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The impact of market perception on sovereign default risk in the European Union

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The Impact of Market Perception on Sovereign Default Risk in the European Union

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I. Introduction

Many countries in the European Union have amassed enormous debts in recent years. From 2010 to 2012, Italy, Spain, Portugal, and Greece have averaged debt to GDP ratios of 118.3, 71.67, 111.27, and 159.2 respectively. Throughout this time period, Greece has experienced differential treatment in regards to its bonds when compared to these other periphery countries. This differential treatment is clearly indicated by the difference in credit default swap spreads. From 2010 to 2012, Greece had an average spread of 4,687 basis points, while Italy, Spain, and Portugal had spreads of 400, 346, and 680 points respectively. Among other factors, such as ownership of debt, cross-country ties due to Basel I-II-III, and eurozone specific criteria (level of debt and budget deficit), an important factor is the debt perception. The objective of this study is to investigate the factors that affect the market perception of sovereign debt.

Since the financial crisis that occurred in 2008, most of the economies in the world have been trying to get back on track. Countries, like the United States, are seeing signs of recovery. However, across the Atlantic Ocean, financial problems are still raging with no end in sight. Over the past couple of years, the Euro has been devalued significantly, unemployment has increased in many countries, and economic growth has been nonexistent.

Currently in the European Union, Greece is at the center of the economic turmoil. Since the financial crisis, Greece has experienced two bailouts and is currently undergoing negotiations to restructure their debts. However, Greece is not the only European country dealing with mounting sovereign debt issues. Spain and Italy, economies much larger than that of Greece, are also experiencing increasing debt levels. All three of these nations currently have debt levels exceeding their gross domestic products. This leads to the question; what is sovereign debt, and why is it important?

Sovereign debt provides a method that countries can use to gain access to government funds that would not normally be available. Sovereign debt has many uses, including financing projects, conducting monetary policy through bond purchases, and financing government spending. However, when debt begins to grow and interest rates increase, it can be a crippling burden for countries. In this context, a key factor is the market perception of a country's debt. Market perception encompasses risk that cannot be valued. Measurement of perception allows for a more thorough understanding of the pricing of debt.

This paper utilizes data on credit default swap spreads (CDS spreads) from 2005-2014 for 17 eurozone countries.[1]The goal of this analysis is to determine how market perception factors into the variation of CDS spreads. Using economic variables, a fixed effect regression is implemented with interaction terms to measure differences in CDS spreads across European countries. Additionally, a perception index was calculated to quantify perception differences across periphery countries.[2]

The fixed effect regression confirmed the hypothesis that Greece had significantly higher CDS spreads than other countries in the sample. The largest interaction coefficient for Greece eclipsed 7,000, while the other periphery countries' largest interaction coefficients were in the 100's. The perception index presented similar results. Greece's CDS were found to be 4 to 5 times greater than they should have been based on economic fundamentals, while no other periphery country was found to have this discrepancy in CDS spreads. This evidence fuels the argument that Greek debt was treated differently than the other countries, and that market perception may be a factor behind this differential.

[1] Countries Included: Germany, Italy, Spain, France, Greece, Portugal, Hungary, Austria, Bulgaria, Iceland, Sweden, Belgium, Croatia, Poland, Romania, Slovakia, and Slovenia.
[2] The periphery countries are Greece, Spain, Italy, and Portugal.

The remainder of this paper is split into four sections. The second section presents a comprehensive literature review of optimal currency areas, the European Union, and debt and market perception, while the following section will explain the data. The third section includes two methodologies, and the final section is the results of the analysis.

II. Literature Review

Optimal Currency Areas

The formation of the European Union was a culmination of political, cultural, and economic factors. In this review, we will delve deeper into the economic factors. The driving theory behind the eurozone is optimal currency area theory. The definition of an optimal currency area is "[A] geographic area in which a single currency would create the greatest economic benefit" (Investopedia). The theory behind OCA's has been developed over decades of studies and research. We will review the ideas that create the foundation for an optimal currency area.

The first idea that is important to OCA theory was factor mobility. Mundell (1961) specifically cites labor mobility as the crucial factor that allows OCA's to function, using an example with two separate regions (A and B) that have fixed exchange rates. If the demand shifts from region A's products to region B's, this will cause inflation in region B and unemployment in region A. If exchange rates were flexible, some of this would be mitigated. However, since they are not, another variable must adjust to restore equilibrium. Mundell makes the case that this must be labor mobility. The ability of labor to move from recessionary region A to the booming B region gets rid of the pressures of unemployment and inflation that would normally be corrected through an exchange rate.

In 1963, McKinnon built upon this idea by splitting factor mobility into mobility among regions and mobility of industries. He stated that if the negatively impacted region can create products similar to the demanded product, then labor mobility is not needed. If this replication cannot occur, then mobility is required. Then, in 1969, Kenen imposed a condition on Mundell's idea by stating that for this to be true, the entire work force must have a similar skill set or the

work must be similar. Otherwise, it would not be possible for workers to travel from one region to another and bring about equilibrium.

The next addition made to OCA theory was also from McKinnon (1963). He stated that the more open an economy is, the more advantageous it will find a fixed exchange rate system. His argument states that when there is a very open economy, the prices of foreign goods are more likely to be factored into the domestic cost of living. This reduces money illusion and causes prices and wages to be influenced more by changes in the exchange rate. This makes exchange rates less efficient as an adjustment mechanism for an economy therefore meaning that smaller countries would be better off joining larger economies. The idea behind this is that that larger economies are more self-sufficient, and therefore do not need as many imports.

In 1969, Kenen added another idea to OCA theory by advocating for the diversification of products. It was Kenen's belief that perfect labor mobility rarely exists, and because of this, he believed that, "…diversity in a nation's product mix, the number of single-product regions contained in a single country, may be more relevant than labour mobility" (Kenen 1969). If a country with a fixed exchange rate produces a small number of products and a negative demand shock occurs, then the natural adjustment method, the exchange rate, cannot be used. This results in unemployment for the area. This is why it is important for OCA's to have product diversification. In this case, a single negative demand shock will not affect the area nearly as much because it is only felt in one of many sectors.

Ingram (1962) was the first person to introduce financial integration into OCA theory. Financial integration allows for capital to flow more easily. When one area is experiencing a negative shock, capital flows to this area help reduce the impact of the shock. Once the effects of the shock are no longer felt, the capital will be redistributed. "With a high degree of financial

integration, even modest changes in interest rates would elicit equilibrating capital movements across partner countries. This would reduce differences in long-term interest rates, easing the financing of external imbalances but also fostering an efficient allocation of resources" (Mongelli 2008). This idea is similar to that of Mundell's labor mobility.

A final point for this section is Corden's addition in 1972. He was concerned with the potential loss of control of monetary and exchange rate policy. Additionally, by forming a currency union with another country, there is a loss of autonomy in the political arena because more powerful countries may dictate policy. If a country believes that their monetary policy or exchange rates are an effective tool for combating shocks, then autonomy may be the better choice. Additionally, Corden (1972) considers inflation preferences of joining countries to be very important. Differences in preference for levels of inflation can cause rifts between members when trying to decide on policy. All of these ideas provided the foundation of optimal currency area theory. In recent years, this theory has been tested through the formation of the European Union. The next section will discuss the Maastricht Treaty, which formed the European monetary union.

Maastricht Treaty and Basel Accords

The Maastricht Treaty, signed in 1992, laid the foundation for the European Monetary Union. Previously, the "Single European Act" was established in order to create one market within Europe. In 1992, "The Single European Market … provided for the free movement of goods, persons, services and capital" (Afxentiou 2000). A singular market led to a great push toward further monetary unification, and, naturally, the idea of a single currency to use within this market was established. However, financially strong countries did not want to be brought

down by financially weak countries that also joined the currency. This laid the foundation of the convergence criteria that was put forth in the Maastricht Treaty.

The Maastricht Treaty lays out four distinct criteria for member states to adhere to in order to join the monetary union. These criteria are in place for a couple of reasons. One is that they help to create a homogenous economic environment that is required for an optimal currency area. The second is because they allow the member states to see whether or not prospective members are willing to make economic sacrifices in order to join the monetary union.

The first fiscal criterion is presented in two parts. The first part states that the government deficit cannot be larger than 3% of GDP. The second part of the criterion requires that the country's debt be no greater than 60% of GDP. However, the treaty does allow some leniency with these criteria by calling them "reference values". The treaty states that countries are still eligible for membership if their deficits and debt "has declined substantially and continuously and reached a level that comes close to the reference value" (Maastricht Treaty 1992). Afxentiou (2000) claims that, "The stability of the euro is reinforced by (these two) criteria, which protect the European Union from threats of inflation which may arise from government budget deficits."

The second criterion states that prospective member's inflation level can be no higher than 1.5% above the average level of the three lowest inflation members. "Germany particularly insisted on adopting this criterion with the view of making the Union's future monetary policy analogous to that of the Bundesbank" (Bukowski). Low inflation rates would help decrease the economic uncertainty of adding a new country into the union. Additionally, if all members hovered around the same inflation rate, they would be more likely to favor similar monetary policies going forward.

Criterion three states that the nominal long term interest rate cannot be more than 2% greater than the average of the three lowest interest rate countries. Economically, the countries in the monetary union benefit from all members sharing a similar interest rate. Since debt from all member countries is denominated in the same currency, higher interest rates before joining may indicate more risk throughout the monetary union. Again, this criterion was desired by Germany because, "Germany was afraid that at a relatively lower interest on their treasury bonds in comparison to that in other EU countries, it would have problems with placing them in the financial markets" (Bukowski).

The final criteria of the Maastricht Treaty states that no country desiring membership can have exchange rate realignment over a two-year period. This refers to the devaluation of the central rate of their currency that is pegged to the euro. Additionally, it is recommended that the country join the European Exchange Rate Mechanism (ERM-II), which, "provides the framework to manage the exchange rates between EU currencies, and ensures stability" (Europa.eu). The reasoning behind this criterion deals with exchange rate fluctuations. "Stabilization of the given country's exchange rate within the ERM-II in the course of 2 years means that despite the lack of currency-related restrictions, the exchange rate is affected by minimum fluctuations around the central exchange rate" (Bukowski).

Although some of these criteria are discussed in optimal currency area theory, it is believed that these criteria were not required to function as a monetary union. However, stronger countries financially, such as Germany, pushed the enforcement of these criteria. Even if the different criteria were not required for an effective currency area, they allowed the current members to see if aspiring members were willing to play ball. They provide a sense of security to current members when a country undertakes all of these measures in order to gain membership

and play a crucial role when considering market perceptions. Requiring these fiscal criteria caused markets to believe that countries were changing in terms of fiscal behavior and they gave investors a sense of security that these countries were not as risky.

In the next section, the Basel Accords will be reviewed. This financial legislation is crucial to the topic of Greek and European debt as it directly impacts how the market perceived the sovereign debt of countries.

The Basel Accords

Basel I

The Basel Accords were created to enforce better banking practices. The goal of the Basel committee was, "to improve the quality of banking supervision globally providing a better understanding in the field of supervision" (Aramburu 2013). This has led to the publishing of Basel I, II, and III, which build a framework for improved banking practices. This section will focus further on each of these three documents and the changes they have implemented.

In 1988, the first of the three Basel Accords was published. The main focus of this document was credit risk specifically, which was believed to be the best practice for handling credit risk. This document laid out a framework known as risk weighting that would recommend banks keep a "minimum" amount of capital in reserve depending on what assets they were holding in order to safe guard them from the risk of borrower default. This document was divided into three distinct sections; the first being "the constituents of capital". The Basel Accord recommended that 50% of a bank's capital be "Tier 1", while the other 50% should be "Tier 2". Tier 1 capital is defined as "a core element comprised of equity capital and published reserves from post-tax retained earnings" (Balin 2013). The second type of capital is more broad and includes, "reserves created to cover potential loan losses, holdings of subordinated debt, hybrid

debt/equity instrument holdings, and potential gains from the sale of assets purchased through the sale of bank stock" (Balin 2013).

The second portion of Basel I laid out risk weighting. Basel I created a five tier system that allowed banks to classify all of their assets and be able to hold the proper amount of capital. The system assigned a 0, 10, 20, 50, or 100 percent weight, depending on the riskiness of the underlying asset. The final pillar in Basel I was the "target standard ratio", which created "minimum standard should be set now which international banks generally will be expected to achieve" (Basle 1988). The target standard is a ratio of capital to weighted risk assets. The committee agreed that a ratio of 8%, with 4% being Tier 1 capital, was the minimum amount needed to protect banks from credit risk. These three pillars are the main ideas presented in Basel I, and they are built upon in Basel II and III. Generally speaking, Basel II and III increase the restrictions presented in Basel I, which were found to be too lenient.

Basel II

In 1999, the Basel Committee proposed a new accord, Basel II, which responded to some of the criticism of Basel I and provided a more complete framework of capital controls for the banking industry. The second accord followed the first in its utilization of a pillar structure. The first pillar of Basel II laid out minimum capital requirements. The goal was to implement restructured capital requirements that adjusted the risk weighting system, and to erase loopholes that banks had been using to avoid proper implementation of the capital requirements.

Basel II also introduced the idea of internal incentivized risk weighting, known as the Internal Ratings Based Approach. Using this method, not only could banks create their own weighting systems with additional help from regulators, they could forgo the additional 6% of capital reserves required by using the standardized system. There are two possible IRBA

approaches: the Foundation IRB and the Advanced IRB. The IRB approach benefited both sides for multiple reasons. The banks were incentivized to take on more customers of all types, their profits grew because the reserve requirements were smaller, and self-regulation was possible. The regulators benefited because less regulation was needed when banks implemented and followed these guidelines.

Basel II's guidelines extend into the operational risk of banks as well. Three different methods were used to evaluate operational risk: Basic indicator Approach, Standardized Approach, and the Advanced Measurement Approach. The Basic indicator required that banks hold capital equivalent to 15% of the average gross income of the bank over the past three years. This percentage was adjusted based on regulator's decisions. The standardized approach applied a weight to each business line a bank had, with the riskier departments receiving a higher weight. The Advanced Measurement Approach is a parallel to the IRB, but for operational risks.

Lastly, Pillar 1 discussed market risk. Basel created two categories for market risk, the first being fixed income securities, and the second includes equities and foreign exchange. It is recommended that banks use Value at Risk (VaR) to evaluate fixed income securities, and allow banks to generate their own weights using this measure. For banks that did not want to use VaR, the Basel Committee recommended two different methods. When dealing with interest rate risk, the weight was tied to the time until maturity, with longer maturity assets receiving higher weights. To deal with volatility, suggested weights were tied to the underlying credit rating of the bond. These were all the changes included for Pillar 1 in Basel II.

Pillar II reviews bank-regulator interactions and gives regulators more power in two areas. The first is supervision over banks, and the second is in the risk weighting process. "Regulators are given the power to oversee the internal risk evaluation regimes proposed in Pillar

I and change them to the simpler, more conservative "bucket-based" approaches if they deem a bank unable to manage its credit, market, and operational risks independently" (Balin, 2013). Regulators can also review a bank's capital assessment policy when they see fit, and are given the mandate to hold senior management responsible if a bank misrepresents its risk positioning. "Moreover, banks are charged with drafting their own risk profiles, and if this reporting is not done, authorities have the right to penalize the at-fault bank" (Balin 2013). Two additional powers are given to regulators by Basel II. The first allows regulators to increase capital requirements for a bank if the bank is not following the reserve requirements. The second allows regulators to intervene and implement a solution if a bank's reserves fall below the required levels.

The final pillar of Basel II tried to increase bank transparency with the public. It was recommended that previous reports and statistics that were not released to the public now be made available. These included: "the aggregate amounts of surplus capital (both Tier 1 and Tier 2) held by a bank, risk-weighted capital adequacy ratios, reserve requirements for credit, market, and operational risk, and a full description (with assumptions) of the risk mitigation approaches of a bank are recommended for quarterly release" (Balin 2013). This forces banks to be held accountable for the actions they are taking with regards to assets. Subsequently, the public could help police internal bank activities. This sums up the changes made in Basel II that were further modified by Basel III.

Basel III

Basel III was implemented in 2010 in response to the financial crisis. "The purpose of Basel III is to remedy the regulatory capital and liquidity failures that resulted in the 2007-2009 global financial crisis" (Eubanks 2010). "Specifically, the central part of the Basel III regulatory

reform package is to establish the minimum regulatory capital and liquidity requirements that banks must hold to absorb unexpected losses" (Eubanks 2010).

One of the changes Basel III implemented was a change to tier 1 capital (defined in the Basel I discussion). Previously, a loophole allowed banks to look like they had a healthy amount of tier 1 capital, but in reality, they lacked the proper amount of tangible equity. "The financial crisis demonstrated that the resources to cushion against credit losses and write-downs came out of retained earnings, which is a part of a bank's tangible equity base" (Eubanks 2010). Basel III essentially eliminates this loophole by shortening the list of capital allowed in tier 1. The goal was to as strictly as possible, only allow tangible equity to be allowed in this category. In addition to this change, Basel III also increased the minimum common equity a bank must hold from 2.5% to 4.5%.

In order to better protect banks during poor financial times, Basel III added a capital buffer that was required on top of the previous minimum total capital. This buffer was intended to be used in times of financial distress when the bank incurs losses. However, once the capital buffer had been reduced, the bank was required to build it back up.

An additional feature that was included in Basel III with regards to the capital buffer was making the capital buffer countercyclical. This measure was included because the restrictions implemented by these accords can counteract against monetary policy. If an economy is contracting, Basel III recommends higher levels of capital because assets are riskier. However, if an economy is contracting, monetary policy is conducted looking to increase lending. These two actions do not work well together, which makes the capital buffer important. Similar to the capital buffer, this countercyclical buffer can range from 0% to 2.5% of total risk weighted assets. The buffer changes based on the state of the economy. In times of expansion, the buffer

grows, and in contractionary times, it shrinks. Additionally, the idea of asset specific buffers was introduced, where if an asset became riskier, then the capital required for them grew. In total, if the countercyclical buffer was at 2.5%, the total amount asked to be held by banks would equal 13%. Another change Basel III implemented was a new liquidity requirement. This was created because even with banks following Basel II's guidelines, they still experienced liquidity problems during the tough financial years. This leads to the last major implementation of Basel III, the global leverage ratio.

This leverage ratio was introduced because banks were able to meet requirements while using too much leverage to finance loans. This problem was multiplied, "when banks were forced by market conditions to reduce their leverage that the system increased the downward pressure in asset prices. This exacerbated the decline in bank capital and the contraction in available credit" (Eubanks 2010). "The leverage ratio addresses endogenous risk and the overall health of a banking system, as opposed to exogenous risk, which only affects the health of an individual institution" (Walker 2013). The ratio used is gross capital divided by average total consolidated on-balance sheet assets. This ratio required additional capital to be held depending on how leveraged the bank was.

The additional regulations implemented in Basel I and II ended up being a problem once the financial crisis occurred. More regulations made it feel like banks were making safer investments. This gets factored into market perception making investors believe that financial risk is being mitigated. Once the financial crisis hit, investors realized this was not the case, and the added value from misplaced market perception quickly evaporated. After the crash, investors felt betrayed and had a more negative outlook, causing the same assets that were overvalued to

be significantly undervalued. This briefly summarizes the role the first two Basel Accords played.

Debt and Market Perception

Debt

Sovereign debt is defined as "The amount of money that a country's government has borrowed, typically issued as bonds denominated in a reserve currency" (Oxford Dictionary) Traditionally, government debt is seen as a mechanism that can be used to finance spending, but as debt grows, it is believed that market perception worsens. This makes it important to understand a few different ways government debt affects a country. In the short run, additional government spending boosts the aggregate demand for goods and services. This results in a multiplier effect as the money gets spent by individuals, resulting in an additional boost to aggregate demand. In recent times, an increase in government spending has been heavily associated with recessions, specifically with the goal of getting out of them more quickly. In addition to the short run effect, a long run effect exists as well. Increases in aggregate demand end up raising interest rates which crowds out investment of the economy. Eventually, with a lower capital stock (a result of the reduction in investment), output ends up falling to a lower level because of a reduction in infrastructure. These two effects are the most common when discussing sovereign debt, but other implications need to be explored. Elmendorf and Mankiw (1998) state different effects caused by government debt.

The first is based off of the idea that countries with high levels of debt often are required to pay higher interest rates. Elmendorf and Mankiw (1998) state that in order to get these rates down, governments may be pressured to use expansionary monetary policy to monetize some of the debt. In this scenario, even with debt shrinking, market perception worsens because the increase in the money supply thereby raises inflation. Theoretically, inflation in an economy

decreases confidence and therefore has an effect on market perception. The second effect of debt is that it causes higher taxes in the future in order to service it. This would occur if governments decided not to monetize the debt, and used higher tax revenues to pay off the debt and servicing costs instead. At first, this method may seem insulated from market perception, but with higher taxes and a fall in consumption, output will contract, and the contraction may result in a negative outlook for a countries economy. If we look at financing debt through bond sales, we see that regardless of how governments pay off the debt, there is a possibility of a negative impact on market perception.

The third claim is that governments spend less carefully when using debt to finance projects. Careless spending leads to the need for additional financing. This creates a vicious cycle that eventually results in a negative impact on market perception. A final claim is that rising debts cause a reduction in international confidence. This confidence reduction comes from a few places. As stated earlier, increased inflation from monetization will hurt international confidence through changes in the exchange rate. Additionally, higher levels of debt are associated with higher probability of default, which hurts confidence and affects the market perception.

Four ideas are presented above that are theoretical side effects of rising debt. Most of these effects can be directly linked to a negative impact on market perception through a story. Establishing this link provides reason to believe that studying debt is crucial to understanding market perception. In the section below, market perception is discussed with information taken from recent papers to provide insight on how it can be measured.

Market Perception

An example can be very useful when trying to describe market perception since it is an obscure concept. Imagine that there are two countries, A and B. Both of these countries are similar in every aspect, including their economies, debt structures, probabilities of default, etc. However, if you look at the bonds offered by each, country A is paying 8% interest on its debt, while country B is paying 2% interest on its debt. The difference in these interest rates has to be explained by something, and this difference is what is considered "market perception". This example helps create a formal definition for market perception which can be put into words as the difference in rates paid by two difference countries that are not accounted for by differences in debt structure, probability of default, or other financial measures.

Recent literature on market perception has been largely focused on the financial crisis period with specific focus on Europe. A paper written by Aizenman et al. (2011) focuses on the pricing of risk in the European Union during the financial crisis with specific focus on the periphery countries (Greece, Ireland, Italy, Portugal, and Spain). Their objective was to "determine whether the perception of relatively high sovereign default risk of the fiscally distressed Euro area countries, as seen in market pricing of credit default swap (CDS) spreads, may be explained by existing past or current fundamentals of debt and deficits relative to tax revenues – which we term *de facto* fiscal space – and other economic determinants" (Aizenman et al. 2011). Another paper written by Gonzalo Camba-Méndez and Dobromił Serwa (2014) also looked to study the market perception of different countries in Europe, as well as figure out some of the drivers behind market perception. To do this, they estimated the probability of default and loss given default by looking at credit default swaps. In addition, they also looked at institutional influence and contagion in their analysis.

Both of these papers used credit default swaps (CDS) instead of bond interest rates to measure market perception. A credit default swap is "A credit derivative contract between two parties where the buyer makes periodic payments (over the maturity period of the CDS) to the seller in exchange for a commitment to a payoff if a third party defaults. Generally used as insurance against default on a credit asset, but can also be used for speculation" (Farlex Financial Dictionary 2012). Aizenman et al. (2011) says that they use CDS to measure market perception of default risk because, "The spreads represent the quarterly payments that must be paid by the buyer of CDS to the seller for the contingent claim in the case of a credit event, in this case non-payment (or forced restructuring) of sovereign debt, and is therefore an excellent proxy for market-based default risk pricing." Additional studies have been done that further support the use of CDS in the analysis of market perception.

Packer and Suthiphongchai (2003) found that "Under certain conditions, this CDS premium should be approximately equal to the credit spread (yield minus risk-free rates) of the reference bond of the same maturity." Alternatively, Fontana and Scheicher (2010) found that this difference was not zero during the financial crisis in Europe. Another study by Beber et al. (2009) found that when using high frequency data, differences in credit quality explained eurozone sovereign yield spreads. Aizenman et al. (2011) suggested that these aforementioned studies, "provided evidence that sovereign interest rates and CDS spreads have common underlying causes, rather than one driving the other."

Additional studies have been done with the goal of linking the macro economy to CDS spreads. Brendt and Obreja (2010) found that "economic catastrophe risk" rose during the financial crisis years and correlated with increases in CDS spreads. Another study by Michu et al. found a strong link between credit rating announcements and fluctuations in CDS spreads.

Finally, Amato (2005) found significant relationships between macroeconomic conditions and resulting CDS spreads. Finding these linkages is expected, and can help quantify market perception. Being able to account for a portion of the CDS spread provides a better idea of how much the spreads are affected by market perception instead of other economic factors. Both Aizenman et al. (2011) and Camba-Méndez and Serwa (2014) found promising results in terms of evidence for differing market perception.

Aizenman et al. (2011) found evidence that "market-priced risk of sovereign debt as measured by CDS spreads is partly explained by fiscal space and other economic determinants." Their conclusions on European countries found mispricing of CDS in the periphery countries Evidence was also found that during calm periods, the pricing was unpredictably low, and that during the financial crisis, the spreads were unpredictably high. Additionally, they compared the periphery countries to five countries outside of Europe with a similar fiscal space, and found that the European countries' risk was priced significantly higher. Camba-Méndez and Serwa (2014) also found that during the financial crisis, there were "excessively high CDS spread levels". Both of these findings reinforce the idea that market perception plays a large role in sovereign debt pricing, especially in the European Union at a time when there was concern of default because of the periphery.

III. Data

The main variables included in the empirical analysis are: five-year Credit Default Swap spreads (CDS), Debt to GDP Ratio (debt/GDP), Inflation Rate (Inflation), Tax to GDP ratio (tax/GDP), and TED Spread. Annual data was collected for these variables over the years 2005 to 2014 for 17 European countries. Data for credit defaults swaps for the 17 country sample was obtained from Bloomberg terminal. The macroeconomic variables debt/GDP, Inflation, and Tax/GDP were obtained from Eurostat, and the TED spread was retrieved from the St. Louis FED.

Table 1 presents the descriptive statistics for each variable and each country. For brevity, only the average value for each variable from 2005-2014 is listed. It is clear from this table that the CDS spreads for Greece are significantly larger than other European countries, even though their macroeconomic variable values are not much different for Greece. Since this thesis focuses on the European debt crisis, Table 2 presents these averages only for the years 2010-2012. This table shows a similar story, but with increased average CDS spreads.

IV. Methodology

In order to estimate the determinants of CDS spreads, a fixed effect regression model is used to exploit the panel data structure described in Section III. A fixed effect regression model accounts for unobserved heterogeneity that can be attributed to country-specific factors not measured in data. It is equivalent to including an indicator variable for all countries in our sample (except one that serves as the base group), and it has the effect of eliminating any observed and unobserved time-invariant country-specific effects from the regression model. As a result, the variation we use to identify our estimates is *within-country* variation. (i.e. changes in independent variables within each country over time). In addition, to show that periphery countries had additional effects on their CDS over and above the euro average during crisis years, we also add an interaction term for such a country (or group of countries in one specification), with an indicator variable for the year (separately for 2010, 2011, and 2012). Formally, our benchmark regression model is given by:

$$Y_{it} = \beta X_{it} + \alpha_i + \gamma_t + Periphery_i \times \gamma_t + \epsilon_{it} \qquad (1)$$

Y_{it} = Credit Default swap (CDS) spread for country i at time t.

X_{it} = is a vector of determinants of country i's CDS that vary over time

α_i = denotes country fixed effects

γ_t = is a vector of dummy variables for the years 2010, 2011, and 2012.

$Periphery_i$: is a vector of indicator variables capturing periphery economies (Greece, Portugal, Spain, and Italy.

ε_{it} = the error term for country i at year t

To provide the intuition for the empirical framework, we use the specification that only included an interaction term for Greece:

$$Y_{it} = \alpha_i + \beta_1 \frac{Debt}{GDP} + \beta_2 \frac{Tax}{GDP} + \beta_3 Inflation + \beta_4 TED\ spread + \beta_5 CDS\ Lag + \beta_6 2010 + \beta_7 2011 + \beta_8 2012 + \beta_9 Greece \times 2010 + \beta_{10} Greece \times 2011 + \beta_{11} Greece \times 2012 + \epsilon_{it}$$

Using this example, the interpretations for the time and interaction dummies are as follows:

β_{10}: Holding all else constant, the CDS spread for Greece in 2010 is β_9 basis points greater than the average CDS spread for non-periphery countries in 2010.

Credit default swap spreads indicate how much a purchaser must spend to insure $10 million worth of debt. The spreads are in terms of basis points and each basis point is the equivalent of $1,000. Therefore, if the spread is 10, it costs the purchasers $10,000 to insure $10 million worth of sovereign debt.

In the following discussion, rationale is provided for the inclusion of the independent variables in our regression model and the expected sign for each coefficient. In an analysis done by Aizenman et. al (2011), a focus was put on "fiscal space", which included two variables: Sovereign debt/tax base and fiscal deficit/ tax base. In this analysis, the debt and tax base are used, but they are in terms of percentage of GDP. Logically, the government debt and deficits should contribute to fluctuations in CDS spreads. As governments become more indebted, they should be considered riskier and spreads should increase. As the debt and deficit grow, governments have the choice to pay off debt through money creation, the sale of bonds, or tax revenues. Using tax revenues is the only method available that decreases the debt or deficit without increasing inflation. However, most of the time the choice is made to use money creation or bond sales. This leads to an increase in the debt and deficit or inflation, which should be followed by an increase in CDS spreads.

Inflation is another important variable to include in the analysis of CDS spreads because of its link to decreased confidence. As inflation increases, prices of goods become higher for consumers, and this remains true for the governing bodies. Rising inflation decreases the purchasing power of a currency at a faster rate. As the purchasing power of a currency decreases, confidence declines, which should lead to increases in CDS spreads.

Tax/GDP is a logical variable to include because it is an indicator of financial health. As the percentage of tax revenue increases, the confidence that a government can pay off its debt should increase as well. The effect of this ratio increasing could have a multiplier effect as well. As the tax base increases, governments not only have more money to pay off debt, but they also have less incentive to use methods such as money creation or bond sales. Reducing the use of these methods should lead to an increase in consumer confidence also.

The TED Spread is a measure of the difference between a three month futures contract for U.S. Treasury bills and a three-month futures contract for eurodollars. Since U.S. Treasuries are thought of as risk free, the difference between the two assets is a measurement of default risk. As the spread increases, default risk increases, and vice versa. This makes the TED spread a logical variable for inclusion. As the spread increases, CDS spreads should also increase, as they reflect default risk as well.

The lagged CDS value was included to account for pricing during the financial crisis. We expect that during the financial crisis the pricing of CDS spreads was no longer linked to macroeconomic factors. If this is the case, there is a chance that the previous spread is a large predictor of future spreads.

In order to estimate a measure of market perception of the sovereign debt, we follow Aizenman et al. (2011), and estimate the baseline regression model with the time and interaction

dummy variables excluded for two time periods. One is over the whole sample (2006-2014), and a second is over the pre-crisis years (2006-2009). The coefficient estimates from the pre-crisis model are then used with the macroeconomic values of 2010-2012 to compute a predicted value. Following Aizenman et. al (2011), we define debt-perception for country i at time t as a ratio of actual CDS to the predicted value from our estimated regression model of CDS.

Formally,

$$\text{Debt perception} = Y_{it} / \hat{Y}_{it}$$

Where:

Y_{it} = actual 5 year CDS spread for country i at year t

$\hat{Y}_{it}$ = predicted 5 year CDS spread for country i at year t

Aizenman et. al (2011) argues that the prediction errors uncover discernable patterns between both groups of countries as well as individual countries. These prediction errors provide evidence whether CDS spreads are over or under predicted. This ratio gives an estimation of the debt perception for a country's sovereign debt during year t. If the ratio is greater than 1, our equation under predicted the CDS spread. When under prediction occurs, the ratio measures how much market perception increased the CDS spread. As the ratio grows larger, the market perception of risk becomes greater. Comparing the size of these ratios provides insight into how the market perceives these countries while controlling for other variables. If this ratio is less than 1, then the market perceives the country's debt as less risky, which lowers the spread compared to what the model predicts.

V. Results

Results will be broken down into two subsections. The first subsection will present the fixed effects regression results, discuss the variable signs, the time and interaction dummies, and provide statistical evidence that Greece's debt was treated differently compared to other periphery countries that were believed to have debt problems. The second subsection will implement the perception index, used by Aizenman et al. (2011), for the crisis time period (2010-2012)[3], to provide an estimate of how much perception factored into each periphery countries' debt.

In Table 3, we present the estimation results for the baseline model outlined in section IV.[4] The coefficient for the debt/GDP ratio is both significant and positive. This is expected because increases in debt should lead to less confidence in a country's ability to pay its current debt. Tax/GDP was insignificant in the model, but the coefficients were all positive. This is a counterintuitive result based on the logic explained in the data section. Inflation was insignificant, but had the expected positive sign. The final macroeconomic variable, TED spread, was significant and carried a positive coefficient, which was the expected result.

Two types of debt-pricing differentials within Europe can be inferred from our estimated regression model. The first is the inclusion of time dummies during the crisis period of 2010-2012. These coefficients show the difference between the average CDS spread in a crisis year compared to the other years in the sample. The time dummies for 2010 and 2011 carry values of 103 and 221 respectively. This indicates that, on average, the CDS spreads in 2011 are 221 basis points greater than the other years in the sample. Both of these years are statistically significant at the 1% level. The second type of pricing differential in this model is country-specific during

[3] Many believe that the European debt crisis began in January 2010 including: Stracca (2013) and De Santis (2012)
[4] All standard errors are corrected for serial correlation and heteroscedasticity.

the crisis years. Dummy variables are included for the four periphery countries over the crisis years of 2010-2012. These dummies provide insight into how periphery countries' CDS spreads changed during the crisis years compared to the rest of the countries in the sample set.

The country this analysis is focused on is Greece, and therefore a comparison between Greece and the other periphery countries is important. The interaction coefficients for Greece are all statistically significant at the 1% level and are the largest of any of the periphery countries. The coefficient for 2011, which is 7,928, is the highest of any coefficient, and is more than double that of Greece's 2012 coefficient of 3,336. Using the same interpretation above for Portugal, we find that the CDS spread in 2011 for Greece is 7,928 basis points greater than the average spread in 2011. This difference is astonishing considering the fact that the country with the next highest coefficient is Portugal at 641. This shows how risky Greece was perceived, even compared to other countries that were seen as risky as well. In order to see if Greek coefficients were statistically different than other periphery countries, t-tests were performed between the periphery countries and Greece for each year. In every case, Greece's coefficients were determined to be different than other countries. This results in two important findings. First, when comparing Greece's CDS spreads from 2010-2012, the Greek spreads are anywhere from 482 to 7,928 basis points higher than the average countries' spread depending on the year. The second finding is that when comparing Greek spreads to other periphery countries, there is statistical evidence that they are larger. These two findings tell us that not only was Greek debt treated differently than other countries in Europe, it was treated differently than other European countries in financial crisis.

When looking at the other periphery, all the coefficients on the interaction dummies are statistically significant. The coefficients for Portugal range from 110 to 641, and as mentioned

above, Portugal is the country with the highest coefficient behind Greece. The major differences in coefficients occur when comparing Greece to Spain or Italy. The coefficients for both of these countries never exceed 260, while Greece's lowest coefficient is 482. When looking at the evidence, the macroeconomic variables for all of these countries were relatively similar, but this regression clearly shows that the spreads for Greek debt were significantly larger. As a result, it can be concluded that other factors such as market perception played a large role when considering Greek debt.

Table 4 looks into the possibility of stability issues in pricing CDS during the financial crisis. Two models are estimated using the same variables as the baseline model, excluding the time and interaction dummies. Three models are presented, with one including the pre-crisis years, a second modeling the crisis years, and a third modeling the full sample. The goal of these estimations is to discover if the model can still account for differences in spreads during the financial crisis years.

During the pre-crisis years, the model fits the data well with an R-squared of .61, and the fiscal space variable, Debt/GDP, is significant, indicating that macroeconomic factors account for variations in spreads. These results change drastically in the model that only includes the crisis years. This model reinforces that a structural break occurred during the European debt crisis. In this model, the fiscal space measure of Debt/GDP is insignificant along with Tax/GDP and Inflation. This indicates that during the crisis years, that risk was being priced based on something other than macroeconomic conditions. Similar to the results in Aizenman et al. (2011), we find that the TED spread becomes an important variable in determining spreads during the crisis years. "The emergence of the TED spread as a key pricing factor in the crisis

also suggests that expectations of market volatility jumped during the crisis and that this pushed up CDS spreads." (Aizenman et al. 2011)

The argument of this paper is that during these years, market perception played a large role in pricing risk. In order to test this, the perception methodology presented in section IV is used. The expected result is that Greece's ratios will be greater than 1 and much larger than other periphery countries, indicating that Greece's CDS spreads were significantly larger than they should have been based on economic variables.

Table 5 presents the results from this index, which generated interesting results. The Euro and non-euro ratios are always less than 1, indicating that the predicted spreads were larger than the actual spreads, and that markets perceived countries as less risky than they actually were. However, an interesting result here is that the ratios of the countries using the euro are always smaller than the ratios of countries not on the euro. This means that the market believes that being a part of the Euro equates to less risk. The difference in ratios for the Euro group to Non-euro group is .19 to .4, depending on the year. For example, take a euro country and a non-euro country in 2011, and say that both of their predicted spreads are 100. Using the ratios, the actual spread for the Euro country would be 37, and the spread for the non-euro country would be 77. This is a huge difference indicating how different the market perceives the risk between countries in these two groups, and the benefit of being part of the euro.

To test the hypothesis that market perception played a larger role in determining Greek spreads, indexes were also created for the four periphery countries. Similar to the results found with the interaction terms, Italy has the lowest values, followed by Spain, Portugal, and Greece. The ratios for Italy range from .21 to .44, which indicates that the markets believed Italy was significantly less risky than it would have been if spreads were based purely on economic

indicators. This is unsurprising since Italy is a large economy in the European Union, and was never believed to be exiting the Euro. The Spanish ratios are larger than Italy, but still well under 1. They range from .35 to .62, which also indicates that the market perception reduced the spread from what it should be given its economic situation.

The most interesting cases from this analysis are Portugal and Greece. Portugal's ratios range from .36 to 1. The ratio of one indicates that Portugal's spread was priced accurately based on its economic situation. Since the effect of being in the Euro is clear, Portugal's spread should be greater than this. This ratio of one is the first case of the Euro effect not being great enough to convince investors that Portugal was less risky than its economic situation. Unsurprisingly, Greece falls into this same category. Greece's ratios range from .68 to 5.06. It was expected that Greece's ratios would exceed 1, but the factor by which they exceed all of the other countries is staggering. In 2011 and 2012, the actual spreads exceed the predicted spreads by a factor of 5.06 and 4.21. This means that the spreads are five and four times greater than what they should have been based on the economic variables. This result is more impressive when considering that the highest ratio outside of Greece is only one. It is obvious that Greece is perceived by the market very differently than other countries. This result confirms the hypothesis, but what is surprising about this result is the magnitude of difference. Even when compared to similar countries with bad economies, Greece was perceived very differently.

VI. Conclusion

The goal of this analysis was to determine the differential treatment that Greece received compared to other countries in the Euro that have comparable situations. This was accomplished by using two models that quantified both country specific effects and the market perception of debt. The first model implemented measured country specific effects for four periphery countries in Europe: Italy, Spain, Portugal, and Greece. This was done with the inclusion of two sets of dummy variables; one set for the crisis years (2010-2012), and another for the interaction effects between the periphery and the crisis years. These interaction terms capture country and time specific effects that can then be compared between countries.

As expected, the Greece interaction coefficients were statistically larger than any of the other three periphery countries. The coefficients for Portugal, Spain, and Italy ranged from 90 to 642 basis points above average CDS spreads, depending on the year. These are minuscule compared to the Greek coefficients which ranged from 482 to 7,928 basis points above average CDS spreads. The coefficients for the other periphery were then tested with the Greek coefficients for the three crisis years. These tests statistically proved that the Greek coefficients were larger for all three years.

The second model used was the same baseline model, but with the time and interaction dummies excluded. Using the pre-crisis years, this model was used to estimate coefficients that could be used to forecast predicted spreads based on a country's economic factors. The ratio of the actual value to the predicted value was used as a measure of market perception. This was done for the four periphery countries, countries on the euro, and countries not on the euro. When comparing the results for the euro and non-euro groups, we found that the predicted values for the euro countries were much greater than the actual values. The non-euro group experienced

similar treatment, but not to the same extent. This showed that there is in fact a premium to being in the euro. Regardless of a country's financial situation, there is evidence that being in the euro results in the market perceiving a country's debt as less risky. This reinforced one of the main goals of a currency union, which is to eliminate risk.

The second finding from this analysis confirmed the belief that Greece was perceived as riskier by the market. The result from looking at the ratios for four peripheries over the crisis years was clear. The only ratios greater than one occurred for Greece in 2011 and 2012. This result showed that based on the economic situation, the spreads for Greece were four to five times greater than they should have been. The situation in Greece was perceived so poorly that even being in the euro did not make markets believe Greece was safe. This most likely stemmed from fears of a Greek exit from the euro, but this could not account for the entire difference.

This paper provided two methods that yield convincing results for differential treatment of Greece. The first result showed that effects specific to Greece during the crisis years led to high CDS spreads. The second result showed that the market perceived Greek debt significantly worse than other periphery countries in Europe. Multiple explanations can be used to explain these results, such as a potential Greek exit, unprecedented corruption and debt levels, and constant media coverage of the situation. Regardless of the reasoning behind the differential treatment, there is plenty of evidence to suggest that it occurred.

Table 1. Descriptive Statistics

Variable Average Values						
Country	**CDS Average**	**Debt/GDP**	**TED Spread**	**Fiscal/GDP**	**Tax/GDP**	**Inflation**
Germany	32.66	72.58	0.52	-1.34	39.00	1.72
Italy	163.73	113.49	0.52	-3.39	41.90	2.00
Spain	152.01	61.68	0.52	-5.21	33.85	2.25
France	61.44	78.75	0.52	-4.31	43.06	1.65
Greece	1657.23	138.32	0.52	-9.04	32.48	2.18
Portugal	280.80	95.33	0.52	-6.34	35.01	1.73
Hungary	249.46	73.31	0.52	-4.77	38.22	4.14
Austria	62.10	75.95	0.52	-2.62	42.28	2.11
Bulgaria	194.16	18.38	0.52	-1.10	28.33	4.31
Iceland	255.70	70.70	0.52	-2.86	36.48	6.15
Sweden	29.82	40.33	0.52	0.45	44.87	1.40
Belgium	84.33	98.20	0.52	-2.69	46.24	2.11
Croatia	246.72	55.88	0.52	-4.78	36.38	2.62
Poland	108.91	50.24	0.52	-4.38	33.47	2.55
Romania	234.44	25.65	0.52	-4.01	28.02	5.40
Slovakia	88.45	40.29	0.52	-3.98	29.50	2.37
Slovenia	132.84	42.10	0.52	-4.62	37.30	2.45

Table 2. Crisis Year Descriptive Statistics

2010 - 2012 Averages						
Country	**CDS Average**	**Debt/GDP**	**TED Spread**	**Fiscal/GDP**	**Tax/GDP**	**Inflation**
Germany	67.25	79.70	0.28	-1.77	38.73	1.93
Italy	339.99	118.30	0.28	-3.57	42.37	2.60
Spain	345.95	71.67	0.28	-9.77	32.37	2.50
France	138.15	85.50	0.28	-5.57	42.87	2.07
Greece	4687.13	159.20	0.28	-10.07	33.33	2.93
Portugal	680.30	111.27	0.28	-8.10	34.57	2.60
Hungary	428.82	79.90	0.28	-4.10	37.67	4.77
Austria	111.76	82.07	0.28	-3.07	42.07	2.63
Bulgaria	253.44	16.13	0.28	-1.93	26.13	2.93
Iceland	254.43	96.17	0.28	-6.37	34.43	5.90
Sweden	43.79	37.23	0.28	-0.33	43.70	1.40
Belgium	205.75	101.97	0.28	-4.07	46.33	2.77
Croatia	352.08	63.30	0.28	-6.33	35.73	2.23
Poland	167.47	53.90	0.28	-5.37	32.43	3.43
Romania	318.00	33.83	0.28	-5.17	27.63	5.10
Slovakia	159.10	45.33	0.28	-5.27	28.43	2.83
Slovenia	235.50	46.10	0.28	-5.43	37.27	2.33

Table 3. Fixed Effect Regression

Regression for all countries					
Variable	**Coefficient**	**Std. Error**	**T-value**	**P-value**	**Significance**
Debt/GDP	6.44	1.79	3.59	0	***
Tax/GDP	9.27	12.56	0.74	0.46	
Inflation	8.78	9.02	0.97	0.33	
TED Spread	165.02	34.19	4.83	0	***
CDS Lag	0.05	0.04	1.17	0.25	
2010	103.68	26.88	3.86	0	***
2011	221.54	40.54	5.46	0	***
2012	-8.91	20.95	-0.43	0.67	
Greece2010	482.19	48.51	9.94	0	***
Greece2011	7927.73	83	95.51	0	***
Greece2012	3336.19	260.57	12.8	0	***
Portugal2010	332.18	21.72	15.29	0	***
Portugal2011	641.97	32.65	19.66	0	***
Portugal2012	110.4	19.39	5.69	0	***
Spain2010	256.26	28.65	8.94	0	***
Spain2011	89.9	39.09	2.3	0.02	*
Spain2012	104.08	30.11	3.46	0	***
Italy2010	96.17	21.02	4.57	0	***
Italy2011	206.65	29.04	7.12	0	***
Italy2012	123.46	23.23	5.31	0	***
R-Squared	0.97	**F-stat**	243.87	0	
Adj-Rsquared	0.74				
N	153				

Table 4. Stability Regressions

Pre Crisis (2006-2009)

Variable	Coefficient	Std. Error	T-value	P-value	Significance
Debt.GDP	11.05	3.62	3.06	0.00	**
Tax.GDP	-4.26	9.82	-0.43	0.67	
Inflation	-1.12	6.72	-0.17	0.87	
TED.Spread	205.43	45.88	4.48	0.00	***
LCDS	-0.08	0.26	-0.29	0.77	
R-Squared	0.61	**F-stat**	14.54	0.00	
Adj-Rsquared	0.41				

Crisis Years 2010-2012

Variable	Coefficient	Std. Error	T-value	P-value	Significance
Debt.GDP	-0.91	4.30	-0.21	0.84	
Tax.GDP	12.70	34.47	0.37	0.72	
Inflation	3.48	23.08	0.15	0.88	
TED.Spread	-1978.60	666.73	-2.97	0.01	*
LCDS	-0.57	0.02	-34.57	0.00	***
R-Squared	0.99	**F-stat**	537.25	0.00	
Adj-Rsquared	0.35				

Full Sample 2006-2014

Variable	Coefficient	Std. Error	T-value	P-value	Significance
Debt.GDP	12.65	7.83	1.62	0.11	
Tax.GDP	30.93	44.21	0.70	0.49	
Inflation	55.69	38.08	1.46	0.15	
TED.Spread	55.91	43.17	1.30	0.20	
LCDS	0.23	0.03	7.27	0.00	***
R-Squared	0.18	**F-stat**	5.83	0.00	
Adj-Rsquared	0.16				

Table 5. Perception Index

		Prediction Error = Actual CDS divided by Predicted CDS value		
Country/Group		**2010**	**2011**	**2012**
Greece	Out of Sample	0.68	5.06	4.21
Italy	Out of Sample	0.21	0.44	0.23
Spain	Out of Sample	0.62	0.60	0.35
Portugal	Out of Sample	0.52	1.00	0.36
Euro	Out of Sample	0.16	0.37	0.13
Non-Euro	Out of Sample	0.51	0.77	0.32

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