The European Monetary Union Crisis: Intervention, Contagion, & Country-Specific Risk

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MATTHEW J. PREMUS

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Professor Marti G. Subrahmanyam	Professor Thomas Cooley
Faculty Adviser	Thesis Advisor

Abstract

This paper explores the differences in government bond yield spread behavior between EMU and non-EMU countries prior to and throughout the duration of the financial crisis that began in 2007. Through empirical analysis, we demonstrate that EMU and non-EMU countries display similar spread behavior during the pre-crisis period, but demonstrate drastically different behavior during the financial crisis. Specifically, all Euro-area sovereign bond spreads display mispricing of international volatility and country-specific macro-fundamentals during the pre-crisis period. However, during the crisis, countries participating in the monetary union exhibit stronger relation to global risk, country-specific macro-fundamentals, and contagion from IMF intervention, than do countries that maintained their own currency. These findings illustrate the difficulties surrounding forfeiture of national monetary control, and highlight the necessity for stronger fiscal discipline monitoring and reform, as well as continued government debt support within the EMU.

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1. Introduction

The European Union, an economic and semi-political alliance, was established under the Maastricht Treaty in 1993 by six founding member states – Belgium, France, Germany, Italy, and Luxembourg. The Treaty was a final step in an extensive progression towards European integration, which began after WWII tore apart the continent. The ultimate adoption of a consolidated European economy was meant to establish free movement of labor, goods, services, and capital, which would catapult the EU to a leading position in the global economy. Furthermore, gradual incorporation of the established economies into the European Monetary Union, and membership to its common currency, would help to create a unified financial market, resolving exchange rate complications, providing price transparency and stability, lowering interest rates, and crafting a dominant international currency. The founders of the EU believed that this new agreement would not only reduce the potential for the conflicts that had so often engulfed the continent for centuries, but would return the region to political and economic pre-eminence once more.

Membership into the European Union is based upon certain fundamental elements; a country must have a stable democracy with comprehensive human rights and judicial laws, as well as a functioning market economy. To date, the EU has 27 member states with widely-varying economies, governments, and laws. Entrance into the European Monetary Union (EMU) is much more rigorous, as all potential members are required to meet strict criteria regarding their inflation rates, Government finances, long-term interest rates, and pegged exchange rates. These constraints ensure that all countries entering the EMU as new members will not disrupt the price stability within the monetary union. The EMU was launched by eleven member states – Austria, Belgium, The Netherlands, Finland, France, Germany, Ireland, Italy, Luxembourg,

Portugal, and Spain.[1] Eventually, the EMU would expand, as six more nations – Greece, Slovenia, Cyprus, Malta, Slovakia, and Estonia – entered later, after a period of strict austerity measures, which allowed them to meet the Maastricht Treaty's requirements.

With the development of this economic union, its critics were quick to voice their concerns, with particular reservations regarding the common currency mechanism. Many maintained that despite the added stability and economic power, the European Union would crumble under a lack of political and fiscal discipline, as well as imperfect mobility of country-specific resources. However, despite these concerns, the integration of the Euro-zone was largely successful (28% of global output in 2010). Several months into the global financial crisis, with the US dollar on the decline, many analysts hailed the euro as the world's next reserve currency. The strength of the euro, supported by a large, free trade economic zone and supposed union-wide fiscal austerity, were apparent signs of success. Nevertheless, the global credit crunch has become a tough test for the European Monetary Union's viability. With the recent strain caused by union-wide government debt issues – namely those of Greece, Ireland, Portugal, and Spain – and the absence of political unity, the euro has faced enormous upheaval.

The first signs of trouble appeared in Greece. The country has never been an exemplar of financial stability, with high levels of inflation, government and economic corruption, deficient tax collection, and low international competitiveness. Only severe austerity policies and lax enforcement of the Maastricht Treaty's entrance criteria allowed Greece to join the EMU in 2002. Following its inception into the monetary union, Greece's government spending skyrocketed – debt could be had for a lower yield payout than ever before. Greece's inability to

[1] The United Kingdom and Denmark both abstained from entering into the agreement, deciding to retain their own currencies instead.

keep public spending in check, combined with corrupt government policies, produced an uncompetitive economy saddled with a large public debt burden. Ultimately, the financial crisis of 2007 provided the spark that burned down the house. Global risk perception accelerated, and anxiety over Greece's fiscal troubles emerged. In 2010, it was discovered that Greek officials had misrepresented the country's deficit levels. Greece's public deficit was found to be nearly twice as high as reported, which provoked a run on Greek sovereign debt during the summer months. As panic spread, Greek government bond premiums over German debt spiked, as did CDS spreads. Fortunately, due to the cooperative action of the EU and the IMF, Greece received a 3-year, €110 million bailout package with 5% annual interest payments. This loan came at a high cost: Greek debt has since been downgraded to junk status (BB-) and Greek yields have soared to more than 15%, with a spread over German debt of over 900 basis points. Greece has temporarily avoided default, but a potential restructuring still looms in the future.

Ireland, Portugal, and Spain have also faced EU/IMF bailouts and/or restructurings, but their stories all begin in remarkably different ways.[2] Ireland, which entered the EMU in 1998 at the outset of the joint currency, has a history plagued with famine, war and recession. However, extraordinary growth in the 1990s made the nation a success story, which prompted many to call Ireland the "The Celtic Tiger." By the time Ireland entered the EMU, the nation was the 6th richest in the world in terms of GDP per capita, had annual GDP growth of nearly 9%, and was running government surpluses. Fueled by cheap credit and the lowest corporate tax rate in the world, Ireland's property market and economy expanded rapidly. With the emergence of the credit crunch in 2007, the nation's housing market collapsed and the country plunged into a deep

[2] According to Standard & Poor's , Greece, Ireland and Portugal seem the likeliest to require further bailouts and/or debt restructurings when the EMU's bailout mechanism comes into establishment in 2013 based on the expected costs of borrowing and upcoming debt maturities.

recession largely as a consequence of the Irish banking sector's over-exposure to the real estate market. Ireland experienced an economic contraction equivalent to roughly 14% of GDP, with unemployment trending upwards of 11.4%. To exacerbate the problem, the Irish government's universal and comprehensive bailout of the entire Irish banking sector shifted the banking sector's systemic default risk to the country's sovereign debt. Although Ireland's troubles stem from issues that are very different from those that Greece confronts, the end result has been similar. The Irish government was forced to take a €85 billion loan with a 5.8% interest rate from the IMF and other EU states. Consequently, Irish debt was downgraded (AA to BBB+), Irish 10-year yields rose above 10%, and spreads over German government bonds jumped to 590 basis points. Like Greece, Ireland's current borrowing rates are unsustainable, foreshadowing a need for additional EU/IMF help in the future.

Portugal adopted the euro in 1999, officially installing the currency in 2002 after an integration period. Like Greece, the country has had its share of political and economic corruption, as well as structural economic troubles and a lack of human capital investment. Portugal's industrial economy is based around the production and export of textiles, footwear, and cork. Since the nation entered the EMU, exports have grown increasingly uncompetitive with the adoption of the higher valued euro. Portugal has the lowest GDP per capita of any Western European country, and from 2002 until 2007, the nation witnessed an unemployment rate increase of 65% - with worse yet to come. With the materialization of a credit crunch in 2007 and public debt issues arising in Greece and Ireland, market tensions have grown quickly as investors fear that the government may struggle to refinance its debt. Structural problems – slow growth, a large public debt burden, and a lack of international competitiveness – continue to drive up doubts and yields (now at a 9.40% historical high). On April 6, 2011, Portugal asked the

EU and IMF for a bailout (potentially €80 billion), the terms of which are still to be determined, but most certainly include severe fiscal austerity measures.[3] Subsequently, Standard & Poor's downgraded the country's debt to BBB- based on worries of repayment risk. Portugal, accosted by rising borrowing costs and a Parliament unable to pass austerity measures, is heading rapidly towards further distress.

Spain, like Ireland, has experienced difficulties due to specific traumas. The country, which entered the EMU in 2002, has the 12th largest economy in the world, and created nearly one-fifth of all jobs in the EU from 2001-2005. Astonishing growth numbers were achieved over this period as a consequence of a real estate bubble fueled by low interest rates and a surge of immigration. Housing prices increased by 80% in many areas of the country, and construction of new property accounted for 16% of GDP and 12% of employment growth in 2005. This economic crescendo helped cultivate the growth of a historically troubled labor market; the country's unemployment rate dropped to 7.6% from a high of 20% in the 1990s. The onset of the credit crisis in 2007 brought this success story to an end. Property prices plummeted and the economy with it. Unemployment swelled to 20% once more. These dynamics, combined with a banking sector that was over-exposed to the ailing construction and development sector, led to inadequate domestic demand and lagging international competitiveness.[4] Although the country's debt burden (53%) is substantially less than that of other troubled European economies, these worrisome factors have contributed to Spain's declining ability to meet its obligations. Like the other besieged sovereigns, Spain's sovereign debt has been recently downgraded (AA+ to AA)

[3] This marks the third time in history that Portugal has asked the IMF for emergency funding. Portugal first required emergency funds in 1977 following the Carnation Revolution, which brought an end to authoritarian rule in the country. The nation also required aid in 1983 due to an economic crisis and large scale inflation.

[4] Spain's cajas, the regional savings banks, which greatly cultivated and benefitted from the property boom in the early 2000s, were consequently over-exposed to the collapse of the regional construction boom.

and spreads over German government bonds have increased significantly (nearly 250 basis points). However, the likelihood of a Spanish bailout seems to be losing steam as reform efforts have gained increasing traction amongst the citizens and politicians of the country. Furthermore, although the size of the nation's economy, several times larger than those of Greece, Ireland, and Portugal, makes Spain's struggles all the more concerning for the EMU, that same prowess also provides the potential for a stronger recovery.

The problems that now plague these periphery EMU countries are largely seen as a reflection of poor union structure. The prevalent criticisms revolve around two areas: inadequate fiscal discipline mechanisms and a lack of national monetary control. The first condemnation stems from the fiscal criteria required by the Maastricht Treaty. These constraints were designed to ensure that all countries entering the EMU would not disrupt price stability within the monetary union. Sadly, there is no similar mechanism to maintain discipline once a country has been accepted into the union. Essentially, the maintenance of EMU price stability rests in the on its members' self-restraint. Periphery economies – think Greece, Portugal, or Slovenia – could battle through a few years of strict fiscal discipline to achieve acceptance into the EMU, and then loosen the belt and borrow exorbitantly immediately after they became a member. In fact, many critics maintain that late-entry countries, Greece among them, were allowed to meet less stringent criteria; standards regarding inflation and government finances were substantially lessened during this period.

The second dilemma arises from the adoption of a common currency controlled by a super-national entity, the European Central Bank. In espousing a common European currency, member countries forego their own national currencies, and thereby sacrifice control over the monetary supply (the same also happens when countries peg to another currency). Without

monetary control, the member states become more vulnerable to fluctuations in domestic and global economic cycles. With a free-floating, national currency, a country with a sluggish economy will see a natural devaluation, which would increase exports and thus ease some of the economic pressures. Furthermore, a country with a free floating currency can also fight rising prices or wages through alterations in the money supply, without having to institute difficult fiscal austerity measures. In the case of the EMU's member states, these monetary tools are unavailable, and they must therefore rely solely on domestic fiscal policy – which is often be clumsy and delayed. In the United Kingdom, Denmark, and Sweden, countries which have retained their own currencies, these tools are still available and have allowed for a more flexible response to the global financial crisis.[5] These three countries have faced economic difficulties similar to those of their EMU counterparts, but their government bond yields/spreads have exhibited far less volatility during the crisis period.

Although there is ever-growing sentiment that the euro-project will have to be disbanded, hope still remains. With the danger of a union-wide sovereign debt crisis looming, the European Monetary Union's leadership must attempt to address these fundamental flaws. The European Central Bank has taken steps to ensure the short term stability of the EMU, first through the institution of the €60 billion European Financial Stabilization Mechanism (EFSM), and more recently through the introduction of the new €700 billion European Financial Stabilization Facility (EFSF), which became fully operational in August of 2010.[6] Now, the ECB must find a

[5] Although Sweden did not negotiate an exemption to the Maastricht Treaty as the UK and Denmark have done, the country has been able to circumvent adopting the euro by purposely not meeting the fiscal criteria required within the treaty.

[6] The European Financial Stabilization Facility is a temporary special purpose vehicle established to provide loans to euro-area countries, other than Greece which has already received IMF/EU aid. The EFSF is a limited-liability fund in which all euro-area countries have ownership – essentially an EU-only IMF. The fund will cease to lend after three years.

long-term plan to re-establish the credibility of union-wide fiscal discipline in hopes of reducing currently unsustainable sovereign borrowing costs.

Despite the presence of wide-ranging opinion on how to approach this problem, the solution is unfortunately not so apparent. Opportunely, the economics literature has rapidly taken up the task of this discussion. Several studies have shown that during the economic downturn that began in 2007, the rapid rise in sovereign bond spreads can be attributed to two factors: an increase in the perceived risk associated with an investment in sovereigns, particularly due to the transfer of banking sector risk to sovereign borrowers (through government-sponsored bank bailouts), and the pricing of heterogeneous macro-fundamentals in combination with the a common international risk factor. This academic mapping is essential for the understanding of this unique crisis, one fraught with sovereign debt problems and an absence of national currencies. The empirical analysis that follows from this theoretical foundation has the potential to provide implications for future policies at both the national and union level.

This paper aims first to substantiate and expand upon previous empirical research, with the intent of incorporating the most recent phase of the European sovereign debt crisis (March 2010 through December 2010). Furthermore, this analysis will test several new hypotheses: First, EMU sovereign spreads display contagion from Ireland. Second, IMF intervention has had a substantial role in increasing perceived restructuring risk and government bond yields/spreads, particularly in the struggling economies of Greece, Ireland, Portugal, and Spain. Third, European Union member nations that do not participate in the monetary union – the United Kingdom, Denmark, and Sweden – do not demonstrate contagion affects from the troubles of Ireland and Greece, nor were they influenced by IMF intervention.

2. Related Literature and Theoretical Framework

There are two realms of related work that are intertwined in our analysis: literature related to EMU government bond yields, and literature exploring currency crises. Both classifications of analysis are inherently important to this work, each for a different purpose. Work done on EMU government bond yields provide us with a foundation for evaluating market perception towards sovereign borrower risk, whereas literature pertaining to currency crises grants us a theoretical establishment upon which to construct a model. Moreover, the work can be bifurcated into empirical and theoretical categorizations.

a. Empirical Efforts

Efforts that have examined EMU government bond yields (and/or spreads) have conditioned such analysis based on three common variables: a common international risk factor, credit risk, and liquidity risk (see Manganelli and Wolswijk (2009)). As shown in Barrios et al. (2009), global risk perception played an important function in shaping government bond spreads relative to investor safe havens like Germany; an effect that was more pronounced in times of financial turbulence and fiscal problems. During the pre-crisis period, discipline measures instituted by the Maastricht Treaty seemed to have quelled investor worries and produced full-convergence sentiment. As shown in Codogno et al. (2003) and Arghyrou and Kontonikas (2010), countries were not being for fiscal imbalances prior to the crisis; country spreads were not strongly correlated to either macro-fundamentals or the international risk factor. However, literature that covers the crisis period clearly displays a correlation between a growing international risk factor and widening EMU government spreads (see Arghyrou and Kontonikas (2010)). The role of banking sector bailouts has been shown to be a critical factor in this crisis, as

global systemic risk becomes embedded in sovereign entities (see Sgherri and Zoli (2009), and Gerlach et al. (2010)). Across the world, bank bailouts have put enormous strain on the fiscal capabilities of sovereigns, increasing their fiscal liabilities and exposing them to the whims of the financial sector. The extent to which each government chose to intervene in the banking industry has had great influence on its borrowing rate. Ireland, with its universal bailout program, has experienced greater exposure to its banking sector, and has thereby experienced greater volatility than those sovereigns with less involvement. These differences are largely responsible for the heterogeneous influence of the global risk factor across different EMU sovereign borrowers (see Barrios et al. (2009), Attinasi et al. (2009), and Arghyrou and Kontonikas (2010)).

In addition to a growing international risk factor during the crisis, macro-imbalances and fiscal troubles have increased the credit risk of sovereign borrowers. As previously mentioned, EMU government bond yields were de-linked from the associated macro-fundamentals during the pre-crisis period, displaying market expectations of full EMU convergence. However, shrinking bond market liquidity and struggling economies have placed substantial weight on the pricing of sovereign bonds during the crisis period. Markets have heavily penalized borrowers with excessive current account deficits, growing debt-to-GDP ratios, and slowed industrial production, among other key macro factors (see Barrios et al. (2009), Manganelli and Wolswijk, (2009), and Arghyrou and Kontonikas (2010)). The interaction of these heterogeneous fiscal differences with the international risk factor, coupled with the disparate management of the banking sector, goes a long way in explaining the diverse spread increases detected across the European Monetary Union.

Lastly, although bond market liquidity has been shown to be somewhat relevant to EMU spread differentials during the pre-crisis period (see Manganelli and Wolswijk (2009), and Beber et al. (2009)), during times of tightening credit the effect of country-specific bond market liquidity has been mostly negligible (see Attinasi et al. (2009), Sgherri and Zoli (2009), and Manganelli and Wolswijk, (2009)).[7]

This literature provides us with a guideline upon which to build an analysis. The majority of these studies, empirical in nature, offer insight into the key factors driving EMU government bond yield spreads. As important as these empirical research findings are, a theoretical framework is necessary in order to substantiate these correlative relationships.

b. Theoretical Framework

Arghyrou and Tsoukalas (2010) pieced together a model of rational EMU commitment based upon second- and third-generation currency crisis models. This work, a thought experiment, I find vital to the understanding of the current crisis, and helped guide the construction of our empirical models. The main underpinning of their analysis is that in the absence of national currencies, systemic risk and macroeconomic shortcomings are diverted to the sovereign bond market. The inability of troubled economies to devalue their currencies results in stagnant growth and a reduced ability to service debt, thereby leading to the observed rises in spreads. Based upon this theory, a model of rational EMU exit can be constructed. Participation in the EMU is

[7] The role of liquidity is controversial, and there is little agreement on its influence. Although most research shows a prominent liquidity effect during the pre-crisis period, Codogno et al. (2003) and Bernoth (2004) find only a limited effect. Furthermore, despite the general consensus that country-specific liquidity has played a minor role during the crisis period, Arghyrou and Kontonikas (2010) do show a statistically significant liquidity influence for some countries. As a whole, crisis-period spread modeling is likely to be influenced more by the common international risk factor and global liquidity than by country-specific bond market liquidity.

equivalent to participation in a fixed exchange rate system. The participating government chooses whether or not to continue membership based on the cost of continued involvement (see Obstfeld (1996)). The decision to exit is made when the cost of exiting the euro (a predetermined constant) is less than the cost of maintaining commitment. The cost of continued involvement is described by Obstfeld (1996) as a positive quadratic function of the deviation of the exchange rate at which the country entered the union from the current purchasing power parity (PPP) exchange rate, or in simplest form, the real effective exchange rate. A massive overvaluation relative to the PPP-consistent exchange rate would lead to considerable macroeconomic imbalances and a rational exit.

A government's commitment is therefore highly dependent on the expectations of the private sector, and thus, as described by Krugman (1998), the market determines the credibility of sovereign commitment. By extension, Arghyrou and Tsoukalas (2010) construct their framework around the principle that the private sector also determines whether or not the fiscal liabilities of an EMU sovereign are fully guaranteed by its fellow members. The combination of this new monetary union framework with currency crisis theory results in the possibility of three unique loss functions which determine rational exit – each one operating in different environment of market expectations. Shifts in market expectations can drastically alter yields and incentives for exiting the monetary union.

The first loss function is derived from expectations that a country's EMU commitment is fully credible and its fiscal liabilities are fully guaranteed by other union members. In this scenario, the loss function is as such:

$$\mathbf{L_1 = [\ \gamma_1\ (q)\ ]^2 \qquad \gamma_1 \geq 0}$$

where:

q = real effective exchange rate

γ_1 = market expectation of fully credible commitment and fully guaranteed liabilities

As mentioned in Obstfeld (1996), the cost of exiting the euro is a positive quadratic function of the real effective exchange rate (q), and by allowing the market expectations variable γ_1 to take a zero value, Arghyrou and Tsoukalas (2010) permit the possibility of a delinking of spreads from macro-fundamentals (a characteristic clearly exhibited by spreads in the aforementioned empirical studies). This function best exemplifies the period leading up to the crisis: as macro-fundamentals deteriorated government bond yield spreads narrowed.

The second loss function is derived from private sector expectations of fully guaranteed fiscal liabilities so long as the sovereign remains within the union, but not longer regards EMU participation as fully credible. The loss function follows as such:

$$\mathbf{L_2 = [\ (\gamma_1 + \gamma_2)\ (q)\ ]^2} \qquad \gamma_1, \gamma_2 > 0$$

where:

q = real effective exchange rate

γ_1 = market expectation of fully credible commitment and fully guaranteed liabilities

γ_2 = market expectation of non-fully credible commitment and fully guaranteed liabilities

With an expectations shift to non-fully credible commitment, no longer are spreads de-linked from macro-fundamentals, but rather the market begins to price the real effective exchange rate into sovereign borrowing rates. Within this scenario, Arghyrou and Tsoukalas (2010) account for a rational EMU exit based upon a real effective exchange rate overvaluation cost that may exceed the fixed cost of exiting the union. This loss function is best reflected in the rapid jump of

EMU spreads in the fall of 2009, when the Greek crisis first materialized, and talk of a potential exit permeated the economic sphere.

The last loss function is derived from market expectations in which fiscal liabilities are not fully guaranteed and EMU participation is not fully credible. The loss function follows as such:

$$\mathbf{L_3 = [\ (\gamma_1 + \gamma_2 + \gamma_3)\ (q)\ ]^2} \qquad \gamma_1, \gamma_2, \gamma_3 > 0$$

where:

q = real effective exchange rate

γ_1 = market expectation of fully credible commitment and fully guaranteed liabilities

γ_2 = market expectation of non-fully credible commitment and fully guaranteed liabilities

γ_3 = market expectation of non-fully credible commitment and non-guaranteed liabilities

As in the second loss function scenario, the market places an exchange rate risk premium on spreads, reflecting a real overvaluation cost and non-fully credible EMU participation. In addition, the market prices in a default risk premium, indicating fiscal liabilities that are not fully guaranteed by the EMU. This third loss function is reflecting in the massive increase of Greek spreads during March of 2010, when a bailout agreement between the EU, the IMF, and the Greek government seemed unlikely.

Within all three potential scenarios, an EMU member country remains committed to the union so long as its loss function is less than the cost of exiting the euro. The nature of these different scenarios provides for varied optimal choices based upon private sector expectations. Thus, a country which had remained fully committed under L_1 expectations may find itself contemplating exit if a sudden shift in market sentiment began pricing spreads to reflect L_3

expectations. This idea is similar to that of second- and third-generation currency crisis theories, which maintain that exit from a currency peg often results from a quick shift in market expectations. By extension, EMU spreads should be heavily influenced by private sector expectations, which could lead to a self-fulfilling prophecy of EMU exit. During the crisis period there was likely a double shift in market expectations, from an environment of credible EMU commitment with fully guaranteed liabilities to one of non-fully credible commitment and non-guaranteed fiscal liabilities. To prevent continued interest rate increases and forcible EMU exit, sovereigns face the challenge of convincing the market that they are making sufficient fiscal and macroeconomic adjustments, which often must be severe.

The empirical work done by Arghyrou and Kontonikas (2010) utilizes this theoretical framework to analyze three specific, testable hypotheses. Their findings were as such: First, during the pre-crisis period (01.1999 – 01.2007) the real exchange rate was not statistically significant in explaining sovereign spreads' movements, demonstrating that sovereign spreads were de-linked from heterogeneous macro-fundamentals and the common international risk factor based on expectations of full convergence with Germany and other economically sound EMU members (exemplifying L_1 expectations). Second, during the crisis period (08.2007 – 04.2010) the real exchange rate was statistically significant in explaining spreads' movements (exemplifying L_2 and L_3 expectations). Lastly, during the crisis period, the Greek spread was significant in explaining spreads in other EMU countries, particularly periphery EMU countries. They found that Greece's troubles stem from deteriorating macro-fundamentals, rather than from speculative pressures.

To further these findings, our paper will to run a similar econometric analysis through the current phase of the crisis period (08.2007 – 12.2010). With greater market scrutiny abound and

new troubles emerging – the Irish Bailout, ramped up ECB government bond purchasing, and sustained economic struggles – this analysis looks to substantiate the following hypotheses: First, a significant influence of macro-fundamentals (i.e. the real effective exchange rate) in explaining country-specific spreads. Second, a statistically significant effect of the global risk factor (i.e. the VIX). Third, the statistically significant influence of Greek and Irish contagion on most EMU countries, with an especially potent effect on Spain, Portugal, and Italy. Fourth, the influence of IMF intervention on EMU country spreads should be positive and statistically significant. Lastly, the affects of Greek and Irish contagion and IMF intervention should be minimal and/or not statistically significant in explaining the spread movements of the non-EMU countries Denmark, Sweden, and the United Kingdom.

3. Descriptive Analysis

This analysis uses the monthly 10-year government bond yield spread relative to Germany for ten EMU member countries and three non-EMU member countries: Austria, Belgium, Denmark, Finland, France, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. This time series data covers the period January 2001 – December 2010. The remaining EMU members were excluded either due to new entry (later than 2008; i.e. Slovakia, Slovenia, etc.) or due to small bond market size (i.e. Luxembourg). This data set was gathered from the European Central Bank.[8]

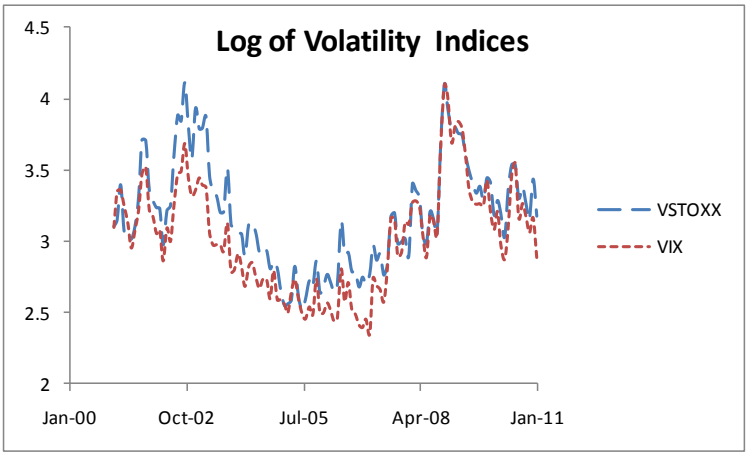
A quick analysis of the government bond yield spreads reveals a drastic difference between pre-crisis and crisis spread behavior (See Figure 1 in appendices). Prior to the crisis

[8] The interest rate data is accessible through the ECB website at: http://www.ecb.int/stats/money/long/html/index.en.html

(01.2001 – 07.2007), the average spread was 14 basis points across the ten countries, with a high of 30 basis points in Greece and a low of 7 basis points in the Netherlands. With the onset of the crisis in the middle of 2007, spreads experienced a rapid ascent. During the crisis period (08.2007 – 12.2010), the average spread was 100 basis points across the same ten countries, with a high of 298 basis points in Greece and a low of 29 basis points in the Netherlands. However, spreads of the three non-EMU member countries behaved very differently: spreads relative to Germany declined on average as the crisis got worse. The average pre-crisis period spreads for Denmark and Sweden were approximately -40 basis points, and the UK spread averaged 61 basis points. During the crisis period, Denmark and Sweden experienced average spreads of -124 basis points, with the UK witnessing an average spread of 48 basis points.

Within our analysis, we use the CBOE Volatility Index (VIX) as a measure of a common international risk factor. The VIX is a forward looking measure of implied US stock market volatility, constructed using call- and put-implied volatilities from the S&P 500's index of 30-day options. The VIX is utilized in our empirical analysis based on the assumption that international risk is a common factor across the globe, thus making the US implied volatility a feasible measure. Many studies have employed the VIX as such (see Beber et al. (2009), Gerlach et al. (2010), and Arghyrou and Kontonikas (2010)), and Mody (2009) finds that although movements in the VIX are not correlated with European government bond yield movements in the short term, the VIX is a reasonable candidate to proxy for global financial instability over longer frequencies. Furthermore, experimentation with the VSTOXX measure of implied European volatility and other global instability measures provides little evidence for a superior

gauge.[9] As shown in the figure below, the VSTOXX and the VIX are highly correlative measures of implied volatility, with a β parameter of 1.06 during the pre-crisis period and .85 during the crisis period (See Figure 3 in appendices for regression results). This data set is comprised of the VIX observed on a monthly basis over the period January 2001 – December 2010. The data was obtained from Bloomberg.[10]



Akin to what was seen with government bond yield spreads, an analysis of the VIX displays obvious differences between pre-crisis and crisis periods. During the pre-crisis period (01.2001 – 07.2007), the implied US market volatility index averaged 18.77, with a high of 39.69 and low of 10.42. However, during the crisis period (08.2007 – 12.2010), the US stock market experienced much less stability. Over the period, the VIX averaged 27.52, with a high of 59.82 and a low of 17.59 – a clear representation of greater perceived global risk.

Lastly, we employ the real effective exchange rate as a measure of country-specific macro-fundamental stability. This data set covers the period January 2001 – December 2010 on a

[9] The differences between the employment of the VIX and the VSTOXX in our empirical evaluation proved negligible in terms of both magnitude and statistical significance. Several studies also utilize US corporate spreads as an estimate for global risk (see Codogno et al. (2003), and Manganelli and Wolswijk (2009)). This measure did not prove superior to the VIX measure either. [VSTOXX returns can be found on Bloomberg.]

[10] The VIX data set can also be found at: http://finance.yahoo.com/q/hp?s=^VIX+Historical+Prices

monthly basis. The data was sourced from the International Monetary Fund's comprehensive international financial statistics database.[11]

An analysis of the logarithm of the real effective exchange rate displays a clear trend of macro-economic deterioration across nearly all ten EMU countries of concern (See Figure 2 in appendices). This deterioration has been constant and upward trending. Even during the pre-crisis period (01.2001 – 07.2007), a phase of stabilizing and declining spreads, macro-economic fundamentals and international competitiveness were declining. Thus, the de-linking of spreads from economic indicators is clearly apparent. However, with the onset of the crisis in the middle of 2007, spreads began to move upwards in unison with the log of the real effective exchange rate. This measure of declining competitiveness and economic instability is prevalent across all countries, but is particularly pronounced in Greece, Ireland, Portugal, and Spain. In regards to the non-EMU countries, the same macro-fundamental deterioration is not seen. By the end of the data period, Denmark's real effective exchange rate increased only slightly, Sweden's was roughly at the same level as it was in the beginning of the period, and the UK's macro-fundamentals have actually improved.

4. Econometric Methodology and Empirical Findings

This analysis contains two distinct subsections: The first, evaluates spreads during the pre-crisis period (01.2001 – 07.2007), and the second subsection models spreads during the crisis period (08.2007 – 12.2010). These estimated econometric models and their empirical findings are described herein.

[11] The real effective exchange rate data set can be found at: http://www.imfstatistics.org/imf/

a. Pre-crisis Period Spreads Modeling

The model for pre-crisis spreads attempts to relate spreads to three factors: prior-period spreads, the common international risk factor, and country-specific macro-fundamentals. Prior-period spreads, represented as spreads from a month prior, are used to test for spread persistence. The common international risk factor is represented by the VIX, and macro-fundamentals are embodied by the real effective exchange rate. The model is given as such:

$$\boldsymbol{spread_t = \alpha + \beta_1 spread_{t-1} + \beta_2 vix_t + \beta_3 q_t + u_t}$$

where:

$spread_t$ = 10-year government bond yield spreads relative to Germany

vix_t = logarithm of the CBOE VIX

q_t = logarithm of the real effective exchange rate

u_t = error term

Table A presents the estimates of our pre-crisis model for the ten EMU-member countries. Spreads over this period are persistent; the β_1 parameter is significantly different from zero at the 1% level for all ten countries of concern. This parameter ranges from 0.44 in Belgium to 0.74 in Finland, with an average value of 0.58. Beyond persistence, spreads during the pre-crisis period either do not display significant relation or exhibit the wrong relation to both the common international risk factor and macro-fundamentals. For nine of the ten countries, the VIX relationship is not significantly different from zero at the 5% level, as indicated by the estimate for β_2, thus demonstrating that spreads were de-linked from the global risk environment during the pre-crisis period. Moreover, our estimates show that spreads were also de-linked from the underlying country-specific macro-fundamental variables as represented by the real effective

exchange rate. For nine of the ten countries, the β_3 parameter for the real effective exchange rate is significantly different from zero at the 1% level - all with the incorrect sign.[12] Government bond yield spreads were mispriced: as international competitiveness declined and the real effective exchange rate appreciated, spreads declined (a parameter average of -0.80). These findings are relatively robust with an average r-squared of 0.80 across the ten countries.

Table A: EMU Pre-Crisis Period Times Series Estimates (01.2001 - 07.2007)

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.65 ***	0.44 ***	0.74 ***	0.51 ***	0.50 ***	0.58 ***	0.52 ***	0.61 ***	0.63 ***	0.67 ***
vix_t	0.02	0.02	0.04 **	0.01	-0.04	0.03 *	-0.03	0.01	-0.02	-0.01
q_t	-0.97 ***	-1.41 ***	-0.50 **	-0.36 ***	-1.17 ***	-0.39 ***	-0.85 ***	-0.47 ***	-1.14 ***	-0.79 ***
$Adj\text{-}R^2$	0.82	0.85	0.86	0.68	0.76	0.90	0.68	0.81	0.81	0.89

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

Table B presents the estimates of our pre-crisis model for the non-EMU countries. Spreads over this period are persistent; the β_1 parameter is significantly different from zero at the 1% level for all three countries. This coefficient was similar across the three – 0.94 in Denmark, 0.99 in Sweden, and 0.93 in the UK – with an average value of 0.95. Beyond persistence, spreads during the pre-crisis period either do not display significant relation or exhibit the wrong relation to both the common international risk factor and macro-fundamentals (as was seen with the EMU member nations). The VIX relationship is not significantly different from zero, as indicated by the estimate for β_2. The estimates also show that spreads were de-linked from the underlying country-specific macro-fundamental variables as represented by the real effective exchange rate. The β_3 parameter is significantly different from zero at the 5% level with the incorrect sign for Denmark and Sweden, and is not statistically significant for the UK. Government bond yield spreads were mispriced here as well; the real effective exchange rate

[12] The one exception was Finland's β_3 parameter, which was also inversely related but only significantly different from zero at the 5% level.

appreciated, with spreads declining in Denmark and Sweden, and increasing slightly in the UK. These findings are robust with an average r-squared of 0.95 across the three non-EMU countries.

Table B: Non-EMU Pre-Crisis Period Times Series Estimates (01.2001 - 07.2007)

	DEN	SWE	UK
$spread_{t-1}$	0.94 ***	0.99 ***	0.93 ***
vix_t	-0.13	-0.09	-0.03
q_t	-2.30 ***	-1.24 **	0.35
$Adj\text{-}R^2$	0.94	0.95	0.96

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

b. Crisis Period Spreads Model

Our first crisis period model attempts to relate spreads to four factors: prior-period spreads, the common international risk factor, country-specific macro-fundamentals, and Greek spreads. As aforementioned, prior-period spreads, represented as spreads from a month prior, are used to test for spread persistence. The common international risk factor is represented by the VIX , and macro-fundamentals are represented by the real effective exchange rate. We test for contagion across EMU countries by running spreads against Greek government bond yield spreads. This model is given as such:

$$spread_t = \alpha + \beta_1 spread_{t-1} + \beta_2 vix_t + \beta_3 q_t + \beta_4 spread_t^{GR} + v_t$$

where:

$spread_t$ = 10-year government bond yield spreads relative to Germany

vix_t = logarithm of the CBOE VIX

q_t = logarithm of the real effective exchange rate

$spread_t^{GR}$ = 10-year Greek government bond yield spread relative to Germany

v_t = error term

Table C presents the estimates of our crisis period model for the ten EMU-member countries. First, spreads show continued persistence throughout the crisis period: the β_1 parameter is significantly different from zero at the 1% level for all ten countries. This parameter ranges from 0.35 in Portugal to 1.04 in Greece, with an average value of 0.63. Second, estimates for the crisis period also display strong relation to both the international risk factor and contagion from Greece's debt woes. For nine of the ten countries, the β_2 parameter, representing relation to the CBOE VIX, was significantly different from zero at the 5% level, indicating the strength of the link between spreads and global risk perception during the crisis. The average parameter for the VIX was 0.25, with Italian spreads showing the greatest exposure and French spreads displaying the lowest. Moreover, seven of the nine countries display a relation to Greek spreads that is significantly different from zero at the 5% level, indicating a robust contagion effect. This contagion effect is positive in all scenarios, but the absolute value is not uniform, displaying country-specific degrees of exposure to the Greek crisis, ranging from high levels in Portugal, Ireland, and Spain, to low levels in France and Finland. Lastly, relation to the real effective exchange rate is positive and significant, unlike the pre-crisis period within which our estimates had displayed a mispricing of macroeconomic risk. Five of the nine countries displayed parameters significantly different from zero at or below the 20% level, indication that country-specific macroeconomic risk is reflected in the EMU's government bond yield spreads. The macroeconomic risk parameters showed the greatest absolute influence on spreads with an average factor of 1.96, ranging from a low of 1.23 in the Netherlands and Belgium and a high of 4.72 in Portugal. These findings are robust with an average r-squared of 0.93.

Table C: EMU Crisis Period Times Series Estimates with Greek Contagion (08.2007 - 12.2010)

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.69 ***	0.59 ***	0.61 ***	0.60 ***	1.04 ***	0.81 ***	0.55 ***	0.67 ***	0.35 ***	0.36 ***
vix_t	0.26 ***	0.24 ***	0.21 ***	0.15 ***	0.24	0.34 **	0.37 ***	0.17 ***	0.23 **	0.26 ***
q_t	2.58	1.23	1.69 **	1.32	0.26	3.07 *	1.83	1.23	4.72	1.70
$spread_t^{GR}$	0.02 *	0.04 ***	0.02 **	0.02 **	-	0.19 ***	0.07 ***	0.01	0.29 ***	0.15 ***
$Adj\text{-}R^2$	0.89	0.90	0.92	0.86	0.95	0.96	0.96	0.90	0.97	0.95

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

Table D presents the estimates of our crisis period model for the three non-EMU nations. First, spreads show continued persistence throughout the crisis period: the β_1 parameter is significantly different from zero at the 1% level for each country with an average value of 0.70. Second, estimates for the crisis period display strong relation to the international risk factor, but in the opposite direction, with an average β_2 parameter value of -0.19 perhaps signifying a flight of capital away from the EMU-member countries. Third, relation to the real effective exchange rate is positive and strong in Sweden, but is insignificant and small for both Denmark and the UK. Lastly, spreads for these three countries do not display a significant or positive relation to Greek spreads. By abstaining from joining the euro, Denmark, Sweden, and the UK have seemingly escaped the Greek contagion effect that was so robust in the crisis period estimates for the EMU-member countries. Furthermore, the market does not seem to be pricing in the increased volatility of the current environment, with macro-fundamentals being priced in only minimally. These findings are robust with an average r-squared of 0.87.

Table D: Non-EMU Crisis Period Times Series Estimates with Greek Contagion (08.2007 - 12.2010)

	DEN	SWE	UK
$spread_{t-1}$	0.80 ***	0.51 ***	0.80 ***
vix_t	-0.20 **	-0.25 **	-0.12
q_t	0.20	2.09 **	0.02
$spread_t^{GR}$	-0.04	-0.07 ***	0.00
$Adj\text{-}R^2$	0.92	0.91	0.76

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

Our second crisis period model relates government bond yield spreads to six different factors: prior-period spreads, the common international risk factor, macro-fundamentals, Greek contagion, Irish contagion, and IMF intervention. The first four factors are employed in the same fashion as was utilized in the first crisis period model, and thus should be expected to behave in the same manner. In order to examine the most recent phase of the crisis – a phase of further EU/IMF intervention and an Irish bailout – this second model incorporates the relation of spreads to Irish spreads and to an IMF intervention dummy variable. The IMF intervention dummy variable works as such: if the IMF intervened through lending agreements within the month or the month prior, this variable's value would be one, and otherwise would be zero. This model follows as such:

$$spread_t = \alpha + \beta_1 spread_{t-1} + \beta_2 vix_t + \beta_3 q_t + \beta_4 spread_t^{IRE} + \beta_5 spread_t^{GR} + \beta_6 \gamma_t^{IMF} + w_t$$

where:

$spread_t$ = 10-year government bond yield spreads relative to Germany

vix_t = logarithm of the CBOE VIX

q_t = logarithm of the real effective exchange rate

$spread_t^{IRE}$ = 10-year Irish government bond yield spread relative to Germany

$spread_t^{GR}$ = 10-year Greek government bond yield spread relative to Germany

γ_t^{IMF} = IMF intervention dummy variable

w_t = error term

Table E presents the estimates of the second crisis period model for the ten EMU member nations. First, spreads show continued persistence throughout the crisis period: the β_1 parameter is significantly different from zero at the 5% level for each country with an average value of 0.62. Second, estimates for the crisis period display a statistically significant relation to the international risk factor with an average β_2 parameter value of 0.24 and a standard deviation of only 0.07. Third, relation to the real effective exchange rate is positive and strong in all countries with an average coefficient of 2.47, and is particularly strong in Greece, Ireland, Portugal, Italy, and Spain. Lastly, spreads for the EMU countries other than Ireland, Greece, Portugal, Spain, and Italy do not display a statistically significant relation to Greek or Irish spreads, or the IMF intervention dummy variables. These five countries – those most vulnerable to the current interest rate environment – display positive values that are statistically different from zero at the 10% level in relation to both Greek spreads and the IMF intervention variable. None of these troubled economies show statistically significant relation to Irish spreads, likely for one of two reasons: First, this lack of relation could be due to the fact that the Irish bailout is relatively recent, and therefore would dictate only a small sample size, most of which might already be captured by the IMF intervention variable, and is thus difficult to capture within the model's estimates. Second, due to the highly volatile environment, the expectations of potential debt problems in the periphery sovereigns may already be priced into the market. It would be

interesting to run this analysis in a few months to examine which of these possibilities is most likely true. These findings are robust with an average r-squared of 0.93.

Table E: EMU Crisis Period Times Series Estimates with Greek and Irish Contagion, and IMF Intervention Dummy (08.2007 - 12.2010)

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.67 ***	0.53 ***	0.64 ***	0.55 ***	1.00 ***	0.81 ***	0.59 ***	0.66 ***	0.28 **	0.49 ***
vix_t	0.25 ***	0.24 ***	0.20 ***	0.15 ***	0.25	0.33 **	0.35 ***	0.16 ***	0.21 *	0.21 ***
q_t	1.82	0.96	2.16 **	1.04	3.61	3.54 **	2.37	1.20	6.33	1.70
$spread_t^{IRE}$	0.03	0.05	-0.02	0.03	-0.04	-	-0.01	0.01	0.03	0.03
$spread_t^{GR}$	0.00	0.01	0.02	0.00	-	0.17 ***	0.06 ***	0.00	0.29 ***	0.09 ***
y^{IMF}	0.04	0.09	0.04	0.05	0.85 **	0.37 **	0.17 **	0.03	0.24 *	0.42 ***
$Adj\text{-}R^2$	0.89	0.91	0.92	0.87	0.96	0.96	0.96	0.90	0.97	0.99

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

Table F presents the estimates of the second crisis period model for the three non-EMU member states. First, spreads show continued persistence throughout the crisis period: the β_1 parameter is significantly different from zero at the 1% level for each country with an average value of 0.72. Second, estimates for the crisis period display an inverse relation to the international risk factor with an average β_2 parameter value of -0.19. Third, relation to the real effective exchange rate is only positive and strong in Sweden, while it is not statistically significant in either Denmark or the UK. Fourth, spreads for the non-EMU countries do not display a positive and statistically significant relationship to Greek spreads, signifying minimal expectations of Greek contagion. However, Denmark and Sweden's spreads do show positive and statistically significant relation to Irish spreads. It is likely that the private sector did not expect the non-EMU countries to be influenced by the bailout of Greece, but with the emergence of a second bailout, and the potential for further ones, there may have been an expectations shift to reflect greater common euro-area risk. Lastly, none of the three countries show a relation to

the IMF intervention variable that is significantly different than zero. These findings are robust with an average r-squared of 0.87.

Table F: Non-EMU Crisis Period Times Series Estimates with Greek and Irish Contagion, and IMF Intervention Dummy (08.2007 - 12.2010)

	DEN	SWE	UK
$spread_{t-1}$	0.85 ***	0.59 ***	0.71 ***
vix_t	-0.26 ***	-0.19 *	-0.13
q_t	-3.39	2.86 ***	-0.11
$spread_t^{GR}$	-0.11 **	-0.12 ***	0.02
$spread_t^{IRE}$	0.17 **	0.16 ***	-0.06
γ^{IMF}	-0.10	-0.06	0.04
$Adj\text{-}R^2$	0.93	0.93	0.75

Note: ***, **, * indicate significance at the 1%, 5%, and 10% level respectively.

5. Discussion

The analysis done herein conveys several important takeaways: First, during the pre-crisis period (January 2001 – July 2007) spreads of EMU and non-EMU euro-area countries were not influenced by either global risk perception or country-specific macro-fundamentals. Astoundingly, nearly every country exhibited market *mispricing*; as the real effective exchange rate appreciated, euro-zone government bond yield spreads narrowed. The market expectation of full EMU convergence played a central role in reducing the spreads of the periphery EMU countries: Greece, Ireland, Spain, Portugal, and Italy. However, this full convergence theory likely played a lesser role in spread reduction for the stronger EMU nations, as non-EMU country spreads (i.e. those of the UK, Denmark, and Sweden) also exhibited a de-linking from macro-fundamentals during the pre-crisis period, which cannot be explained by convergence

theory. More likely, the spread diminution of these countries should be attributed to the highly liquid, easy credit environment that predominated the seven years leading up to the crisis.

Second, during the crisis period (August 2007 – December 2010) spreads of EMU member countries demonstrate strong relation to the global risk environment and the underlying country-specific macro-fundamentals, whereas the non-EMU countries – Denmark, Sweden, and the UK – do not. Why the disparity? For one, all EMU countries are under greater scrutiny because of the intense coverage of the debt crisis and the bailouts of Greece, Ireland, and Portugal. With worries of contagion and the transfer of risk through these bailouts, it is sensible that the market should be more closely pricing EMU government bond yields to their underlying macro-fundamentals and the general risk environment. Antithetically, the non-EMU countries either exhibit negative or insignificant relations to both fundamentals and risk perception. Such evidence is likely a cause of two factors: First, the market is so entirely focused on the current EMU sovereign debt crisis that it either misunderstands the risks in the non-EMU sovereigns, or does not care. Thus, less scrutiny of non-EMU countries has led to mispricing. Second, we are witnessing a flight of capital from EMU countries to non-EMU countries, likely due to the perceived level of risk surrounding Europe's monetary union. These factors can explain the decreasing yields of non-EMU member countries despite unsubstantial improvement in country-specific macro-fundamentals or the global risk environment.

Third, during the crisis period (August 2007 – December 2010) government bond yield spreads of EMU countries displayed a positive relation to Greek contagion and IMF intervention, but not Irish contagion. Non-EMU countries displayed a contagion effect from the Irish bailout, but did not exhibit an association to either Greek contagion or IMF intervention. The nations of the EMU received an adverse shock from the Greek crisis, and a universal increase in spreads.

This spreads increase was a response of closer scrutiny of EMU macro-imbalances, but also a response to the likely after-effects that a Greek default or bailout might have on the monetary union (particularly due to the high level of bank interconnectivity prevalent across the EU). This reasoning pertains to the IMF intervention variable as well. Many might be inclined to argue that the EU/IMF bailout should have reduced spreads, as this was a guarantee of the fiscal liabilities of the troubled nations. However, Germany's initial reluctance to approve of such a bailout combined with the temporary nature of the financial stabilization mechanism have done nothing to quell the fears of eventual default or restructuring. If anything, the EU/IMF bailout increases the risks associated with Greek or Irish default as many EMU member nations are now even more exposed to distressed debt.

Peculiarly, EMU spreads were not positively influenced by Irish contagion because periphery country bailout risk was presumably priced into spreads following the Greek crisis. However, non-EMU nations did not exhibit a similar adverse shock to the Greek crisis, displaying a significant and negative relation to Greek spreads. Again, this could likely be a sign of flight to quality away from EMU countries. Non-EMU nations did demonstrate positive relation to Irish contagion, implying that although the Greek crisis had little effect on market expectations for these countries, the Irish crisis signified a more widespread European sovereign debt crisis and greater uncertainty of all European economies (even those with their own currencies). This shift in market expectations was similar, although less severe than the shift that EMU countries faced through the Greek crisis. Therefore, although the UK, Denmark, and Sweden did not face positive influence from the Greek crisis, there seems to be a growing perception of sovereign risk across Europe.

6. Concluding Thoughts

The evidence that has been realized through our analysis possesses several details of consequence. First, the evidence demonstrates that joining the European Monetary Union was not a great strategic move for Europe's stronger economies like Germany and France (or these stronger economies should have imposed stricter Maastricht Treaty criteria). The United Kingdom, Denmark, and Sweden all escaped much of the contagion effects of the EMU bailouts and IMF intervention, by maintaining their own currencies while still participating in the EU. Furthermore, the non-EMU nations have managed to keep their government bond yields lower by avoiding the increased market scrutiny of macro-imbalances that plague the EMU, while also experiencing an influx of capital that has fled from their troubled EMU counterparts.

Second, the data demonstrates that joining the European Monetary Union was a fantastic idea for the currently troubled periphery economies. Greece, Ireland, Spain, and Portugal all experienced record low inflation levels, improved economic output, and the lowest borrowing rates in their histories. Not only were these countries able to borrow beyond their capabilities, but when crisis struck, their stronger EMU affiliates had no other option but to provide them with emergency funds or risk greater hardship for the entire monetary union. It is because of this very reason that an EMU exit does not make sense for Greece, Ireland, or Portugal; these periphery economies would be facing a worse sovereign debt crisis without their fellow EMU member states to provide them with the sustainable borrowing rates that the public market refuses to supply.

These two conclusions lead us to believe that the periphery economies of Greece and Portugal, and to a lesser extent Ireland and Spain, should not have been permitted to enter the monetary union to begin with. However, now that they are a part of the EMU, exit is not an

option. The Greek, Irish, and Portuguese bailouts expose the EMU's stronger economies to the banking and sovereign risk of these periphery economies. The banishment of any of the troubled nations would bring about an inevitable sovereign default, and would therefore simultaneously damage the balance sheets of the stronger EMU nations. Exit is an option no EMU nation can afford. The monetary union, led by its stronger members, must work to regain the credibility of its fiscal policies. Fiscal reform and austerity measures make sense for both the strong EMU and periphery EMU countries. The economies of Greece, Ireland, Portugal and Spain will have to go through painful adjustments in their fiscal policies and labor markets – changes that their people will not like. An expanded and extended European Financial Stabilization Facility is likely necessary, as are stronger corrective mechanisms that maintain fiscal discipline across the union. It will be difficult for the ECB to deal with an overheated German economy that needs an interest rate increase at a time when the periphery nations can't afford one (particularly when Germany's bailout funds give it enormous influence in ECB operations). With future bailouts and possible restructurings on the horizon, it will likely be several years before Greece, Ireland, Portugal, and Spain are able to borrow from the public market at a reasonable rate once more. The road will be long and difficult. The countries of the European Monetary Union are thus bound together forever – for better or for worse.

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Appendices

Figure 1: Euro-zone 10-year Government Bond Yield Spreads relative to Germany

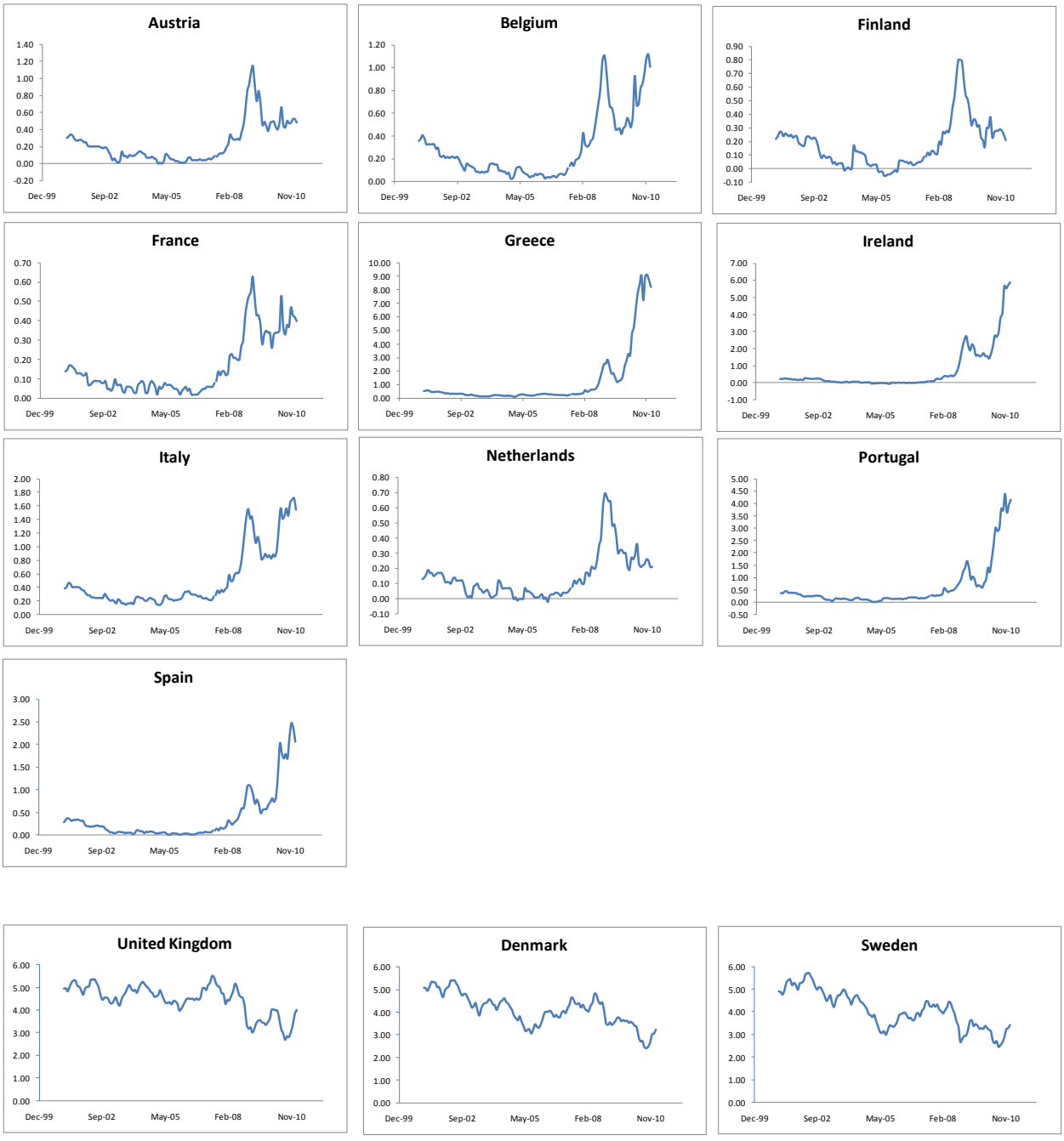

Figure 2: Log Real Effective Exchange Rate

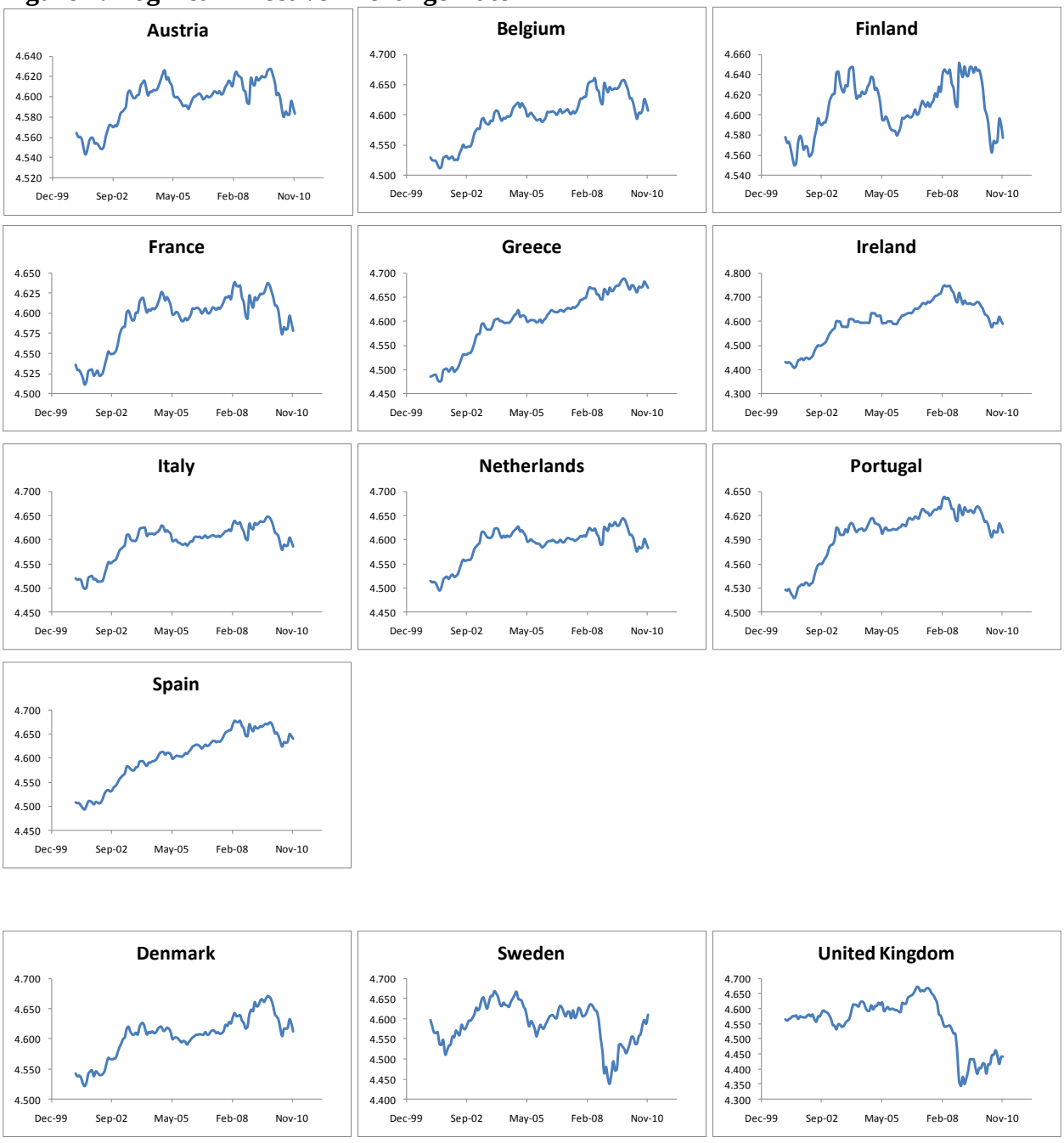

Figure 3: Relation of VIX to the VSTOXX

Pre-Crisis Period

Regression Statistics	
Multiple R	0.928718002
R Square	0.862517127
Adjusted R Square	0.860731635
Standard Error	0.145683278
Observations	79

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.033647784	0.139546414	0.241122527	0.810101065
X Variable 1	1.060500551	0.048250962	21.97884802	6.47292E-35

Crisis Period

Regression Statistics	
Multiple R	0.944780631
R Square	0.892610442
Adjusted R Square	0.889856863
Standard Error	0.093583617
Observations	41

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	0.544272987	0.156875759	3.469452456	0.001287721
X Variable 1	0.85633322	0.047562047	18.0045494	1.70133E-20

Regression Results:

Regression A: Pre-Crisis Times Series Estimates
Period: 01.2001 - 07.2007

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.65	0.44	0.74	0.51	0.50	0.58	0.52	0.61	0.63	0.67
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
t-stat	*7.78*	*5.17*	*10.75*	*5.80*	*6.76*	*7.23*	*6.89*	*7.89*	*8.56*	*9.07*
vix_t	0.02	0.02	0.04	0.01	-0.04	0.03	-0.03	0.01	-0.02	-0.01
p-value	*0.28*	*0.32*	*0.02*	*0.54*	*0.11*	*0.08*	*0.13*	*0.59*	*0.23*	*0.54*
t-stat	*1.10*	*0.99*	*2.30*	*0.61*	*-1.59*	*1.78*	*-1.53*	*0.55*	*-1.22*	*-0.61*
q_t	-0.97	-1.41	-0.50	-0.36	-1.17	-0.39	-0.85	-0.47	-1.14	-0.79
p-value	*0.01*	*0.00*	*0.01*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*
t-stat	*-2.77*	*-5.10*	*-2.60*	*-3.19*	*-1.59*	*-4.70*	*-4.36*	*-4.23*	*-4.20*	*-3.93*
$Adj\text{-}R^2$	0.82	0.85	0.86	0.68	0.76	0.90	0.68	0.81	0.81	0.89

Regression B: Pre-Crisis Times Series Estimates
Period: 01.2001 - 07.2007

	DEN	SWE	UK
$spread_{t-1}$	0.94	0.99	0.93
p-value	*0.00*	*0.00*	*0.00*
t-stat	*19.02*	*23.81*	*24.92*
vix_t	-0.13	-0.09	-0.03
p-value	*0.13*	*0.34*	*0.42*
t-stat	*-1.53*	*-0.96*	*-0.81*
q_t	-2.30	-1.24	0.35
p-value	*0.01*	*0.02*	*0.25*
t-stat	*-2.69*	*-2.35*	*1.16*
$Adj\text{-}R^2$	0.94	0.95	0.96

Regression C: Pre-Crisis Times Series Estimates w/ Greek Contagion
Period: 01.2001 - 07.2007

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.69	0.59	0.61	0.60	1.04	0.81	0.55	0.67	0.35	0.36
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.01*
t-stat	*8.71*	*6.36*	*7.32*	*6.71*	*25.78*	*12.79*	*6.38*	*7.40*	*3.64*	*2.91*
vix_t	0.26	0.24	0.21	0.15	0.24	0.34	0.37	0.17	0.23	0.26
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.44*	*0.02*	*0.00*	*0.00*	*0.03*	*0.00*
t-stat	*4.50*	*4.33*	*5.07*	*4.25*	*0.79*	*2.42*	*5.65*	*4.12*	*2.28*	*3.53*
q_t	2.58	1.23	1.69	1.32	0.26	3.07	1.83	1.23	4.72	1.70
p-value	*0.20*	*0.27*	*0.03*	*0.17*	*0.97*	*0.10*	*0.22*	*0.15*	*0.31*	*0.39*
t-stat	*1.30*	*1.13*	*2.26*	*1.40*	*0.04*	*1.70*	*1.24*	*1.48*	*1.03*	*0.86*
$spread_t^{GR}$	0.02	0.04	0.02	0.02	-	0.19	0.07	0.01	0.29	0.15
p-value	*0.07*	*0.00*	*0.03*	*0.02*	*-*	*0.00*	*0.00*	*0.18*	*0.00*	*0.00*
t-stat	*1.87*	*3.69*	*2.25*	*2.50*	*-*	*4.74*	*4.23*	*1.36*	*6.44*	*5.48*
$Adj\text{-}R^2$	0.89	0.90	0.92	0.86	0.95	0.96	0.96	0.90	0.97	0.95

Regression D: Pre-Crisis Times Series Estimates w/ Greek Contagion

Period: 01.2001 - 07.2007

	DEN	SWE	UK
$spread_{t-1}$	0.80	0.51	0.80
p-value	*0.00*	*0.00*	*0.00*
t-stat	*5.54*	*3.66*	*8.60*
vix_t	-0.20	-0.25	-0.12
p-value	*0.03*	*0.03*	*0.14*
t-stat	*-2.20*	*-2.19*	*-1.51*
q_t	0.20	2.09	0.02
p-value	*0.93*	*0.04*	*0.95*
t-stat	*0.09*	*2.18*	*0.06*
$spread_t^{GR}$	-0.04	-0.07	0.00
p-value	*0.27*	*0.01*	*0.80*
t-stat	*-1.13*	*-2.78*	*-0.26*
$Adj\text{-}R^2$	0.92	0.91	0.76

Regression E: Crisis Times Series Estimates with Greek and Irish Contagion, and IMF Intervention Dummy

Period: 08.2007 - 12.2010

	AUS	BEL	FIN	FRA	GRE	IRE	ITA	NEL	POR	SPA
$spread_{t-1}$	0.67	0.53	0.64	0.55	1.00	0.81	0.59	0.66	0.28	0.49
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.02*	*0.00*
t-stat	*7.63*	*4.66*	*6.93*	*5.58*	*11.77*	*13.35*	*6.13*	*6.87*	*2.54*	*5.62*
vix_t	0.25	0.24	0.20	0.15	0.25	0.33	0.35	0.16	0.21	0.21
p-value	*0.00*	*0.00*	*0.00*	*0.00*	*0.45*	*0.02*	*0.00*	*0.00*	*0.05*	*0.00*
t-stat	*4.27*	*4.58*	*4.77*	*4.29*	*0.77*	*2.47*	*5.76*	*4.04*	*2.02*	*4.92*
q_t	1.82	0.96	2.16	1.04	3.61	3.54	2.37	1.20	6.33	1.70
p-value	*0.44*	*0.38*	*0.03*	*0.30*	*0.66*	*0.05*	*0.13*	*0.24*	*0.20*	*0.20*
t-stat	*0.78*	*0.89*	*2.23*	*1.05*	*0.44*	*2.05*	*1.56*	*1.19*	*1.30*	*1.29*
$spread_t^{IRE}$	0.03	0.05	-0.02	0.03	-0.04	-	-0.01	0.01	0.03	0.03
p-value	*0.44*	*0.17*	*0.48*	*0.17*	*0.83*	*-*	*0.83*	*0.72*	*0.59*	*0.38*
t-stat	*0.78*	*1.39*	*-0.71*	*1.42*	*-0.21*	*-*	*-0.21*	*0.37*	*0.55*	*0.89*
$spread_t^{GR}$	0.00	0.01	0.02	0.00	-	0.17	0.06	0.00	0.29	0.09
p-value	*0.91*	*0.34*	*0.13*	*0.73*	*-*	*0.00*	*0.00*	*0.94*	*0.00*	*0.00*
t-stat	*0.12*	*0.97*	*1.55*	*0.35*	*-*	*4.56*	*3.20*	*0.08*	*6.43*	*5.10*
γ^{IMF}	0.04	0.09	0.04	0.05	0.85	0.37	0.17	0.03	0.24	0.42
p-value	*0.54*	*0.14*	*0.44*	*0.22*	*0.04*	*0.04*	*0.02*	*0.45*	*0.07*	*0.00*
t-stat	*0.61*	*1.50*	*0.78*	*1.25*	*2.16*	*2.19*	*2.51*	*0.76*	*1.89*	*7.16*
$Adj\text{-}R^2$	0.89	0.91	0.92	0.87	0.96	0.96	0.96	0.90	0.97	0.99

Regression F: Crisis Times Series Estimates with Greek and Irish Contagion, and IMF Intervention Dummy

Period: 08.2007 - 12.2010

	DEN	SWE	UK
$spread_{t-1}$	0.85	0.59	0.71
p-value	*0.00*	*0.00*	*0.00*
t-stat	*6.16*	*4.40*	*5.46*
vix_t	-0.26	-0.19	-0.13
p-value	*0.01*	*0.08*	*0.11*
t-stat	*-2.92*	*-1.80*	*-1.62*
q_t	-3.39	2.86	-0.11
p-value	*0.20*	*0.00*	*0.76*
t-stat	*-1.30*	*3.18*	*-0.30*
$spread_t^{GR}$	-0.11	-0.12	0.02
p-value	*0.02*	*0.00*	*0.37*
t-stat	*-2.51*	*-4.13*	*0.90*
$spread_t^{IRE}$	0.17	0.16	-0.06
p-value	*0.02*	*0.00*	*0.30*
t-stat	*2.52*	*3.08*	*-1.06*
γ^{IMF}	-0.10	-0.06	0.04
p-value	*0.46*	*0.62*	*0.74*
t-stat	*-0.75*	*-0.49*	*0.33*
$Adj\text{-}R^2$	0.93	0.93	0.75