inflation Rate					-0.00522
					(0.0141)
Constant	0.00391	3.635***	3.757***	4.244**	3.834**
	(0.321)	(1.290)	(1.349)	(1.937)	(1.875)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,500	1,500	1,462	929	885
R-squared	0.910	0.910	0.909	0.925	0.932

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Fitting Spreads by Country Group with Time Dummies and Controls; Euro Area (2000-2020)

VARIABLES	(1) Euro Area	(2) Euro Area	(3) Euro Area	(4) Euro Area	(5) Euro Area
Current Acct Balance	14.40***	14.40***	14.53***	14.07***	14.33***
	(1.205)	(1.205)	(1.239)	(1.369)	(1.415)
Exchange Rate	-0.0268*	-0.0268*	-0.0267*	-0.0489***	-0.0467**
	(0.0158)	(0.0158)	(0.0161)	(0.0179)	(0.0191)
GDP Growth	-0.396***	-0.396***	-0.401***	-0.459***	-0.458***
	(0.0173)	(0.0173)	(0.0177)	(0.0199)	(0.0210)
Fiscal Space	5.272***	5.272***	5.349***	5.129***	5.133***
	(0.470)	(0.470)	(0.483)	(0.511)	(0.536)
Fiscal Space^2	-0.867***	-0.867***	-0.885***	-0.855***	-0.856***
	(0.0875)	(0.0875)	(0.0901)	(0.0940)	(0.0980)
AAABAA		-3.190	-2.203	-4.404**	-4.321*
		(1.968)	(2.139)	(2.204)	(2.262)
VIX			0.00691		
			(0.0119)		
Inflation Rate				-0.127***	-0.144***
				(0.0269)	(0.0340)
Change in Inflation Rate					0.0293
					(0.0231)
Constant	2.576	4.544*	3.565	7.905***	7.663***
	(1.625)	(2.321)	(2.498)	(2.666)	(2.792)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,452	1,452	1,402	1,349	1,284
R-squared	0.729	0.729	0.731	0.747	0.745

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Fitting Spreads by Country Group with Time Dummies and Controls; Including Cost Component; Standalone (2000-2020)

VARIABLES	(1) Standalone	(2) Standalone	(3) Standalone	(4) Standalone	(5) Standalone
Current Acct Balance	-0.232	-0.233	4.555***	3.956**	4.588**
	(0.758)	(0.770)	(1.415)	(1.807)	(1.969)
Exchange Rate	0.0286***	0.0203***	0.00843	0.00984	0.00854
	(0.00462)	(0.00510)	(0.0130)	(0.0137)	(0.0138)
GDP Growth	-0.113***	-0.108***	-0.145***	-0.146***	-0.145***
	(0.0186)	(0.0187)	(0.0252)	(0.0256)	(0.0257)
Fiscal Space	-1.514**	-1.101*	-4.509***	-5.013***	-4.495***
	(0.613)	(0.618)	(0.945)	(0.915)	(1.116)
Fiscal Space^2	0.859***	0.758***	2.068***	2.362***	2.062***
	(0.284)	(0.284)	(0.485)	(0.404)	(0.548)
AAABAA	-8.975***	-8.419**	21.11***	21.87***	21.06***
	(3.343)	(3.324)	(2.957)	(3.323)	(3.469)
Inflation Rate	0.0462**	0.0331	-0.0134	-0.0116	-0.0135
	(0.0212)	(0.0214)	(0.0288)	(0.0290)	(0.0291)
Change in Inflation Rate	0.0371*	0.0411*	-0.0386*	-0.0391*	-0.0385*
	(0.0215)	(0.0216)	(0.0231)	(0.0231)	(0.0232)
Corruption Index		-0.00489	0.0666***	0.0671***	0.0665***
		(0.00691)	(0.0114)	(0.0115)	(0.0115)
Current Debt in Default			0.00251		0.00254
			(0.00290)		(0.00312)
Historical Debt in Default				0.000563	-5.13e-05
				(0.00193)	(0.00207)
Constant	4.390*	4.877*	-21.55***	-52.87	-18.74
	(2.577)	(2.622)	(3.868)	(105.7)	(113.8)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	920	889	352	352	352
R-squared	0.927	0.930	0.971	0.971	0.971

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Fitting Spreads by Country Group with Time Dummies and Controls; Including Cost Component; Euro Area (2000-2020)

VARIABLES	(1) Euro Area	(2) Euro Area	(3) Euro Area	(4) Euro Area	(5) Euro Area
Current Acct Balance	14.12***	12.68***	9.627**	3.281	4.006
	(1.411)	(1.374)	(4.111)	(4.498)	(4.064)
Exchange Rate	-0.0490***	-0.0185	0.0303	0.155***	0.00932
	(0.0180)	(0.0177)	(0.0579)	(0.0587)	(0.0556)
GDP Growth	-0.462***	-0.471***	-0.399***	-0.366***	-0.386***
	(0.0202)	(0.0195)	(0.0419)	(0.0445)	(0.0402)
Fiscal Space	5.132***	4.302***	1.683	-11.26**	-11.28***
	(0.517)	(0.506)	(3.400)	(4.423)	(3.995)
Fiscal Space^2	-0.855***	-0.677***	4.563*	13.75***	12.28***
	(0.0947)	(0.0932)	(2.489)	(3.043)	(2.754)
AAABAA	-4.885**	-6.017***	-2.294	-9.774**	-7.004*
	(2.356)	(2.285)	(3.794)	(4.116)	(3.731)
Inflation Rate	-0.151***	-0.115***	0.178*	0.0322	0.273***
	(0.0293)	(0.0285)	(0.0912)	(0.0937)	(0.0890)
Change in Inflation Rate	0.0668**	0.0640**	-0.109	-0.0981	-0.134*
	(0.0316)	(0.0305)	(0.0849)	(0.0900)	(0.0814)
Corruption Index		-0.107***	-0.196***	-0.273***	-0.204***
		(0.0108)	(0.0254)	(0.0256)	(0.0244)
Current Debt in Default			2.17e-05***		1.91e-05***
			(2.22e-06)		(2.17e-06)
Historical Debt in Default				6.66e-06***	4.99e-06***
				(9.64e-07)	(8.91e-07)
Constant	8.365***	13.28***	11.24*	12.57*	19.32***
	(2.759)	(2.721)	(6.732)	(7.267)	(6.609)
Country FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,339	1,332	432	432	432
R-squared	0.748	0.767	0.911	0.900	0.918

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix B: Data Appendix

Variable	Label
qtr	Quarter
year	Year
Country	Country Name
country_code	Three letter country code
country	Two digit country number
InterestRate	10 Year Sovereign Bond Rate
spread	Interest Rate Spread to German 10 Year Bund or US 10 Year Treasury
debt_gdp_ratio	Country's debt as % of GDP
Bund	10 Year Bund Rate
UStreasury10Y	US 10 Year Treasury
ExchangeRate	Exchange rate to 143 Trade partners
TaxRevenueGDP	Tax Revenue as % of GDP
fiscalspace	Government debt/Total tax revenues
CurrentAcctBalance	USD accumulated since the year 2000
GDPgrowth	GDP Growth Rate (%)
GDP	Current GDP in Millions of USD
CurrentAcctBalancetoGDP	Current Account Balance to GDP Ratio
countrygroup	Standalone or Euro Area
corruption	Corruption Score (0 being most corrupt)
coreeuro	Indicator for a "core" Euro area country
debt_gdp_squared	Debt to GDP Ratio Squared
fiscalspacesquared	Fiscal Space Squared
lagged_spread	Spread from previous quarter
lagged_spread2	Spread from 2 quarters prior
spread_prior2q_dif	Difference in spread in previous two quarters
lagged_exchangerate	Exchange rate from previous quarter
change_ER	Change in exchange rate from previous quarter

AAA	AAA US Corporate Debt 10 Year Yield
BAA	BAA US Corporate Debt 10 Year Yield
AAABAA	AAA to BAA Yield Spread
AAAyield	AAA Spread to US Treasury
BAAyield	BAA Spread to US Treasury
lagged_GDPgrowth	GDP growth rate of previous quarter
lagged_GDPgrowth2	GDP growth rate from 2 quarters prior
JunkBond	ICE BofA US High Yield Index
JunkBondyield	High yield Spread to US treasury
inflation	Quarterly Estimated CPI (%)
change_inflation	Change in inflation rate (%)
VIX	Chicago Board Options Exchange's CBOE Volatility Index
debtindefault	Millions of USD
sumdebtindefault	Cumulative debt in default for each year since 1960

VIII. References

Amadeo. (2020, May 18). *Understand the Greek Debt Crisis in 5 Minutes*. The Balance. Retrieved December 18, 2021, from https://www.thebalance.com/what-is-the-greece-debt-crisis-3305525

Beck, H.; Prinz, A. (2012) : The trilemma of a monetary union: Another impossible trinity, Intereconomics, ISSN 1613-964X, Springer, Heidelberg, Vol. 47, Iss. 1, pp. 39-43, http://dx.doi.org/10.1007/s10272-012-0404-0

Beers, D., Jones E., and Walsh, J.F. CFA. 2021, BoC-BoE Sovereign Default Database.https://centerforfinancialstability.org/BoC_BoE_Debt.php

Berger, H., Dell'Ariccia, G., & Obstfeld, M. (2018, February 21). *The Euro Area Needs a Fiscal Union*. IMF Blog. Retrieved December 17, 2021, from https://blogs.imf.org/2018/02/21/the-euro-area-needs-a-fiscal-union/

Blot, Christophe, Bruno Ducoudré, and Xavier Timbeau. 2016. "Sovereign Debt Spread and Default in a Model with Self-Fulfilling Prophecies and Asymmetric Information." Journal of Macroeconomics 47 (B): 281–99. https://doi.org/10.1016/j.jmacro.2015.10.003.

Board of Governors of the Federal Reserve System (US), Market Yield on U.S. Treasury

Securities at 10-Year Constant Maturity [DGS10], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/DGS10, January 5, 2022.

Chicago Board Options Exchange, CBOE Volatility Index: VIX [VIXCLS], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/VIXCLS, January 5, 2022.

Cimenti, C. (2010, March 17). *"No Bailout" Clause? The EU's Greek Rescue Problems*. CNBC. Retrieved December 17, 2021, from https://www.cnbc.com/id/35327584

Coudert, & Gex, M. (2008). Does risk aversion drive financial crises? Testing the predictive power of empirical indicators. Journal of Empirical Finance, 15(2), 167–184. https://doi.org/10.1016/j.jempfin.2007.06.00

Cruces, Juan J, and Christoph Trebesch. 2013. "Sovereign Defaults: The Price of Haircuts." American Economic Journal. Macroeconomics 5 (3): 85–117. https://doi.org/10.1257/mac.5.3.85.

Daly, Kevin. 2016. "A Secular Increase in the Equity Risk Premium." International Finance (Oxford, England) 19 (2): 179–200. https://doi.org/10.1111/infi.12085.

Darvas, Zsolt (2021) 'Timely measurement of real effective exchange rates', Working Paper 2021/15, Bruegel, 23 December 2021

De Grauwe, P. (2012). The Governance of a Fragile Eurozone. *Australian Economic Review*, *45*(3), 255–268. https://doi.org/10.1111/j.1467-8462.2012.00691.x

De Grauwe, & Ji, Y. (2013). Self-fulfilling crises in the Eurozone: An empirical test. Journal of International Money and Finance, 34, 15–36. https://doi.org/10.1016/j.jimonfin.2012.11.003

De Grauwe, P. (2016, February 12). *How to reboot the Eurozone and ensure its long-term survival*. VOX, CEPR Policy Portal. Retrieved December 17, 2021, from https://voxeu.org/article/how-reboot-eurozone-and-ensure-its-long-term-survival

ECB (2010), 'Introductory statement with Q&A', Transcript, 6 May 2010. https://www.ecb.europa.eu/press/pressconf/2010/html/is100506.en.htm

ECB Monthly Bulletin (2005). *DETERMINANTS OF THE FALL OF CORPORATE BOND SPREADS IN RECENT YEARS.* https://www.ecb.europa.eu/pub/pdf/other/mb200501_focus02.en.pdf , January 4, 2022.

ESM. (2021). *The revised ESM Treaty envisages the introduction of single-limb Collective Action Clauses (CACs). What are they?* European Stability Mechanism. Retrieved December 17, 2021, from https://www.esm.europa.eu/content/revised-esm-treaty-envisages-introduction-single-limb-collective-action-clauses-cacs-what

European Central Bank. “Five Things You Need to Know about the Maastricht Treaty.” European Central Bank, November 18, 2021. https://www.ecb.europa.eu/ecb/educational/explainers/tell-me-more/html/25_years_maastricht.en.html.

Froot, & O'Connell, P. G. J. (2003). The Risk Tolerance of International Investors. https://doi.org/10.3386/w10157

González-Hermosillo. (2008). Investors' Risk Appetite and Global Financial Market Conditions. International Monetary Fund.

Gros. (2012). A Simple Model of Multiple Equilibria and Sovereign Default. In Centre for European Policy Studies, Jul 2012, 20 pp.

Ha, Jongrim, M. Ayhan Kose, and Franziska Ohnsorge (2021). "One-Stop Source: A Global Database of Inflation." Policy Research Working Paper 9737. World Bank, Washington DC.

Harper, D. H. (2021, April 30). *Corporate Bonds: An Introduction to Credit Risk*. Investopedia. https://www.investopedia.com/investing/corporate-bonds-introduction-to-credit-risk

Ice Data Indices, LLC, ICE BofA US High Yield Index Option-Adjusted Spread [BAMLH0A0HYM2], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/BAMLH0A0HYM2, January 5, 2022.

Khan, M. (2020, November 30). *Eurozone finance ministers strike deal over bailout fund reform*. Financial Times. Retrieved December 17, 2021, from https://www-ft-com.ezp-prod1.hul.harvard.edu/content/827f3d0c-ff1d-417e-bdc9-afd55be003b0

Kalemli-Özcan, Şebnem, Carmen Reinhart, and Kenneth Rogoff. 2016. "SOVEREIGN DEBT AND FINANCIAL CRISES: THEORY AND HISTORICAL EVIDENCE." Journal of the European Economic Association 14 (1): 1–6. https://doi.org/10.1111/jeea.12167.

Land Portal Foundation. (2021). *Corruption Perceptions Index.* https://landportal.org/book/dataset/ti-cpi

Mallucci, Enrico. 2021. "Domestic Debt and Sovereign Defaults." Journal of Money, Credit and Banking. https://doi.org/10.1111/jmcb.12864.

Manganelli, Simone, and Guido Wolswijk. 2009. "What Drives Spreads in the Euro Area Government Bond Market?" Economic Policy 24 (58): 191–240. https://doi.org/10.1111/j.1468-0327.2009.00220.x.

Minenna, M. (2019, December 23). *The European (In)stability Mechanism*. Financial Times.

Retrieved December 17, 2021, from https://www.ft.com/content/319e2cbc-1558-4ddd-8348-cd7a39c7fca3

Moody's, Moody's Seasoned Aaa Corporate Bond Yield [AAA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/AAA, January 4, 2022.

Moody's, Moody's Seasoned Baa Corporate Bond Yield [BAA], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/BAA, January 5, 2022.

MSCI. (2021). *MSCI Investment Insights 2021: Global institutional investor survey*. https://www.msci.com/documents/1296102/22910163/MSCI-Investment-Insights-2021-Report.pdf

Organization for Economic Co-operation and Development, Long-Term Government Bond Yields: 10-year: Main (Including Benchmark) for the Euro Area [IRLTLT01EZM156N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/IRLTLT01EZM156N, January 5, 2022.

Remolona, Eli; Scatigna, Michela; and Wu, Eliza. "Interpreting Sovereign Spreads." 2007. BIS Quarterly Review. https://www.bis.org/repofficepubl/arpresearch_fs_200703.02.pdf

Rövekamp. (2020). The Evolution of the European Stability Mechanism: Lessons for Asian Integration. In Policy File. Asian Development Bank Institute.

Sandleris, Guido. 2014. “Sovereign Defaults, Credit to the Private Sector, and Domestic Credit Market Institutions.” Journal of Money, Credit and Banking 46 (2-3): 321–45. https://doi.org/10.1111/jmcb.12108.

Wijffelaars, Maartje, and Herwin Loman . “The Eurozone (Debt) Crisis – Causes and Crisis Response.” RaboResearch - Economic Research. Rabobank, December 18, 2015. https://economics.rabobank.com/publications/2015/december/the-eurozone-debt-crisis--causes-and-crisis-response/.

World Bank, World Development Indicators. (2021). *Quarterly Public Sector Debt (% of GDP).* https://databank.worldbank.org/source/quarterly-public-sector-debt/Type/TABLE/preview/on#

World Bank, World Development Indicators. (2021). *Current account balance (BoP, current US$).* https://data.worldbank.org/indicator/BN.CAB.XOKA.CD

World Bank, World Development Indicators. (2021). *Gross Central Govt Debt as % of GDP.* https://databank.worldbank.org/embed-int/Table-C2.-Gross-Central-Gov.-Debt-as-percent-of-GD/id/668c5dc2