Sovereign Credit Default Swap Premia*

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Abstract

This paper reviews the young but rapidly growing literature on sovereign credit default swap premia. A discussion of current debates in the academic and popular press hopefully raises thought-provoking questions with valuable insights for academics, policymakers and practitioners alike. The main elements of the review relate to the determinants of sovereign CDS spreads, spillovers and contagion, frictions, the relationship to and impact on public bonds, as well as trading in the market for sovereign credit derivatives. In addition, I describe key statistical and stylized facts about prices, the market and its players.

Keywords: Credit Default Swap Spreads, Default Risk, Descriptive Statistics, Literature Review, Sovereign Debt, Term structure

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1 Introduction

Whether for right or wrong, credit default swaps (henceforth CDS) have been bedeviled as weapons of mass destruction, time bombs[1] or financial hydrogen bombs.[2] With the deepening of the European sovereign debt crisis, the blame game has carried over to insurance products written on government debt. Referencing speculation in the sovereign CDS market as a cause of rising government borrowing costs, the German financial regulator implemented an outright ban on *naked* sovereign CDS positions in May 2010.[3] The European Union followed suit in November 2012 by restricting the use of sovereign credit insurance to investors seeking to hedge long positions only.

Despite critical voices raising their concerns about the use of sovereign CDS, proponents argue that they are efficient vehicles to transfer and manage credit risk, with the ability to decrease adverse selection and monitoring costs. In addition, they may allow for enhanced risk sharing, thereby encouraging greater market participation. Policy makers, regulators and investors increasingly look at sovereign CDS prices to gauge the health of our system.[4] In addition, observed market prices are imputed into risk management tools and used as risk factors or hedging vehicles for investment management purposes. The Basel III framework explicitly recognizes sovereign CDS as an effective hedge to reduce Credit Valuation Adjustment (CVA) risk capital charges. While there have been several reviews of the corporate CDS market, a comprehensive overview of the sovereign analogue does not exist.[5] This manuscript attempts to fill this gap by providing market participants and end users with an informed overview of the key controversies and debates surrounding sovereign CDS in the academic literature and in the popular press.[6] To this end, I stick to the factual definition of what sovereign credit default swaps really are, namely insurance contracts offering protection against the default of a referenced sovereign government.

More specifically, the goal of this paper is to describe the key characteristics of the market for sovereign CDS. In addition, it emphasizes the academic debate surrounding the determinants of

[1] See Warren Buffett, Berkshire Hathaway Annual Report for 2002, p.13, on line at http://www.berkshirehathaway.com/2002ar/2002ar.pdf

[2] Felix Rohatyn, a Wall Street banker employed at Lazard Frères, quoted in Tett (2009).

[3] A *naked* position refers to an investment position that is unhedged.

[4] Hart and Zingales (Fall 2011), for example, suggest the use of financial CDS to evaluate the health of banks.

[5] See for example Das and Hanouna (2006) for a review of corporate CDS and Stulz (2010) for a review of corporate CDS in relation to the financial crisis.

[6] This review emphasizes the literature on sovereign CDS spreads. I apologize to any authors on sovereign bond spreads who feel that their work is relevant and should have been included in this review.

spreads, the relationship with and implications for the bond market, and it lays out some basic trading patterns. Understanding the market's properties is especially relevant if these products are regularly used in practice. For example, if risk factors underlying the variation in spreads are time-varying, hedges meant to reduce capital requirements, or risk models, could break down during crisis periods precisely then when they are the most needed. On the other hand, a partially informed view about the implications of sovereign CDS trading may result in regulation which could ultimately be detrimental to financial markets as a whole.

I hope that this literature review provides a useful starting point for anyone interested in this asset class with an underlying public debt market of approximately 48 trillion USD[7], and that the exposition raises some thought-provoking questions for academics, policy makers and practitioners alike.[8] Before diving into the specifics, however, I would like to highlight some puzzling observations and questions as a teaser. Despite the huge press coverage of credit derivatives, they represent only a tiny fraction (4.68%) of the overall "over-the-counter" derivatives market.[9] Moreover, among all traded credit default swaps, sovereign contracts make up roughly 11%. Although the overall size of the CDS market is valued at 27 trillion USD, the net economic exposure is only 1.2 trillion USD.[10] Furthermore, why is it that contracts on emerging market economies tend to trade in high numbers and small volumes, while developed economies tend to trade with a larger net economic exposure per contract and have fewer contracts outstanding? Why are hedge funds so often blamed for speculation in the sovereign CDS market, when in fact they represent only a small fraction of all counterparties? Why is there such a surge in CDS trading on the US government in 2011? What determines the shape of the sovereign yield curve when government term structures exhibit similar patterns as those of corporations, but country-specific factors play relatively weaker roles in explaining variation in CDS spread levels? And finally, why is it so important to avoid a trigger on Greek CDS when the net reported economic exposure is below 4 billion at the end of 2011? These facts and more are highlighted along the road.

[7]This estimate of global public debt is based on the 2012 numbers from the Economist global debt clock. Source: www.economist.com.

[8]A review of the institutional and legal background of CDS is omitted because of space limitations, but can be found in section 2 of the working paper version New York University, Stern School of Business Working Paper EC-12-10. For pricing aspects of CDS, I refer the reader to Duffie (1999), Hull and White (2000a) and Lando (2004).

[9]These numbers are for June 2012. Source: www.bis.org.

[10]The net economic exposure can be understood as an upper bound on insurance payments upon default. Actual payments are expected to be lower, because recovery values of defaulted bonds are generally non-zero.

The remainder of this document structures as follows. Section 2 describes the evolution and growth of the sovereign CDS market followed by a description of the key characteristics in section 3. In section 4, I review the literature on the determinants of sovereign CDS. Section 5 reviews the emerging literature on spillovers and contagion. Section 6 follows up with a discussion on the relationship between sovereign CDS and public bonds and reviews the evidence about frictions. Finally, section 7 gives an overview of the trading in sovereign CDS markets based on data from the global data repository DTCC, and provides some indication on how this relates to country-specific fundamentals. I conclude in section 8.

2 The Market for Sovereign Credit Default Swaps

Engineered in the early nineties by JP Morgan to meet the growing demand to slice and dice credit risk, CDS featured nearly three-digit growth rates year by year over the last decade.[11] I review first the market size and structure of the sovereign CDS market. Then I discuss the market participants.

2.1 Market Size and Structure

CDS exploded from roughly 6 trillion USD of gross notional amount outstanding in 2004 to a peak of 58 trillion USD in the second term of 2007.[12] Panel A of Table 1 illustrates that these figures have since come down to 27 trillion USD in June 2012, which is mostly linked due to a netting of outstanding positions as regulators' increasing concerns about counterparty risk and calls for higher transparency have led to portfolio compressions. But it is also partly due to the fact that credit derivatives were central to the 2007-2009 financial crisis.[13] While contracts written on a single underlying reference made up for the bulk of the trading volume in 2004 with a market

[11]The exact year of creation is not clear. Tett (2009) refers to the first CDS in 1994, when J.P. Morgan off-loaded its credit risk exposure on Exxon by paying a fee to the European Bank for Reconstruction and Development. More importantly for this review, the author also references a deal between J.P. Morgan and Citibank asset management on the credit risk of Belgian, Italian and Swedish government bonds around the same time (p.48).

[12]These statistics are based on the bi-annual reports on the notional amounts outstanding and gross market values of OTC derivatives published by the Bank for International Settlements. Statistics for CDS are available since 2004. The notional amounts are likely to slightly underestimate the total value of the market, as until the end of 2011, only 11 countries are reporting their OTC derivative statistics to the BIS. Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States. From December 2011, Australia and Spain are expected to contribute to the semiannual survey, bringing to 13 the number of reporting countries. Source: www.bis.org.

[13]Portfolio compression refers to the process by which two counterparties maintain the same risk profile, but reduce the number of contracts and gross notional value held by participants.

share of 80%, multi-name instruments have increased more rapidly due to the practice of synthetic securitization and represented roughly 42% of the market in 2012. While these numbers sound impressive, CDS still account for only 4.21% of the total amount of notional outstanding in all OTC derivatives, which has grown to 638.93 trillion USD. The largest fraction comes from interest rate derivatives, which is estimated to have a size 494.02 trillion USD, or equivalently 77.32% of the market.

Notional amounts outstanding provide a measure of market size and a reference from which contractual payments are determined in derivatives markets. Gross market values, on the other hand, reflect the sum of all market values in a current gain or loss position. This provides a more accurate measure of the scale of financial risk transfer taking place in derivatives markets.[14] Gross market values are with 1.19 trillion USD during the first half of 2012 significantly lower than the gross notional amounts. In addition gross credit exposures, which account for netting agreements between counterparties, make these numbers shrink even further to a value of 310 billion USD. This number still reflects a sizable market, but it is much less breathtaking than the total notional amount outstanding of 27 trillion USD.

Panel B in Table 1 illustrates that sovereign credit derivatives, with 2.99 trillion USD in 2012, make up approximately 11% of the overall market for OTC credit derivatives. In contrast to corporate CDS, they are on the other hand largely concentrated around single-name products, which reflect a trading volume of 2.85 trillion USD, or respectively a fraction of 95%. More detailed statistics for gross credit exposures of sovereign CDS are not publicly available on the BIS website. But we can get a noisy estimate if we make the simplifying assumption that the fraction of gross credit exposure to total notional amount traded is the same for sovereign reference entities and the overall market. Under this assumption, the gross market value of all outstanding contracts is approximately 132 billion USD, while the total net exposure reduces to roughly 34.4 billion USD. Although these are still economically meaningful numbers, regulators ought to keep such rough magnitudes in mind when they justify interference in the market, as they did to prevent a default payout trigger for Greece in 2012. During Greece's default episode, net notional amounts outstanding for contract written on the Hellenic Republic were in the order of magnitude of 3 billion

[14]BIS defines gross market value as the sums of the absolute values of all open contracts with either positive or negative replacement values evaluated at market prices prevailing on the reporting date.

USD.[15]

While CDS investors have access to a wide range of contract maturities, liquidity for *corporate* CDS is mostly concentrated around five-year contracts, as is illustrated in Panel C of Table 1.[16] The total volume of notional amount outstanding with maturities above one and up to five years, was 18.25 trillion USD in 2012, representing a market share of 67.76%. This fraction has fluctuated closely around this level since the BIS started the reporting on CDS. The remaining contracts are somewhat balanced among maturities below one year, with a total volume 5.61 trillion USD (20.85%), or above five years, with a total volume of 3.07 trillion USD (11.39%). It seems however that over the last 2 years, short maturities have gradually been trading more relative to long maturities. For *sovereign* reference entities, trading is less concentrated in the 5-year contract. Pan and Singleton (2008) and Packer and Suthiphongchai (2003) reproduced earlier BIS statistics from 2003, documenting that the 3- and 10-year contracts each accounted for roughly 20% of the volumes in sovereign markets, and the 1-year contract accounted for an additional 10% of the trading.

2.2 Market Participants

Speculative one-sided bets by hedge funds in the market for sovereign credit derivatives have also been blamed for a rise in public borrowing costs throughout the European debt crisis. A snapshot of the counterparties involved in sovereign CDS trading in Panel D of Table 1 reveals that it is to a large extent the reporting dealers who operate in this market. Their reported trading volume is approximately 2.03 trillion USD, reflecting a market share of 71.13%, followed second by Banks and Security Firms with a market share of 13.27% or an underlying notional amount outstanding of 378 billion USD. Hedge funds are only third in line, with a total volume of 154 billion USD. While this is no evidence, it suggests at least that sovereign CDS are used primarily for hedging purposes, rather than for speculative bets.[17] We should however be cautious with such fast conclusions, as their trading volume has almost doubled from 2010 to 2012, which may reflect arbitrage opportunities linked to the European sovereign debt crisis, whereas banks and security

[15] Source: www.dtcc.com.

[16] CDS have the attractive feature that they are constant maturity products. Thus, every day, a market participant can buy an insurance contract with an identical remaining maturity. This contrasts with cash bonds, which have decreasing maturities over time.

[17] Bongaerts et al. (2011) also cite evidence that banks are primarily net buyers of (corporate) CDS, while insurance companies and funds are mainly net sellers.

firms have reduced their exposure from 828 billion USD to 378 billion USD over the same period. Panel E further illustrates that the CDS market is mostly a transnational market. 80.10% of all trades are with a counterparty based in a foreign country, in contrast to only 19.90% of all contracts that are handled with a counterparty of the home country. The international nature of the trading raises questions about the usefulness of unilateral policy decisions affecting the market, such as the ban of naked CDS by Germany in May 2010, and by the European Union in November 2012.

3 Statistical Facts about Sovereign CDS

This section provides some stylized statistical facts about the probability distributions of sovereign CDS, based on a data set used in Augustin and Tédongap (2012). The sample consists of daily mid composite USD denominated CDS quotes for 38 sovereign countries taken from Markit over the sample period 9 May 2003 until 19 August 2010. All contracts contain the full restructuring clause. Spreads come from the entire term structure, including 1, 2, 3, 5, 7 and 10-year contracts, and span 5 geographical regions, including the Americas, Europe, Africa, the Middle East and Asia.

A first set of summary statistics is provided in Table 2. Countries are grouped by their average credit rating on external debt over the sample period. The term structure is always upward sloping on average, going from 15 basis points at the 1-year horizon to 26 basis points at the ten-year maturity for AAA rated entities, and from 433 to 599 basis points for the B rated countries. A mean upward sloping term structure was also shown for a set of three emerging countries in Pan and Singleton (2008). Augustin (2012), however, reports negative sample averages of the slope for a series of countries if the sample period includes the European sovereign debt crisis.[18] As countries become less creditworthy, the volatility of their CDS spreads jumps up. For example, the average standard deviation of the 5-year CDS spread is 34 basis points for the most creditworthy country, and 328 basis points for the least creditworthy. Moreover, the level of CDS spreads exhibit positive skewness, with a value usually around 2, and they have very fat tails. But the excess kurtosis generally decreases with the asset horizon. Finally, CDS spreads are also very persistent. Among all statistics, the lowest and highest first-order autocorrelation coefficients are 0.9901 and 0.9979

[18] More specifically, four countries have a negative slope on average, using a monthly data frequency, over the period January 2001 to February 2012. Greece exhibits the most negative slope with an average of -382 basis points.

respectively for daily observations.[19]

A common theme of interest is the behavior of the term structure of spreads. A structural credit model of Merton (1974) predicts that the credit curve is increasing for high-quality credit levels, hump-shaped for intermediate credit quality and decreasing for low levels of creditworthiness. Lando and Mortensen (2005) have confirmed these predictions for corporate CDS. For their analysis, they rank their observations based on the average five-year spread level. I attempt to do the same exercise for the sovereign CDS sample. Hence for each country on each day, I look at the 5-year CDS spread and group the observations into ranges of 100 basis points and then report within each category, the average spread, as well as the difference between the 10-year and the 1-year spread, the 10-year and the 3-year spread and the 3-year and the 1-year spread. The average values are calculated across time and entities. The results, which are shown in Table 3, yield similar conclusions as for corporate CDS. The overall slope, defined as the difference between the 10-year and 1-year spread, first increases as the credit quality weakens, and then decreases before becoming negative at very high spread observations. Yet, if we look separately at the gap between the 1 to 3-year, as well as the 3 to 10-year spread, it is evident that the former turns negative only much later, confirming the humped shape curve for intermediate groups.

Another way to look at this is by computing the average slope levels in the same three segments, as well as the fraction of negative values for sliding groups of 400 curves. This yields the outcome plotted in Figure 1, from which we can draw the same conclusion. At first glance, such results make us feel comfortable that statistical models of credit curves can be applied equally well to corporate and sovereign reference contracts. From an empirical perspective, however, it raises the question about the determinants of the shape of the sovereign credit curve, as country-specific factors seem to have relatively weaker explanatory power for the time-series variation of sovereign CDS, at least at higher sampling frequencies. This contrasts with the predictions of a Merton (Merton 1974) type world. This issue is further discussed in the following section.

[19] At lower data frequencies, sovereign CDS spreads are less persistent. See Longstaff et al. (2011) and Augustin (2012) for statistics with a monthly data frequency.

4 Determinants of Sovereign CDS spreads

Intuitively, one would expect the fluctuations in sovereign spreads to be driven by country-specific fundamentals.[20] Yet, abundant evidence shows that a major fraction of the variation in sovereign CDS spreads is determined by global variables unrelated to a country's economy, in particular at higher trading frequencies. Moreover, most studies reference some sort of risk originating in the United States. However, the European sovereign debt crisis has brought the role of domestic factors back to the forefront, with a spotlight on the sovereign-bank nexus. Surveying the literature highlights the fact that the role of domestic risk factors tends to be more important in times of distress and for countries undergoing financial turmoil, while global risk factors tend to be favored in studies excluding distressed countries and typically outside crisis periods. Future research is encouraged to focus on the time-varying properties of both sources of risk.

Understanding the risk factors underlying the variation in spreads is important from several perspectives. If the truth is that global factors are largely responsible for the time-series dynamics, then any sort of government intervention to bring down spreads may prove ineffective. On the other hand, if the drivers of risk are state-dependent, then such properties need to be taken into account to develop useful risk monitoring tools and to build hedges, which don't break down specifically in times when they are most needed. Here, I review the main academic results.

4.1 Global Risk Factors

The importance of global risk factors in explaining sovereign CDS spreads is usually motivated by the fact that sovereign spreads tend to co-move significantly over time, as can be seen in Graph 2a for a sample of 38 countries. In addition, averaging the level of spreads over all countries in Figure 2b illustrates that spreads jump sharply every time there is a run-up in risk aversion due to a global risk-related event, such as changes in U.S. monetary policy following falling growth rates, which have led traders to unwind their carry trades, major corporate bankruptcies of the usual suspects Bear Stearns and Lehman Brothers, or when the European governments underwent major political bailouts. This casual observation suggests that global risk factors bear some responsibility

[20] In fact, the classical Merton model predicts that variation in credit spreads is primarily determined by asset volatility, financial leverage and the risk-free term structure. See Ericsson et al. (2009) for a discussion on the determinants of *corporate* CDS in relation to the Merton model.

for the variation in spreads. In addition, support to the influence of global risk is also provided by the strong factor structure in spreads, as the first principal component is able to explain a very large fraction of the spread variation, much higher than is the case for equities. The precise figure depends on the sample frequency and countries studied, but can be as high as 96% at the daily level or 64% at a monthly decision interval as shown by Pan and Singleton (2008) and Longstaff et al. (2011) respectively.[21]

Among those studies leaning more towards an explanation of global factors is for example Longstaff et al. (2011). The authors study monthly 5-year CDS of 26 countries over the time period October 2000 to January 2010 and consider variables related to the local economy, global financial variables, global risk premia, global investment flow measures as well as regional and global sovereign credit risk. They conclude that sovereign CDS can be explained to a large extent by U.S. equity, volatility, and bond market risk premia. Interestingly, they argue that global risk is not only a better predictor of risk premia, but also of the part of spreads compensating investors for expected losses. A tight link between sovereign CDS spreads and global risk is also reported by Pan and Singleton (2008), who study the term-structure of daily CDS spreads of Korea, Mexico and Turkey from March 2001 to August 2006. Their main interest lies in using the information in the term structure to disentangle the parameters of the risk neutral default and recovery processes.[22] With this goal in mind, they develop a theoretical pricing model to decompose spreads into the part related to expected losses and a risk premium. Risk premia appear to co-move strongly over time and are strongly related to the CBOE VIX option volatility index, the spread between the 10-year return on US BB-rated industrial corporate bonds and the 6-month US Treasury bill rate, and the volatility in the own-currency options market. These findings corroborate the intuition of time-varying risk premia in the sovereign CDS market.

Ang and Longstaff (2013) conduct a comparative analysis of CDS spreads written on sovereign

[21] Pan and Singleton (2008) study 3 countries. Augustin and Tédongap (2012) report that the first principal component explains 78% of the daily variation for a set of 38 countries. Augustin (2012) shows that the first principal component explains on average 57% of the variation in monthly spreads of 44 countries and links the magnitude of the factor loadings to the shape of the sovereign term structure.

[22] The authors show that if the recovery rate is defined as a function of face value, the term structure can be used to identify separately the parameters governing the default and loss processes. Their results suggest that the common practice of setting a constant recovery rate of 25% for sovereign reference entities works well for medium sample sizes. The importance of accounting for stochastic recovery rates in the pricing of CDS spreads, especially for sovereign reference entities, is emphasized in Bilal and Singh (2012).

states in the United States and European countries. Rather than extracting the risk premium, they extract the dependence of spreads on a common component and define this part as systemic risk. The authors find evidence that this systemic risk component is influenced by global financial factors and dismiss links with macroeconomic fundamentals. Related to the paper by Pan and Singleton (2008) is the work of Zhang (2008), who develops a CDS pricing model and applies it to Argentina to infer differences in expectations about expected recovery rates upon default and expected default probabilities. The author documents that the wedge between risk-adjusted and historical default probabilities is associated with changes in the business cycle, both the U.S. and Argentine credit conditions as well as the overall local economy.

Augustin and Tédongap (2012) provide empirical evidence that the first two common components among a set of 38 countries spanning a wide geographical region are strongly associated with expected consumption growth and macroeconomic uncertainty in the United States. The authors study daily quotes over the time period April 2003 to August 2010 and document that this link is robust against the influence of global financial market variables such as the CBOE volatility index, the variance risk premium, the U.S. excess equity return, the price-earnings ratio as well as the high-yield and investment-grade bond spreads. In addition, they rationalize this new finding in a structural asset pricing model with recursive preferences and a long-run risk economy where the default rate process is driven by the global long-run expectations of future consumption growth and macroeconomic uncertainty. Overall, the results confirm the existence of time-varying risk premia in sovereign spreads as a compensation for exposure to common U.S. business cycle risk.

Further evidence of influence from the United States on sovereign CDS premia is provided by Dooley and Hutchison (2009). They document how the subprime crisis channeled through to a sample of 14 geographically dispersed countries, based on a series of both positive and negative real and financial news over the sample period January 2007 to February 2009. While they document that a range of news had statistically and economically significant effects, they find that in particular the Lehman event and the expansion of Federal Reserve swap lines with the central banks of industrial and emerging countries uniformly moved all country spreads (in the sample).[23] Wang

[23] On 13 October 2008, the Fed removed its USD swap limits to industrial countries, and on 29 October 2008, the FOMC established swap lines with the central banks of Brazil, Mexico, Korea and Singapore for up to $30 billion each.

and Moore (2012) study the dynamic correlations between the sovereign CDS spreads of 38 emerging and developed economies with the U.S. from January 2007 to December 2009. Results indicate that in particular developed economies have become much more integrated with the United States since the Lehman shock. This tighter link with the U.S. seems to be driven mainly by the U.S. interest rate channel.

Finally, Benzoni et al. (2012) suggest that the co-movement in sovereign spreads arises because agents update their beliefs about the state of the underlying economy, which is a *hidden* factor. To mitigate uncertainty about the distribution of the underlying state, posterior probabilities of bad states are over weighted. Thus in case of a negative shock, the probability of being in a bad state is revised, which negatively affects the default probability of all other countries. Thus, updating of beliefs will generate correlations in credit spreads that are significantly higher than if spreads were functions of the macroeconomic conditions only. This mechanism is explained in the fragile beliefs framework of Hansen and Sargent (2010).[24] In addition to the hidden factor, which the authors define as contagion risk, spreads are modeled to depend also on global financial uncertainty (VIX and the U.S. high-yield bond spread defined as the difference between the BB and BBB Bank of America Merrill Lynch corporate bond effective yields) and a country-specific macroeconomic conditions index.[25]

4.2 Global and Local Risk Factors

A good transition between the "pro-global" and "pro-local" camps is provided by Remolona et al. (2008). Based on the intuition that financial asset prices are driven by both country-specific fundamentals and investor's appetite for risk, Remolona et al. (2008) decompose monthly 5-year emerging markets sovereign CDS spreads over the period January 2002 to May 2006 into a market-based measure of expected loss and a risk premium. They analyze how each of these two elements is linked to measures of country-specific risk and measure of global risk aversion/risk appetite. Fundamental variables include inflation, industrial production, GDP growth consensus forecasts, and foreign ex-

[24]The model is estimated based on daily 5-year sovereign CDS spreads of 11 Euro zone countries over the sample period 12 February 2004 to 30 September 2010.

[25]The macroeconomic conditions index summarizes country-specific macroeconomic information derived from a political stability indicator, real GDP growth and GDP per capita, unemployment rate, exports to GDP, inflation, the ratio of government surplus to GDP and debt to GDP, and the ratio of the M3 money measure over GDP and foreign exchange reserves over GDP as proxies for country-specific liquidity.

change reserves. Proxies for global risk aversion are taken as the Tsatsaronis, Karamptatos (2003) effective risk appetite indicator, the VIX and a Risk Tolerance Index by JP Morgan Chase. They find empirical evidence that global risk aversion is the dominant determinant of sovereign risk premium, while country-specific fundamentals and market liquidity matter more for sovereign risk. Both components thus behave differently.

Carlos Caceres and Segoviano (2010) analyze how much of the rising spreads can be explained by shifts in global risk aversion, country-specific risks, directly from worsening fundamentals, or indirectly from spillovers originating in other sovereigns. The authors argue that the widening of spreads during the early period of the crisis was essentially driven by changes in a self-computed measure of risk aversion, but later in the crisis, country-specific factors identified by each country's stock of public debt and budget deficit as a share of GDP played the dominant role. In a similar spirit, Arghyrou and Kontonikas (2012) find evidence in favor of a regime-shift in sovereign debt pricing towards country-specific macro-fundamentals during the crisis. Prior to the crisis, differential macro-fundamentals are not able to explain cross-sectional differences in spreads. Finally, Aizenman et al. (2013) study the relationship between 5-year sovereign CDS spreads and fiscal space using the deficit-to-tax and public debt-to-tax ratios for 60 countries over the period 2005 to 2010, but they focus their analysis on the GIIPS countries. They confirm the importance of fiscal space in explaining sovereign spreads. Quantitatively, their results indicate that a 1 percentage point rise in the debt-to-tax ratio increases 5-year spreads by between 15 and 81 basis points, while a 1 percentage point rise in the fiscal balance to tax ratio predicts a decrease in spreads by 194 to 829 basis points.

Carr and Wu (2007) present a joint valuation framework for sovereign CDS and currency options written on the same economy and execute an empirical test for Mexico and Brazil over the time period January 2, 2002 to March 2, 2005. They document that CDS spreads show strong positive contemporaneous correlations with both the currency option implied volatility and the slope of the implied volatility curve in moneyness.[26] This analysis confirms their conjecture that economic or political instability often leads to both worsened sovereign credit quality and aggravated currency return volatility in a sovereign country. Interestingly, their results suggest that there are additional

[26] More specifically, the authors refer to the delta-neutral straddle implied volatilities and the risk reversals.

systematic movements in the credit spreads that the estimated model fails to capture. Hui and Fong (2011) reverses the analysis and documents information flow from the sovereign CDS market to the dollar-yen currency option market during the sovereign debt crisis from September 2009 to August 2011. In a similar spirit, Pu (2012) exploits pricing differences between USD and EUR denominated sovereign CDS spreads to show that the dual-currency spread significantly affects the bilateral exchange rate for ten Eurozone countries from January 2008 to December 2010 and has predictive power up to a period of ten days. Gray et al. (2007) apply the contingent claims analysis to price sovereign credit risk by using the government's balance sheet and exchange rate volatility as inputs to their model and compare the results to observed CDS spreads. More recently, Plank (2010) also suggests a structural model for sovereign credit risk based on macroeconomic fundamentals. In this model, the probability of default reflected in the CDS spread depends on a country's foreign exchange reserves, as well as its exports and imports.

Ismailescu and Kazemi (2010) consider the possibility of rating changes affecting the sovereign CDS spreads of 22 emerging economies over the time period January 2, 2001 to April 22, 2009.[27] Using classic event study analysis, the authors conclude that the CDS of investment grade countries respond mainly to negative credit rating announcements, while the spreads of speculative grade countries respond largely to positive announcements. In addition, the information content of negative credit events is anticipated and already reflected in CDS spreads by the time the credit rating change is announced. Alternatively, CDS spreads do not fully anticipate upcoming positive credit rating events, which seem to contain new information. Furthermore, the paper documents evidence of spillover effects arising mainly from rating upgrades, with a one notch rise in the rating of an event country increasing the average CDS spread of a non-event country by 1.18%. These effects are asymmetric, high grade countries reacting stronger to rating upgrades and low-grade countries reacting stronger to rating downgrades. Although controlling for previous rating downgrades reduces the magnitude of the spillover effect, it is increased if countries have a common creditor, which seems to be one channel of transmission. However, competition effects arise if two countries have similar levels of trade flow correlation with the U.S.[28]

[27]For early evidence on the relationship between credit ratings and pricing information, see Cossin and Jung (2005), who show that ratings become more informative after a crisis event.

[28]Arezki et al. (2011) provide further evidence on the relationship between rating changes and sovereign CDS spreads.

4.3 Local Financial Risk Factors - The Sovereign-Bank Nexus

With the intensification of the European sovereign debt crisis following the bank bailouts during the financial crisis, more and more evidence appears on a tight relationship between sovereign and domestic financial risk. Acharya et al. (2013) for example illustrate the two-way feedback effect between sovereign risk and the financial sector. Their results indicate that government bailouts can negatively impact the financial strength of the sovereign, which in turn reduces the value of the government guarantees implicit in the financial institutions and causes collateral damage to the banks' public bond holdings. As a consequence, CDS spreads of sovereign countries and financial companies co-move strongly once the government has committed excessively to financial guarantees.

While the authors stress the two-way feedback effect, Dieckmann and Plank (2011) underscore the unilateral private-to-public risk transfer through which market participants incorporate their expectations about financial industry bailouts.[29] They find that both the state of a country's financial system and of the world financial system have strong explanatory power for the behavior of CDS spreads, while the magnitude of this impact seems to depend on the importance of a country's financial system pre-crisis. In addition, they provide evidence that Economic and Monetary Union member countries exhibit higher sensitivities to the health of the financial system. Likewise, Ejsing and Lemke (2011) provide evidence of a private-to-public risk transfer over the period January 2008 to June 2009 by showing that financial bailouts decreased banks' CDS spreads at the expense of rising sovereign spreads.

Altman and Rijken (2011) propose a "bottom-up" approach to evaluate sovereign default probabilities by adapting the well-known credit-scoring method to countries. This suggests that the profitability and financial condition of the local economy significantly impacts default risk. The outcomes are compared to implied CDS rankings provided by the financial market.

Evidence that contingent liabilities of sovereigns arising from implicit or explicit guarantees of the banking system influence sovereign CDS premia is also provided in Kallestrup et al. (2011). The authors use consolidated BIS banking statistics combined with CDS spreads to construct a financial network matrix, reflecting cross-country bank linkages and banks' exposures to both the

[29] Dieckmann and Plank (2011) study eighteen advanced western economies on a weekly basis during the 2007/2008 financial crisis, from 2007 to 2010.

domestic and foreign public, bank and private (non-bank) sectors. Large exposures to one country turn out to be primarily important when the credit risk of that country is high. Cross-country financial linkages are shown to have explanatory power for the variation on sovereign CDS spreads beyond what can be accounted for by common and country-specific risk factors. Also Kallestrup (2011) shows that there are strong interactions between sovereign credit risk and macrofinancial risk indicators calculated based on bank balance sheet variables.

Sgherri and Zoli (2009) conduct an analysis of the co-movement between sovereign CDS and those of the financial sector for ten European countries from January 1999 to April 2009. While they confirm the dominance of a common time-varying factor, they find that concerns about the solvency of the national banking systems have become increasingly important. Alter and Schüler (2012) use a vector error correction framework to analyze price discovery mechanism among both sovereign and bank CDS spreads before and after government rescue packages. In a nutshell, the authors find that prior to a financial rescue package, default risk was transmitted primarily from the bank to the sovereign sector, while post-bailouts, risk was also transmitted the other way round from sovereigns back to banks.[30]

Taken at face value, the above results suggest that the role of risk factors underlying the variation in sovereign spreads is time-varying. Country-specific factors seem to play a more important role in crisis periods, in particular the sovereign-bank nexus. Such an explanation is in the spirit of Augustin (2012), who argues that both country-specific fundamentals and global shocks matter for the pricing of sovereign credit risk, but that they simply matter at different times. The author argues that the shape of the term structure may serve as a signal to identify the relative importance of each source of risk. More specifically, in good times, when we observe an upward sloping term structure for countries, variation in spreads is relatively more driven by global risk factors, while in bad times when we observe a downward sloping term structure, country fundamentals play a more important role in explaining variation in spreads.[31] That observation could be useful for risk monitoring and credit scoring methods, as the slope of the term structure is observable in real time.

[30] Further evidence on the relationship between sovereign and bank CDS is also provided by Aktug et al. (2013).

[31] Augustin (2012) documents the empirical relationship between the shape of the term structure and the explanatory power of local risk factors. The mechanism is rationalized in an equilibrium model with recursive utility and long run risk for CDS spreads. Time variation in the term structure consistent with observed stylized facts arises through the tension between global and local risk.

The state-dependent nature of the term structure may thus be a decision input for time-varying weights associated with various risk factors.

To summarize, there is a strong debate on whether sovereign CDS spreads are driven relatively more by global risk factors or by country-specific fundamentals, the latter being mostly related to the health of the domestic financial sector. The truth lies probably somewhere between these two explanations. Thus, future research is encouraged to focus on the time-varying properties of both sources of risk. In addition, while the majority of papers focuses on the level of spreads, time-variation in the term structure may provide valuable information going forward, as suggested in Pan and Singleton (2008) and Augustin (2012).[32]

5 Spillovers and Contagion

The deepening sovereign debt crisis has been accompanied with a proliferation of the notions *contagion* and *spillovers* of sovereign risk across countries, both in academic work and in the popular press. The existence of real contagion is ambiguous. It could be the case that country spreads co-move simply more or less because of their common exposure to global or regional shocks, which have time-varying correlations. Alternatively, shocks to these factors may be transmitted with time-varying intensities. Results in the literature largely depend on the exact definition of the concept.

Beirne and Fratzscher (2013) investigate the presence of contagion effects among 31 developed and emerging countries over the period 2004 to 2011.[33] The authors distinguish between three types of contagion: Fundamentals contagion arising from higher sensitivity of financial markets to existing fundamentals during crisis periods, regional contagion defined as an intensification of cross-country transmission of sovereign risk, and herding contagion or pure contagion, identified by temporal cross-country correlations of the unexplained components of sovereign risk (the residuals).[34] Their results suggest evidence in favor of fundamentals contagion, in the sense that financial markets

[32]Pan and Singleton (2008) emphasize the information in the term structure to help identify recovery rates. Augustin (2012) emphasizes the role of the term structure as a signal to identify the relative importance of global and local risk factors.

[33]Beirne and Fratzscher (2013) investigate the presence of contagion for bond yields, CDS spreads and sovereign credit ratings. The sample period for bond yields and credit ratings covers the period 1999 to 2011.

[34]More specifically, the presence of tail clustering in the distribution of error terms at a given point of time should be evidence in favor of pure contagion.

experienced a *wake-up call* by becoming more sensitive to countries' economic fundamentals during the crisis period compared to the pre-crisis period. This was particularly pronounced for the GIIPS countries. In contrast, regional spillovers have, if anything, decreased during the crisis and there is no indication of spill-overs from GIIPS countries to other regions. Finally, there has been only little evidence of pure contagion, which was generally very short-lived and didn't dominate the crisis period.

Caporin et al. (2013) reject the presence of sovereign contagion across 8 European countries over the period November 2008 to September 2011 by testing whether the propagation effect across countries is different for large shock realizations relative to average shocks, after conditioning on common factors.[35] Using quantile regression techniques, it is shown that the dependence between movements of any two CDS changes does not change as a function of the size and sign of the movements. This is strong evidence of linearity in the propagation of shocks, indicating that the linkage among the different countries are the same during normal or turbulent times.[36] Additional tests emphasize that pairwise correlations across countries have reduced with the intensification of the sovereign debt crisis and that correlations are lower for large changes in spreads, but higher for small changes of spreads.[37]

Bai et al. (2012) focus on the contagion channel through correlated country fundamentals, differentiating between domestic and aggregate credit and liquidity shocks for a sample of twelve European countries from 2 January 2006 to 31 May 2012. A stylized rational expectations equilibrium model illustrates how aggregate or country-specific shocks may affect each other through spillovers and feedback effects. Decomposing spreads into a fundamental credit risk and liquidity component, it is argued that the first wave of the sovereign debt crisis (August 2008 to April 2010) was triggered by liquidity (although the liquidity component seems to be negligible before the Lehman crash), while the second wave (May 2010 to May 2012) seems to be driven by fundamental credit risk. Tests for spillovers and feedback loops based on a structural vector autoregression yield four main messages: There were contagion effects based on the fundamental channel in both

[35] The authors look at France, Germany, Greece, Ireland, Italy, Portugal, Spain and the United Kingdom.

[36] Note that the same test with bond yields show that the intensity of the propagation mechanism even decreased from the period 2008 to 2011 relative to the period 2003 to 2006.

[37] In contrast, Kalbaska and Gatkowski (2012) investigate exponentially-weighted-moving-average correlations and Granger causality for nine sovereigns from August 2005 to September 2010. They find an increase in pair-wise correlations and 13 directional pairwise Granger causalities.

directions as domestic credit shocks tend to have significant effects on the aggregated credit shocks in other European countries and vice-versa, foreign credit shocks tend to generate a positive and significant reaction of CDS premia. Secondly, there is a significant contagion effect though the aggregate liquidity channel as domestic liquidity seems to react significantly to foreign liquidity shocks. Thirdly, Domestic liquidity shocks seem to have a significant negative effect on the aggregated liquidity shocks in all other countries, pointing to a flight-to-liquidity phenomenon. Lastly, domestic liquidity shocks seem to have no effect on either domestic or foreign credit risk. Thus, in Bai et al. (2012), contagion arises primarily through the fundamental credit risk channel.

In contrast Darolles et al. (2012) focus purely on a liquidity channel for 18 emerging markets from 1 January 2007 to 25 February 2011. Using the CDS-bond basis as a proxy for (il)liquidity, the authors estimate a state-space model allowing for time-varying asymmetric volatilities and document that the probability of being in a state of high correlations coincides with periods of high market illiquidity. They infer that contagion effects are due to liquidity problems in the sovereign debt market.

Benzoni et al. (2012) suggest a contagion channel through a hidden state of the underlying economy. Uncertainty about the distribution of defaults makes agents overweight bad outcomes. Thus, in response to a negative sovereign credit shock, agents update their beliefs about the posterior probabilities in being in the bad state of the world. This updating of beliefs raises the perceived default intensity of other countries, which generates correlations in credit spreads that are significantly higher than if spreads were functions of the macroeconomic conditions only. In Zhang et al. (2012), spillovers across countries are captured by increasing time-varying conditional default probabilities. They propose a Copula-based framework to estimate daily marginal, joint and conditional risk-neutral default probabilities, allowing for skewed and fat-tailed distributions of spread changes, as well as time-varying volatilities and correlations across countries.[38] The model is calibrated daily to a panel of ten European countries over the period 1 January 2008 to 30 June 2011, using USD denominated daily 5-year CDS spreads. Brutti and Sauré (2012) show how financial shocks to Greece spill over to eleven other European economies. The magnitude of contagion depends on the cross-country bank exposures to sovereign debt. All else being equal, the

[38]More specifically, the model is based on a multivariate mean-variance mixture distribution, where the risk indicators follow jointly a Generalized Hyperbolic skewed t-distribution.

transmission rate to the country with the greatest exposure to Greece (1.22 percent of GDP) has been roughly 46 percent higher than the rate to the country with the least exposure (0.08 percent of GDP).

In parallel to the literature on the relationship between sovereign and bank risk, several papers investigate spillover effects between the sovereign and banking sector. Bruyckere et al. (2013) study contagion/spillovers between sovereign and bank risk for 15 countries and more than 50 banks during 2006 to 2011. They define contagion by the correlation in spreads after having accounted for the influence of economic fundamentals and common exposures. In other words, they look at the correlation in the residuals, which they define as excess correlations. They find statistically significant excess correlations for 86% of the banks in the sample, with an average excess correlation of 17%. In a second step, these excess correlations are used to identify the determinants with respect to bank and country-specific characteristics. The results suggest that excess correlations between banks and their home countries are on average 3.2% higher than the average excess correlation with other countries, which is 15.5%. The results are stronger for GIIPS countries (4.47%). Moreover, excess bank-country correlations are stronger if banks are larger, less-well capitalized banks, if banks rely more on wholesale funding, and if banks have a higher proportion of non-interest income. Furthermore, excess correlations are higher for countries with higher credit risk, but high capital adequacy ratios can reduce this effect. Using the information from the European Banking Authority stress tests, the authors also show that banks which have a one standard deviation higher bond exposure to country A than to country B have an excess correlation with country A which is about 1.5 percentage points higher. Finally, the bank-country contagion seems more pronounced for countries with higher debt-to-GDP ratios, and this effect is largest in magnitude for the home country.[39]

Alter and Beyer (2013) attempt to quantify spill-over effects among sovereigns and banks during the sovereign debt turmoil using daily 5-year bank and sovereign CDS spreads of 11 EU countries from October 2009 to 3 July 2012. They estimate a VAR model augmented with exogenous factors to account for any impact from common and regional factors and use the results from impulse-response functions to construct spill-over indices. Aggregation of spill-over indices over time yields

[39] A one standard deviation increase in the debt-to-GDP ratio increases excess correlations by 1.14 percentage points.

a contagion index, which the authors decompose into four components to capture excess spillover among sovereigns, among banks, from sovereigns to banks and from banks to sovereigns. In sum, the results indicate increased interdependencies between sovereigns and banks during the sovereign debt crisis.

Bai and Wei (2012) study the risk transfer from the sovereign to the corporate rather than the financial sector by focusing on the role of institutions (property rights and creditor/contracting rights) as a channel to influence the strength of the risk transfer. Using CDS spreads for 2,745 corporations in 30 countries from 2 February 2008 to 16 February 2010, the authors find that a 100 bps rise in sovereign CDS spreads leads on average to a 71 bps increase in corporate CDS spreads. This relationship is stronger for state-owned institutions, both financial and non-financial. Regarding the channel, strong property rights tend to weaken the association between sovereign and corporate credit risk (constraints on executives, expropriation risk, rule of law), while the strength of the contracting/creditor institutions (credit right index, contract enforcement days) seems to have no material effect on the relationship between sovereign and corporate CDS. Augustin et al. (2012) use the joint Greek government bail out and the violation of the no-bail out clause in the 1992 Maastricht Treaty as an exogenous event to investigate how a rise in sovereign credit risk affects corporate borrowing costs in Europe. They show that a 1% rise in Greece's credit risk raises corporate borrowing costs of non-Greek companies by 0.18% on average. Cross-sectional evidence suggests that companies with subsidiaries in Greece and those sharing a common currency are affected more strongly by approximately 3 and 4 basis points respectively. In a contemporaneous paper, Bedendo and Colla (2013) provide additional evidence that higher sovereign CDS spreads are associated with higher corporate borrowing costs.

To summarize, the literature on contagion largely differs on how the concept is defined. Accordingly, there is significant heterogeneity in the empirical results. Going forward, it would be fruitful to differentiate explicitly between the various concepts of contagion and to investigate in more detail the precise channels through which spillovers may be transferred.

6 Frictions and the CDS-Bond Relationship

Duffie (1999) illustrates theoretically that the spread on a par floating rate note over a risk-free benchmark should essentially be equal to the CDS spread.[40] As such, the CDS-Bond basis, defined as the difference between the CDS and bond spread, should be zero. However, empirically observed imperfections of this theoretical arbitrage relationship have led researchers to investigate whether the CDS market is more informationally efficient than the cash bond market and whether it reflects new information more quickly, or vice-versa. Alternatively, people have looked at the determinants of the basis, which relates explicitly to limits of arbitrage and frictions in one of the two markets, or both.

6.1 Price Discovery and Informational Efficiency of Sovereign CDS Spreads

Regarding price discovery, there seems to be some consent that the CDS market is more efficient for *corporate* reference entities. For *sovereign* reference entities however, results are very mixed and ambiguous. These discrepancies may be related to the different samples, time periods, sampling frequency and data sources.[41] However, while some conclude in favor of the bond market and others in favor of the CDS market, my interpretation of the literature is that there is increasing price discovery in the credit derivative market as the market has matured.

Arce et al. (2013) make the sensible point that price discovery is state dependent and related to the relative liquidity in both markets. As the CDS market has become more mature over time, this would also explain why its relative informational efficiency has increased. A similar argument is also made in Ammer and Cai (2011), who provide some evidence that the relatively more liquid market tends to lead the other, as their measure of relative CDS price leadership is correlated positively with the ratio of the bond bid-ask spread to the CDS bid-ask spread and negatively with the number of bonds outstanding. Another main take-away is that a positive basis is usually more persistent, due to the difficulty of shorting bonds. Moreover, except for some minor exceptions,

[40] Other references are Lando (2004) and Hull and White (2000a).

[41] Abstracting from technical details, this literature usually adopts the common approach to test whether the two markets are co-integrated, that is whether they are characterized by a long-run stationary relationship, and then to look at short-term deviations from equilibrium to verify which market adapts to the other one. This is executed using the techniques of vector error correction modeling, computing Hasbroucks's and Gonzalo-Granger's information measures, or by analyzing statistical causality using Granger's method.

almost all studies focus exclusively on the most liquid 5-year segment of the market. Without spending too much time on the details, I provide a shopping list of the references in the following paragraph.

Palladini and Portes (2011) study 6 developed economies in Europe from 30 January 2004 through 11 March 2011 using CMA quote data and conclude that CDS spreads lead in the price discovery process.[42] A similar conclusion is drawn by Varga (2009), who takes a special look at Hungary from 6 February 2004 to 18 June 2008 using the CMA database.[43] Using likewise the CMA data, O'Kane (2012) studies cross-correlations and performs Granger causality tests for 6 European economies from 1 January 2008 to 1 September 2011.[44] He finds that for Greece and Spain, Granger causality flows from the CDS to the bond market, while the results is reversed for Italy and France. For Portugal and Ireland, there seems to be two-way causality.

Studying 18 sovereign developed and emerging economies from January 2007 to March 2010, Coudert and Gex (2013) conclude that bonds seem to lead for developed European economies, while the derivative market wins the horse race in emerging economies.[45] The authors also put forth a differential liquidity argument and argue that the role of CDS has intensified during the crisis, as bond market players with a bearish view will simply *stay out* of the markets, while CDS buyers will *stay in* and purchase protection. This contrasts with Arce et al. (2011), who argue that the role of bond markets has increased for European Economies during the financial crisis. They study 11 European economies from January 2004 to September 2010 using CMA data.[46] Fontana and Scheicher (2010) look at 10 Euro area countries from January 2006 to June 2010 using again CMA data[47]. In contrast to most other studies, which use the 5-year spread, the authors study 10-year spreads. In line with the previous mixed results, in half of the sample countries, price discovery takes place in the CDS market and in the other half, price discovery is observed in the

[42] The 6 countries are Austria, Belgium, Greece, Ireland, Italy, and Portugal.

[43] While Varga focuses on Hungary, some additional analysis is also provided for 14 emerging countries from 3 January 2005 to 30 May 2008. These countries are Brazil, Bulgaria, Czech Republic, South Africa, Estonia, Croatia, Poland, Latvia, Lithuania, Russia, Romania, Slovakia, Turkey and Ukraine.

[44] The 6 countries are France, Greece, Italy, Ireland, Portugal and Spain.

[45] See also Coudert and Gex (2010). The sample includes Austria, Belgium, Denmark, Finland, France, Netherlands, Greece, Ireland, Italy, Portugal and Spain for the advanced European countries; Argentina, Brazil, Mexico, Lithuania, Poland, Turkey and Philippines for the emerging countries; in addition the authors study 17 financial companies.

[46] The 11 EMU countries are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Spain.

[47] Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain.

bond market. Further evidence is provided by M. Kabir Hassan and Suk-Yu (2011), who study 7 emerging economies from January 2004 to October 2009 using data from JP Morgan Chase.[48] They find that bond markets lead for Brazil and the Philippines, CDS markets lead for Argentina, and there is no clear dominance for Mexico, China, and South Africa. The additional contribution is to link pricing efficiency to financial integration. It is argued that sovereigns, for which bond markets lead the price discovery process, are more financially integrated with the world economy.

Li and Huang (2011) witness an increasing contribution of sovereign CDS rates to credit risk discovery based on a sample of 22 emerging countries using Thomson Reuters data from 1 January 2004 to 31 July 2008.[49] C. Emre Alper and Gerard (2012), studying CDS premia in relation to asset swap spreads, conclude in favor of price discovery in the derivative market given a sample of 21 advanced economies from January 2008 to January 2011[50]. Their data comes both from Datastream and Markit. Aktug et al. (2012) study 30 emerging markets at a monthly sampling frequency from January 2001 to November 2007 using data from Markit.[51] They show that bond markets lead CDS markets in general, but that they lag CDS spreads in some cases, and that the markets have become more integrated over time. Support for the bond markets is also found in Ammer and Cai (2011). The latter investigate 9 emerging economies from 26 February 2001 to 31 March 2005 using Markit data.[52] Overall, they find that the bond market leads the CDS market more often. In an early paper, Chan-Lau and Kim (2004) have a hard time concluding in favor of any market using CreditTrade data for 8 emerging economies from 19 March 2001 to 29 may 2003.[53] Delis and Mylonidis (2011) look at Greece, Italy, Portugal and Spain using CMA data from 9 July 2004 to 25 May 25 2010. Based on 10-year spreads, they argue that CDS almost uniformly Granger cause bond spreads. Feedback causality is, however, detected during times of intense financial and economic turbulences.

[48]The countries are Argentina, Brazil, China, Colombia, Mexico, Philippines and South Africa.

[49]The sample is composed of Argentina, Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, Indonesia, Israel, Korea, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, South Africa, Turkey, Venezuela.

[50]The 22 countries are Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, the UK and the US.

[51]They study Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech Republic, Dominican Republic, Ecuador, Egypt, El Salvador, Hungary, Korea, Lebanon, Malaysia, Mexico, Morocco, Pakistan, Panama, Peru, Philippines, Poland, Russia, South Africa, Thailand, Turkey, Ukraine, Venezuela and Vietnam.

[52]Brazil, China, Colombia, Mexico, the Philippines, Russia, Turkey, Uruguay, and Venezuela.

[53]The following countries are reviewed: Brazil, Bulgaria, Colombia, Mexico, the Philippines, Russia, Turkey, and Venezuela.

Gündüz and Kaya (2012) focus on the informational efficiency of sovereign spreads directly, rather than on the informational efficiency relative to bonds. They investigate the long-memory properties of spread returns (spread changes) and volatilities (squared spread changes) for 10 European economies from August 2007 to October 2011, using both parametric and non-parametric techniques.[54] The authors find evidence in favor of long memory in spread changes, suggesting that markets are (weak-form) informationally efficient and that information is timely impounded into prices. On the other hand, there is strong evidence in favor of long memory in volatilities for 6 out of 10 countries, suggesting that sovereign default uncertainty is persistent.[55] In addition, there is evidence of Granger causality from volatilities to the levels and changes, suggesting that higher sovereign default uncertainty raises country risk. Finally, additional elements of analysis can be found in In et al. (2007), Boone et al. (2010), Li (2009), Bowe et al. (2009), Carboni (2010) and Adler and Song (2010).

As a conclusion, results are very inconclusive, but differential liquidity seems to matter. Based on this intuition, Calice et al. (2013) investigate liquidity spillovers between the two markets and find substantial variation in the patterns of the transmission effect between maturities and across countries. For several countries, including Greece, Ireland and Portugal the liquidity of the sovereign CDS market has a substantial time varying influence on sovereign bond credit spreads. In et al. (2007) study the volatility transmission among the two markets across emerging economies.

6.2 Liquidity and the Determinants of the CDS-Bond Basis

While the dynamics between the cash and derivative market raise interesting questions, another angle to analyze is the determinants of the short-term deviations from the equilibrium relationship. Differential liquidity may naturally explain the seemingly arbitrage opportunity. Early studies on this topic assumed that the credit derivative market was perfectly liquid, as the underlying traded instruments are by nature simple contractual agreements. This contrasts with the cash market, where hard money is actually exchanged when the asset is purchased. In this spirit, Longstaff et al. (2005) postulated CDS spreads to be pure indicators of default risk in order to infer liquidity

[54]The ten countries are Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain. The non-parametric approach involves log-periodogram regressions, while the parametric approach involves estimating a dual long memory ARFIMA-GARCH model.

[55]The 6 countries are Greece, Italy, Ireland, Portugal, Belgium and Spain.

characteristics of the bond market.[56] Academic work on liquidity effects in the CDS market is very young, even for corporate reference contracts, but the literature is rapidly growing. Two papers that study liquidity characteristics in the synthetic credit derivative market for corporate reference entities are for example Tang and Yan (2007) and Bongaerts et al. (2011). The former show that both liquidity characteristics and liquidity risk explain about 20% of the time series variation in CDS spreads, while the latter provide strong evidence for an expected liquidity premium earned by the protection seller. The premium is however economically small.

For sovereign CDS, Pan and Singleton (2008), who study the term structure of recovery rates of Mexico, Brazil and Turkey, report anecdotal evidence of liquidity effects from discussion with practitioners. Lei and Ap Gwilym (2007) study the determinants of CDS liquidity proxied by bid-ask spreads for a sample of daily CDS spreads from CreditTrade over the sample period 7 July 2003 to 3 March 2005. The subsample of sovereigns represents approximately 10% of the overall sample. The authors find that demand-supply pressure/imbalance, volatility, price clustering and downgrade watch status are associated with higher bid-ask spreads. In addition, wider bid-ask spreads are associated with less popular CDS maturities and weaker credit ratings. Higher notional amounts traded is related to lower bid-ask spreads, and there is evidence of commonality in bid-ask spreads. Bid-ask spreads have also narrowed as their trading has matured. Most importantly, speculative-grade sovereign reference entities have wider bid-ask spreads on average than speculative-grade corporate reference entities, but there seems to be no difference for investment grade issuers. Finally, CDS spreads referencing subordinated debt and contracts defining restructuring as a credit event have larger bid-ask spreads.

Badaoui et al. (2013) use a factor model to decompose sovereign CDS spreads into their default risk component, a country-specific liquidity component, a systematic liquidity component and a correlation component to account for correlated credit and liquidity risk. The authors make the identification assumption that bond and CDS spreads are driven by the same default risk component, but that they may have different country-specific and systematic liquidity components, all of which may be correlated. A daily calibration using both CDS and bond spreads to 9 emerging countries over the period November 2005 to September 2010 yields that the credit risk compo-

[56]The assumption that sovereign CDS spreads are pure indicators of default risk is also made in Bai et al. (2012) and Beber et al. (2009).

nent represents approximately 55.6% of sovereign CDS spreads, the liquidity risk component about 44.32% and correlation risk is small with a fraction of roughly 0.043%. In addition, the results suggest a negative relationship between default and liquidity risk. In Badaoui et al. (2012), the same authors study the dynamic properties of the risk-neutral liquidity risk premium embedded in the term structure of sovereign CDS, using information on the 1, 3 ,5 ,7 and 10-year daily spreads for Brazil, the Philippines and Turkey from September 2005 through September 2010. The results suggest that the term structure of liquidity risk is roughly flat, slightly higher at short and long horizons, with inversions during periods of distress. Also, the average liquidity risk is higher for bonds than for CDS. However, the ratio of the CDS to Bond liquidity increases as the default intensity increases, implying that the surge in liquidity risk is stronger for CDS. The results thus broadly indicate that there is a significant liquidity risk premium in the term structure of CDS, which contributes to the time variation in the term structure.

Regarding the determinants of the CDS-bond basis, a liquidity story is supported by Arce et al. (2011), who show that differential liquidity between the bond and the CDS partially explains the difference. Specifically, differential liquidity is proxied by the ratio of the bid-ask to the mid spread in the CDS market divided by the bid-ask to the mid spread in the bond market. In addition, the authors show evidence for the role of counterparty risk, which is the risk that a CDS counterparty may not be able to honor its obligations from the insurance contract. This risk becomes especially important when the default of the counterparty occurs at the same time as the default event of the underlying reference entity. Arora et al. (2012) show that counterparty risk is significantly priced in the corporate market, but that it is economically small in magnitude. On average, counterparty credit risk needs to increase by 646 basis points to reduce the insurance price by 1 basis point. This small effect is likely the result of collateralization (and maybe overcollateralization) agreements. In a similar spirit, Levy (2009) also links the pricing discrepancies to both counterparty risk and liquidity. Kucuk (2010) finds that the basis is strongly associated with various bond and CDS liquidity variables such as (for bonds and CDS) the average sample bid-ask spread and percentage bid-ask spread, and (for bonds) lagged trading volume, notional amount outstanding, age and time to maturity. Similar to the debate on global versus local factors for sovereign CDS spreads, Fontana and Scheicher (2010) relate the basis mainly to common factors.

Another potential source of friction, which can create a wedge between the CDS and bond spread is the Cheapest-to-Deliver option embedded in CDS contracts. Upon the occurrence of a credit event, the holder of the insurance contract has the right to deliver the cheapest among a set of defaulted debt obligations to his counterparty in return for the insurance settlement. This option makes the contract riskier from the perspective of the CDS seller, and should be relatively more important, the closer a country is to default. Ammer and Cai (2011) provide a treatment of the sovereign case, while Jankowitsch et al. (2008) provide positive evidence for corporate CDS. For sovereigns, some early analysis is also available in Singh (2003).

Fisher (2010) studies theoretically how heterogeneous investors with different beliefs about the probability of default of a sovereign borrower affect the sovereign CDS-Bond basis. The results of the model depend on the assumption that a fixed proportion of investors are unable to sell CDS. The latter constraint becomes binding in bad times, when a relatively bigger proportion of investors is pessimistic and wants to sell off credit risk (buying CDS). But as the supply is limited, this constraint creates a wedge between the bond and CDS prices and induces a positive basis. Thus, the time-varying equilibrium basis depends on the time-varying proportion of pessimistic investors. A second mechanism that induces the (positive basis) in his model is the prospect of lending fees from the bonds in bad times. As supply in the CDS market is restricted, some pessimistic investors who want to take a short position in sovereign credit risk need to short-sell the physical bond. This allows those who hold on to the bond to charge higher fees by lending it out to short-sellers. This fee raises bond prices, lowers spreads, and creates a positive basis.

Finally, Adler and Song (2010) provide evidence that short-selling costs were partly responsible for persisting positive bases for sovereign reference entities. In addition, the authors provide a more general theoretical pricing framework for the basis, which corrects for biases arising from accrued spread or coupon payments and bond prices away from their par value.[57] In fact, the model illustrates how accrued payments and bond prices below (above) par may mechanically introduce a negative and positive (negative) basis respectively. It is exactly this latter effect, which may explain the well documented basis smile. The average credit quality of a portfolio of bonds depends on the statistical distribution of historical rating transitions. Hence, the joint consideration of price and

[57] The pricing framework considered in Adler and Song (2010) is a useful extension to the treatment in Duffie (1999).

credit quality will determine the shape of the basis smile, which could very well be a “frown”.

6.3 The Impact of Sovereign CDS on Public Bonds

During the European debt crisis, speculation in the sovereign CDS market was blamed as a cause of derailing public borrowing costs. As a consequence, BaFin, the German financial regulator, went ahead with an outright ban on naked sovereign CDS in May 2010, despite an official report by the European Commission failing to provide conclusive evidence (See Criado et al. 2010.). The European Union followed Germany by restricting the use of sovereign credit insurance to investors seeking to hedge long positions in November 2012.[58]

Academic opinions don't seem to agree on this idea. Richard Portes (see Portes 2010) advocates a ban, arguing that naked CDS buying (equivalent to shorting the bond) artificially drives up prices, thereby increasing a country's borrowing costs. The argument is largely based on the fact that sovereign CDS spreads incorporate information more quickly than bond spreads, and that there is a statistical information flow from the derivative to the cash market. Darrell Duffie (Duffie April 29 2010a, Duffie 2010b), on the other hand, argues that a ban on naked sovereign CDS trading may instead increase execution costs and lower the quality of price information. In contrast, he argues that holders of both the derivative and the underlying cash bond have in fact no more incentive to monitor the borrower, which may induce the borrower to invest less efficiently and thus increases the probability of default. Goderis and Wagner (2011) argue theoretically that without insurance, the sovereign country has no incentive to optimally invest (or exert effort) as there is the possibility of offering a debt restructuring in the bad states of the world, which the lender cannot credibly commit to reject. When the lender can purchase insurance on the bond, the threat of rejecting the restructuring offer becomes credible and the debtor will have to internalize more of the costs in the bad states. This provides incentive to invest more efficiently ex-ante, which in turn reduces default. Strategic purchase by a (single) bondholder to increase the bargaining power in debt renegotiation deal is thus beneficial from an ex-ante perspective. However, in the presence of many bondholders, there may be coordination failures. This may lead to a situation, where lenders buy more insurance than is socially optimal, which leads to an increased probability of default.[59]

[58] See http://ec.europa.eu/internal_market/securities/short_selling_en.html.

[59] Bolton and Oehmke (2011) study this so called “empty creditor” problem theoretically for *corporate* CDS, while

Sambalaibat (2011) studies the issue of naked CDS theoretically and shows that the effect depends on the infrastructure of the insurance market. The overall outcome depends on the parameter values, and naked CDS buyers may either induce over-investment, leading to lower borrowing costs or to under-investment with higher borrowing costs. For a legal treatment of how credit derivatives may affect the sovereign debt restructuring process, see Verdier (2004). Ismailescu and Phillips (2011) investigate whether the existence or initiation of sovereign CDS has any adverse impact on sovereign bonds.[60] The authors characterize sovereign CDS as efficient monitoring tools which can reduce the adverse selection costs for informationally opaque countries. Moreover, they allow for greater risk-sharing among high-default countries and therefore encourage market participation. Their results indicate that CDS initiation makes public bond markets more complete, that price efficiency of sovereign bonds increases post CDS initiation (although this seems to be restricted to high default risk and low financial market openness countries). Finally, CDS initiation reduces the borrowing costs for investment grade countries, with an average reduction in borrowing costs of 15-26% or 13 bps, but in increases the borrowing costs of high default risk and low financial market openness countries of about 3 to 5% or roughly 14 basis points.[61]

To summarize, the theoretical and empirical evidence makes it difficult to draw any conclusion in favor or against the argument that rising CDS spreads caused public borrowing costs to rise during the sovereign debt crisis. Sustaining the argument in favor based on price information only, without having insight into trading positions in relation to actual public exposures, is, in my point of view, hard to justify. In addition, recent evidence of trading information relative to the size of the public debt market is rather small. I will review these numbers in the following section. However, even if one believes that price discovery in the CDS market with information flow from the derivative to the cash market is evidence in favor of price speculation driving up public borrowing costs, regulators should keep in mind that empirical results are largely ambiguous when making drastic

Subrahmanyam et al. (2012) provide empirical evidence. The concept of empty creditor refers to the separation of cash flow and voting rights through the use of credit derivatives. A debt holder, whose exposure is insured with a CDS, keeps an economic interest in the firm's claims, but has no more risk alignment with other bondholders, who enjoy no such protection.

[60] The authors study 54 emerging and developed countries over the sample period 1 January 2000 to 27 February 2009.

[61] The authors also find that CDS initiation is positively predicted by higher financial market uncertainty (local stock market volatility) and the ability of a country to service its debt (foreign currency reserves and exchange rates relative to the USD).

regulatory changes that may ultimately negatively affect the efficient information transmission in financial markets.

7 Trading in the Sovereign CDS Market

Very little is known about the trading patterns in the sovereign CDS market. Based on a three-month sample of detailed transaction-level data over the time period May 1 to July 31 2010 generously received from a set of dealers, the Federal Reserve Bank of New York spoiled us a with a more detailed picture of the CDS trading behavior in their staff report No. 517.[62] Keeping in mind the caveat that the data set stems from a period, where overall trading activity was below historical average, the results indicate that CDS trade not that often despite their highly standardized nature. For the 29,146 single name sovereign CDS transactions recorded for 74 reference entities, the most actively traded reference entities traded on average 30 times per day, the less frequently traded 15 times per day on average and the infrequently traded reference entities traded only 2 times per day on average. Another way to say this, is that *a long tail* of reference entities trade less than once a day. In terms of size, the USD denominated trades were mostly traded in 5 million USD tickets, with a median and mean trade of 10 and 16.74 million USD respectively. For EUR denominated trades (which amounted to only 574 transactions), the mode was 10 million USD, with a median trade of 5 million and a mean trade of 12.53 million. For matters of comparison, sovereign single name CDS trades were on average twice as large as their corporate counterparts.

Although the number of trades seems rather low, market participation for sovereign reference entities was rather active. On average, 50 market participants are reported to have traded at least once a day, 200 traded at least once a week and 340 traded at least once a month. In addition, dealers were more likely to be sellers of protection and the four most active dealers were involved in 45% of the buying and selling of all CDS trades and in 50% of the overall notional amount. Yet, according to regulatory definitions of the Department of Justice, the Herfindahl Hirshman concentration index with levels ranging between 885 and 965 is considered to be low.[63] Finally, the

[62]See Chen et al. (2011).

[63]Note that Giglio (2011) emphasizes the high concentration of the CDS market, thereby referring to industry reports, which state that in 2006, the top 10 counterparties (all broker/dealers) accounted for about 89% of the total protection sold. See footnote 8.

market is confirmed to be highly standardized, as 92% of all single-name CDS contracts within the sample had a fixed coupon and 97% had fixed quarterly payment dates.

Using transactions and quote data from CreditTrade on 77 sovereign reference entities from January 1997 to June 2003, Packer and Suthiphongchai (2003) emphasized the low trading volume by indicating that (in 2002), only 6% of all quotes resulted in transactions, with a strong concentration in a few reference entities. The top five names accounted for more than 40% of all quotes. These countries were Brazil, Mexico, Japan, the Philippines and South Africa. Lei and Ap Gwilym (2007) provide descriptive statistics on the characteristics and evolution of credit default swap trading for a sample of American (North America and Latin America) quotes and trades, provided by CreditTrade, from 10th June 1997 to 3rd March 2005. Roughly 12% of the sample is made up by sovereign quotes and trades, the majority of which (85.2%) comes from Brazil, Mexico, Columbia and Venezuela. The dominating currency denomination is USD (99%), 98.32% of the sample references senior unsecured debt and 90.36% of the sample uses the Modified Restructuring clause.[64] There has been a shift in the most commonly traded/quoted notional amounts, going from 10 million USD before 2002 to 5 million USD thereafter. This change is likely due to the development of the CDS index market. 5-year maturities are the most heavily quoted (83%). In addition, the average number of reference entities quoted/traded has steadily increased over time, with an average number of 56 per day in 2005. Also note that in every year, the minimum amount of reference entities traded/quoted is 1 (except in 2005 it is 4). The number of quotes to trades is substantial, but decreasing over time. Finally, the total number of quotes and trades exhibits an inverse U-shape pattern during the week, peaking on Wednesdays.

Another more exhaustive source of information on CDS trading behavior is the Depository Trust and Clearing Corporation (DTCC). In October 2008, the DTCC Trade Information Warehouse started to publish detailed weekly reports on stocks and volumes in CDS trading. More specifically, current and historical positions are shown on an aggregate level and for the 1,000 mostly traded reference contracts. This move towards higher transparency is greatly welcome. Oehmke and Zawadowski (2011) use this data to study the determinants of corporate trading and find that higher amounts of (corporate) CDS outstanding are associated with companies, which have more

[64] Note that this is prior to the Big Bang protocol.

assets on their balance sheet, more bonds outstanding, that are investment grade firms or firms that have just recently lost their investment grade status, as well as with higher analysts' forecast dispersion. Duffie (April 29 2010a) illustrates a few statistics on sovereign CDS from this database in his testimony to the United House of Representatives. Berg and Streitz (2012) use the data on sovereign reference entities for 57 countries over the sample period October 2008 to July 2010 to show that higher ratios of net notional amounts outstanding normalized by total debt (size) are associated with smaller countries and for countries with a credit rating just above the investment grade cut-off, while larger countries and those with a speculative grade rating are associated with higher levels of turnover normalized by net notional amounts outstanding (turnover). In addition, only negative rating changes and negative rating watches are associated with increases in turnover, but not with size. As there is still little evidence on the information made available by the DTCC, I provide below a summarized overview of the main statistical facts for government credit derivatives.

Table 4 illustrates the average gross and net notional amounts outstanding in (million) USD equivalents on all sovereign CDS contracts (excluding sovereign states in the US) among the 1,000 mostly traded contracts over the time period 31 October 2008 through 12 April 2013. In addition, there is information on the average number of contracts over that period, the ratios of gross to net notional amount outstanding and the net notional amount outstanding to the number of contracts. The countries are classified into five geographical regions following the practice of Markit: Americas, Asia Ex-Japan, Australia and New Zealand, Europe-Middle East-Africa (EMEA) and Japan. While the weekly total gross notional volume recorded for sovereign countries in the data repository is approximately 2.3 trillion USD, the net exposure, which accounts for offsetting effects between buyers and sellers and represents therefore a more economically meaningful measure, reflects with 213.5 billion USD about 9.23% of that amount. Keeping in mind that this number does not report the values for sovereign US states and other non-government supranational bodies, this amount represents approximately 81% of the sovereign single name CDS outstanding as reported by BIS in the first semester of 2012 (see Table 1).

The total number over all country-specific averages of traded contracts is 165,089, the mean ratio of gross to net notional amount is 11.70 and on average, the net credit exposure per contract is 1.8 million USD. There is however a significant cross-sectional dispersion. Further analysis also reveals that three of the five GIIPS countries rank among the top ten countries with the highest amount of net notional exposure. Another striking feature we observe is that emerging economies tend to have higher numbers of traded contracts, but smaller net exposures per contract on average, while developed economies trade in bigger bulks, but have fewer contracts outstanding. The world's two biggest reference bond markets, the US and Germany, top the list with 5.42 and 6.34 million USD per contract respectively. At the bottom of the list are the Philippines and Ukraine with an average of 390,000 and 380,000 USD per traded contract. Moreover, the top ten list of countries with the highest amount of gross volume outstanding is dominated by emerging market economies, while developed distressed economies cluster in the top ten list with the highest net notional exposure.[65]

Columns 8 and 9 in Table 4 indicate the gross amount of public debt in billion USD and the debt-to-GDP ratios from the World Economic Outlook Database. An interesting fact is that the net notional amount outstanding relative to gross public debt is on average only 2.2%, with a median value of 1.3%. In particular Estonia and Bulgaria skew the statistics with values of 23.3, 11.4 and 6.5%. In other words, the net economic exposure of traded insurance contracts relative to public debt is for many countries below 2%. Figure 3 provides some more intuition about how the CDS trading is related to individual governments' debt levels. There seems to be a statistically significant relationship between the net notional amount of CDS outstanding and the gross amount of government debt.[66] This relationship appears much weaker if debt levels are compared against gross exposures and the number of contracts outstanding. Duffie (April 29 2010a, 2010b) shows empirical evidence that the volume of CDS is unrelated to the level of spreads, which is confirmed in Figure 3c.[67] This raises once more interesting questions. We have seen that spreads are mostly related to global risk factors and the health of the domestic financial sector, but less to individual government characteristics. On the other hand, government characteristics seem somewhat associated with volumes.

[65] Additional (unreported) statistics at a yearly frequency show that average weekly gross and net volumes, as well as ratios of gross to net exposure have increased only modestly over time, with the ratio of gross to net exposure being roughly equal to a factor of 11. The average number of contracts reported in the warehouse has changed slightly more over time, which explains the bigger fluctuations in the net notional exposure per contract, which has come down from 3.6 million USD in 2008 to a mean 1.22 million in 2012. These tables are available from the author upon request.

[66] The relationship between sovereign CDS trading and the level of GDP is very similar. These results are available from the author upon request.

[67] The relationship is likewise similar if I do the comparison with GDP.

Table 5 separately reports statistics for the United States government and the sovereign US states, which are registered in the DTCC database. In contrast to the statistics on other sovereign governments, all yearly average values for CDS on US Treasuries exhibit a sharp increase in 2011 and have remained elevated ever since. In fact, the mean gross notional amount jumps by 94% from 2010 to 2011, going from 13.2 to 25.6 billion USD. That's a huge surge. The same observation holds for net exposure, which rises by 84% over the same time period, going from 2.4 to 4.6 billion USD, while the number of live contracts increases from 479 million to approximately 1.1 billion contracts, which corresponds to an increase of roughly 133%. These spikes raise the provoking thought that investors may actually have seriously considered the possibility of US government default during the lock-out period in summer 2011. In particular, as no such sharp changes are recorded for the individual states. The evidence is mixed. Gross exposures and number of traded contracts unilaterally increased, while net notional exposure increased mainly for Illinois in 2011, while it dropped for instance for New York City, Texas or Florida.

8 Conclusion

Sovereign credit risk is undoubtedly a topic of crucial importance. The supranational bailouts of Greece, Ireland, Portugal and the vast amount of European Union summits ever since the start of the sovereign debt crisis eliminate any doubt about the relevance of this topic.[68] As we speak, trying to avoid information on sovereign debt issues is like walking through a mine field in North Korea.

This paper reviews the young, but steadily growing literature on sovereign CDS. In addition, it highlights some key debates and discusses controversial statements about the economics of sovereign CDS in relation to basic statistics from the Bank for International Settlements and the Trade Information Warehouse from the Depository Trust and Clearing Corporation. Hopefully, the manuscript raises some thought-provoking questions with useful insights for academics, policymakers and practitioners alike. I had fun writing this document, I hope you enjoyed reading it.

[68] I stopped counting at 16.

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A What Are Credit Default Swaps

Engineered in the early nineties by JP Morgan to meet the growing demand to slice and dice credit risk[69], credit default swaps represent the most simple ("vanilla") instrument among the class of credit derivatives. Nevertheless, they remain till this date highly controversial. While the proponents would defend them as efficient vehicles to transfer and manage credit risk as well as means to widen the investment opportunity set of return chasers, opponents denounce them as weapons of mass destruction, time bombs[70], financial hydrogen bombs[71] or speculative bets on government default. For the sake of this review, let us stick to the factual definition of what they really are: insurance contracts offering protection against the default of a referenced sovereign government or corporation.

Technically speaking, a credit default swap is a fixed income derivative instrument, which allows a protection buyer to purchase insurance against a contingent credit event on an underlying reference entity by paying an annuity premium to the protection seller, generally referred to as the Credit Default Swap spread. The premium is usually defined as a percentage on the notional amount insured and can be paid in quarterly or bi-annual installments. Readers not familiar with this particular notion of insurance should simply bear in mind the example of car insurance. But whereas for car insurance, the contract would be written on a specific vehicle, credit insurance could be contracted on a given brand, think of a Volkswagen for the sake of the argument. Thus, any Volkswagen involved in an accident would trigger a payout to the holder of the contract. In the language of credit derivatives, you would purchase a CDS on a company, the reference entity, and if that company fails to meet its obligations for any of a predetermined set of its debt obligations, the payout would occur. More specifically, the contract comprises usually a specific class of the firm's capital structure, such as the senior unsecured or the junior debt portion of the company, and references a particular amount of insured debt, the notional amount.

Failure to meet the debt obligations is labeled a credit event. Hence, a credit event triggers a payment by the protection seller to the insuree equal to the difference between the notional principal and the loss upon default of the underlying reference obligation, also called the mid-market value. In general, the occurrence of a credit event must be documented by public notice and notified to the investor by the protection buyer. Amid the class of qualifying credit events are Bankruptcy, Failure to pay, Obligation default or acceleration, Repudiation or moratorium (for sovereign entities) and Restructuring, and represent thus a broader definition of distress than the more general form of Chapter 7 or Chapter 11 bankruptcy.

The settlement of insurance contracts comes in two forms, it may be either physically or cash

[69] The exact year of creation is not clear. Tett (2009) refers to the first CDS in 1994, when J.P. Morgan off-loaded its credit risk exposure on Exxon by paying a fee to the European Bank for Reconstruction and Development. More importantly for this review, the author also references a deal between J.P. Morgan and Citibank asset management on the credit risk of Belgian, Italian and Swedish government bonds around the same time (p.48).

[70] See Warren Buffett, Berkshire Hathaway Annual Report for 2002, p.13, on line at http://www.berkshirehathaway.com/2002ar/2002ar.pdf

[71] Felix Rohatyn, a Wall Street banker employed at Lazard Frères, quoted in Tett (2009).

settled. In case of a cash settlement, the monetary exchange involves only the actual incurred losses and the claimant holds on to the physical piece of paper providing him with a claim on the capital structure of the sovereign balance sheet. On the other hand, if there is a physical settlement, the claimant may hand any reference obligation referenced in the contractual agreement to the insurer and obtains the full notional amount of the underlying contract in return. The insurer can then try to maximize its resale value in the secondary market. This implies that the claimant literally holds a Cheapest-to-Deliver option, as he may deliver the least valuable eligible reference obligation.[72] This option is particularly relevant in the case of a corporate restructuring, which is why the restructuring credit event is the most critical. As a consequence, it has been adapted numerous times and comes in multiple colors and associated contractual clauses. In particular, apart from Full Restructuring, which allows the delivery of any obligation with a remaining maturity up to 30 years, a contract may simply omit this definition, in which case it is labeled No Restructuring, or it may qualify as Modified Restructuring or even Modified Modified Restructuring. The former definition is more prevalent in the U.S. and limits the remaining maturity of the deliverable reference obligation to a maximum of 30 months, whereas the latter is predominant in Europe, but restricts the maximum maturity to 60 months. Even after default, prices of bonds usually suffer from wide market fluctuations, so the question remains as to how the precise value of the insurance settlement is determined. Markets have converged to a practice where the mid-market value is obtained through a dealer poll. Whether this pricing mechanism is efficient, remains unclear. Three recent papers have taken a closer look at this issue for corporate CDS: Helwege et al. (2009), Chernov et al. (2011) and Gupta and Sundaram (2012).

Credit default swaps are part of the over-the-counter market (OTC). Thus they are not trading on an organized exchange and remain to a large extent unregulated. The reason for this is a provision inserted in 2000 in the Commodity Futures Modernization Act by Senator Phil Gramm, who from 1995 to 2000 presided over the Senate Banking Committee, exempting CDS from regulation by the Commodity Futures Trading Commission (CFTC).[73] Nevertheless, guidance on the legal and institutional details of CDS contracts is given by the International Swaps and Derivatives Association (ISDA).[74] They also act as a non-voting secretary for the Credit Determination Committee, which deliberates over issues involving Reference Entities traded under Transaction Types that relate to the relevant region, including Credit Events, CDS Auctions, Succession Events and other issues. Moreover, ISDA has played a significant role in the growth of the CDS market by providing a standardized contract in the 1998 ("the ISDA Master Agreement"), which was updated in 2002, and supplemented with the 2003 Credit Derivatives Definitions ("The Definitions") and the July 2009 Supplement. The contractual details of these contracts are crucial, and as usual, the devil lies in the details, as was recently proved in the restructuring case of Greek government

[72]See Ammer and Cai (2011) for evidence on sovereign CDS and Jankowitsch et al. (2008) for evidence on corporate CDS. Ammer and Cai (2011) also study the short-run dynamics between sovereign CDS spreads and their cash counterparts, in a similar fashion as Blanco et al. (2005) did for the corporate market.

[73]See Nouriel Roubini and Stephen Mihm, Crisis Economics, pp.199.

[74]See www.isda.org.

debt. European officials have heavily pushed towards a voluntary restructuring, which would not be binding on all bondholders. In such a case, it would not be be likely that the agreed deal would trigger payments under existing CDS contracts.[75] The landscape for CDS has further altered with the implementation of the CDS Big Bang and Small Bang protocols on 8 April and 20 June 2009 for the American and European CDS markets respectively. The biggest changes relate to the standardization of the coupon structure and the settlement process. Going forward, the Dodd-Frank Act in the U.S. will likewise have a significant impact on the way these products are traded. The Inter-continental Exchange (ICE), a subsidiary of the NYSE, is already recording growing market share in the clearing process and both academic and political voices call for a move towards organized exchanges, more transparency and more orderly price dissemination.[76]

[75]See Greek Sovereign Debt Q&A, October 31 2011, www.isda.org

[76]Another growing clearing platform for CDS is provided by the CME.

Table 1: Sovereign Credit Default Swaps: Notional Amount outstanding, Market Values and Credit Exposures ('000,000,000)

This table reports the total gross notional amount outstanding, gross market values and gross credit exposures in billion USD of all OTC derivatives and the respective market shares in %. Panel A reports statistics for all OTC derivatives, all credit derivatives (and their market share in % of all OTC derivatives), and the breakdown of credit derivatives into single-name and multi-name instruments (and their market share in % of all credit derivatives). Panel B reports statistics for sovereign credit derivatives. Panel C shows the counterparties of sovereign single-name credit default swaps, and Panel D displays the location of counterparty for all OTC credit derivatives. Panel E documents the total notional amount outstanding for all OTC credit derivatives by remaining time to maturity and their respective market shares. The remaining contract maturity is determined by the dfference between the reporting date and the expiry date of the contract and not by the date of execution of the deal. Data on total notional amount outstanding are shown on a net basis, that is transactions between reporting dealers are reported only once. Source: www.bis.org.

Panel A: OTC Derivatives - Notional Amount outstanding, Market Values and Credit Exposures ('000,000,000)

Period	**All OTC**	**Gross MV**	**Credit Derivatives** (%)	**Gross MV**	**Gross CE**	**Single Name** (%)	**SN Gross MV**	**Multi-Name** (%)	**MN Gross MV**
2004-H2	258 628	9 405	6 396 (2.47)	133	-	5 117 (80.00)	112	1 279 (20.00)	22
2007-H2	585 932	15 803	58 244 (9.94)	2 020	-	32 486 (55.78)	1 158	25 757 (44.22)	862
2011-H1	706 884	19 518	32 409 (4.58)	1 345	375	18 105 (55.86)	854	14 305 (44.14)	490
2011-H2	647 777	27 278	28 626 (4.42)	1 586	417	16 865 (58.91)	958	11 761 (41.09)	628
2012-H1	638 928	25 392	26 931 (4.21)	1 187	310	15 566 (57.80)	715	11 364 (42.20)	472

Panel B: Sovereign Credit Derivatives - Notional Amount outstanding ('000,000,000)

Period	**Credit Derivatives** (%)	**Sov. All** (%)	**Sov. Single Name** (%)	**Sov. Multi-Name** (%)
2011-H1	32 409 (4.58)	2 908 (8.97)	2 749 (8.48)	159 (0.49)
2011-H2	28 626 (4.42)	3 039 (10.62)	2 928 (10.23)	111 (0.39)
2012-H1	26 931 (4.21)	2 986 (11.09)	2 848 (10.58)	138 (0.51)

Panel C: Credit Derivatives - Maturity Structure ('000,000,000)

Period	**Total**	**1y or less** (%)	**Over 1y up to 5y** (%)	**Over 5 years** (%)
2004-H2	6 395.744	491.270 (7.68)	4 659.521 (72.85)	1 243.778 (19.45)
2009-H2	32 692.683	3 432.429 (10.50)	21 307.787 (65.18)	7 952.441 (24.32)
2012-H1	26 930.572	5 614.808 (20.85)	18 248.184 (67.76)	3 067.609 (11.39)

Panel D: CounterParties of Single-Name Sovereign Credit Default Swaps - ('000,000,000)

	2010-H1	**2011-H1**	**2012-H1**
All Counterparties	2 393.580	2 749.259	2 848.232
Reporting Dealers	1 320.039	1 836.889	2 026.031
(Fraction)	(55.17)	(66.81)	(71.13)
Other Financial Institutions	1 017.122	891.483	801.572
(Fraction)	(42.51)	(32.43)	(28.14)
Central Counterparties	-	2.075	116.420
Banks and Security Firms	828.023	592.194	378.090
Insurance & Fin. Guaranty Firms	8.858	14.688	14.399
SPVs	7.905	18.106	11.487
Hedge Funds	88.519	145.178	154.013
Other Financial Customers	83.817	119.241	127.161
Non-Financial Institutions	55.429	20.885	20.629
(Fraction)	(2.32)	(0.76)	(0.72)

Panel E: Credit Derivatives - Location of CounterParty ('000,000,000)

Period	**Total**	**Home Country** (%)	**Abroad** (%)
2011-H1	32 409.444	5 928.421 (18.30)	26 481.023 (81.71)
2011-H2	28 626.407	5 540.312 (19.35)	23 086.095 (80.65)
2012-H1	26 930.572	5 358.831 (19.90)	21 571.741 (80.10)

Table 2: Summary Statistics

The table reports summary statistics for the CDS term structure of 38 sovereign countries over the sample period May 9th, 2003 until August 19th, 2010. All CDS prices are mid composite quotes and USD denominated. Rating classification is achieved by assigning an integer value ranging from 1 (AAA) to 21 (C) at each date to each country. The equally weighted historical average is then rounded to the nearest integer, which is used as the final rating categorization. The Mean (Median) spread is calculated as the historical mean (median) spread, where at each date, all observations within a given rating category are aggregated by taking the mean. Similarly, the standard deviation is calculated as the standard deviation of the data series aggregated at each date within a given rating category. AC1 is the first-order autocorrelation coefficient. Source: Markit

AAA	1	2	3	5	7	10	**AA**	1	2	3	5	7	10
Mean	15	17	19	23	24	26	**Mean**	24	27	31	38	41	45
Median	2	2	3	4	5	7	**Median**	3	4	5	8	12	16
Minimum	0	0	1	1	2	2	**Minimum**	0	1	1	2	2	3
Maximum	304	301	293	274	270	266	**Maximum**	557	536	499	461	433	410
Volatility	26	28	30	34	34	33	**Volatility**	36	38	40	44	44	43
Skewness	2	2	2	2	2	2	**Skewness**	2	2	2	2	2	2
Kurtosis	6	6	5	5	4	4	**Kurtosis**	6	6	5	5	4	4
AC1	0.9940	0.9949	0.9970	0.9975	0.9975	0.9974	**AC1**	0.9969	0.9972	0.9975	0.9978	0.9978	0.9977
A	1	2	3	5	7	10	**BBB**	1	2	3	5	7	10
Mean	49	55	61	71	76	81	**Mean**	77	95	109	132	143	155
Median	12	18	24	34	41	49	**Median**	33	54	74	106	123	139
Minimum	1	2	3	5	5	6	**Minimum**	3	3	5	8	11	14
Maximum	1235	1172	1127	1015	952	893	**Maximum**	1190	1100	1110	1106	1096	1081
Volatility	69	72	74	77	75	73	**Volatility**	105	106	105	103	99	96
Skewness	2	2	2	2	2	2	**Skewness**	3	2	2	2	2	2
Kurtosis	6	5	5	5	5	5	**Kurtosis**	9	8	7	7	6	6
AC1	0.9967	0.9970	0.9971	0.9974	0.9973	0.9972	**AC1**	0.9976	0.9974	0.9970	0.9967	0.9966	0.9964
BB	1	2	3	5	7	10	**B**	1	2	3	5	7	10
Mean	110	157	196	255	281	305	**Mean**	433	484	517	564	574	599
Median	78	115	146	197	225	250	**Median**	328	403	455	517	538	562
Minimum	15	7	1	1	74	72	**Minimum**	19	34	55	117	140	186
Maximum	822	845	903	1032	1036	1039	**Maximum**	3654	3504	3400	3234	3111	3053
Volatility	92	111	125	138	138	138	**Volatility**	371	362	350	328	303	286
Skewness	2	1	1	1	1	1	**Skewness**	2	2	2	2	2	2
Kurtosis	7	4	3	3	3	3	**Kurtosis**	7	6	6	6	7	6
AC1	0.9979	0.9977	0.9976	0.9974	0.9972	0.9971	**AC1**	0.9901	0.9916	0.9926	0.9927	0.9889	0.9928

Table 3: Slope of the CDS Spread Curve

Summary statistics by groups of the 5-year spread level. For each group and maturity, the average spread level and slope has been calculated across time and entities. The groups are sorted according to the 5-year spread level. Source: Markit

		Average CDS premium (bps)						Average Slope (bps)				
	Group	1y	2y	3y	5y	7y	10y	10y-1y	3y-1y	10y-3y	#curves	#entities
2	(101-200 bps)	66	88	107	143	160	177	111	41	69	14 012	35
3	(201-300 bps)	139	172	201	245	263	279	141	62	79	5 995	34
4	(301-400 bps)	209	256	295	347	367	386	176	86	91	3 711	27
5	(401-500 bps)	273	334	383	447	468	490	217	111	106	2 444	24
6	(501-600 bps)	362	433	484	542	557	572	210	122	88	1 137	21
7	(601-700 bps)	503	567	603	642	633	661	158	100	58	645	17
8	(701-800 bps)	617	693	725	745	713	741	125	108	16	346	10
9	(801-900 bps)	622	759	812	850	846	840	218	189	29	230	8
10	(901-1000 bps)	724	845	894	940	932	919	195	170	25	148	6
11	(1001-1100 bps)	1 008	1 051	1 052	1 043	1 002	964	-44	44	-87	96	4
12	(1101-1200 bps)	1 075	1 142	1 149	1 145	1 095	1 052	-23	74	-98	70	2
13	(1201-1300 bps)	1 207	1 256	1 257	1 251	1 195	1 148	-60	50	-109	48	1
14	(1301-1400 bps)	1 347	1 382	1 376	1 363	1 309	1 260	-87	29	-116	33	1
15	(1401-1500 bps)	1 357	1 410	1 425	1 444	1 395	1 349	-8	67	-75	69	1
16	(1501-3234 bps)	2 369	2 362	2 334	2 281	2 213	2 146	-223	-35	-188	155	1

Table 4: Trade Information Warehouse Data

This table reports the average gross (Column 3) and net (Column 4) notional amount (in million USD) on CDS contracts outstanding in USD equivalents of the sovereign reference entities among the 1,000 mostly traded contracts over the time period 31 October 2008 through 12 April 2013. All numbers are reported in million USD. Column 5 indicates the average number of contracts live in the Depository Trust & Clearing Corporation's (DTCC) Trade Information Warehouse (Warehouse) over the same time period. Column 6 reports the ratio of gross to net notional amount outstanding and column 7 is the average ratio of net notional amount outstanding to number of contracts outstanding. The notional values are represented as US dollar equivalents using the prevailing foreign exchange rates. Columns 8 and 9 report the gross amount of public debt in billion USD and the debt-to-DGP ratio as of 2012, taken from the World Economic Outlook database in Datastream Thomson Reuters. The final row labeled *Total* reports the sum over all rows for column 3, 4 and 5, and the average for columns 6 and 7. The values are reported in descending order according to the net notional amount outstanding. The countries are grouped in five regions: Americas, Asia ex-Japan, Australia and New Zealand, Europe/Middle East and Africa (EMEA) and Japan. Source: www.dtcc.com.

(1) Country	(2) DC Region	(3) Gross Notional	(4) Net Notional	(5) # Contracts	(6) Gross/Net	(7) Net/Contract	(8) Debt	(9) Debt/GDP
Italy	EMEA	270 981	22 519	7 785	12.17	3.41	2 502	1.26
Germany	EMEA	91 108	15 141	3 026	5.88	6.34	2 796	0.83
France	EMEA	93 262	15 043	4 114	5.99	4.92	2 322	0.90
Brazil	Americas	152 475	14 793	10 759	10.56	1.38	1 554	0.64
Spain	EMEA	135 864	14 449	5 854	9.49	3.13	1 216	0.91
UK	EMEA	50 369	8 535	3 250	6.06	3.00	2 158	0.89
Mexico	Americas	109 732	7 411	8 792	14.97	0.84	501	0.43
Greece	EMEA	66 710	6 537	3 375	11.63	2.68	435	1.71
Austria	EMEA	45 893	6 510	1 992	7.49	3.65	291	0.74
Japan	Japan	44 079	6 434	4 216	6.49	2.12	14 157	2.37
Portugal	EMEA	59 996	6 331	3 081	10.14	2.68	251	1.19
Turkey	EMEA	149 734	5 938	9 921	25.72	0.61	295	0.38
China	Asia Ex-Jp.	44 703	5 497	4 715	9.12	1.13	1 828	0.22
Belgium	EMEA	42 209	5 352	2 126	8.16	3.61	472	0.99
Russia	EMEA	106 661	4 816	7 950	22.90	0.62	215	0.11
Korea	Asia Ex-Jp.	63 559	4 711	6 860	13.95	0.69	385	0.33
Ireland	EMEA	38 218	4 178	2 222	9.87	2.59	241	1.18
United States	Americas	17 580	3 272	756	5.24	5.42	16 777	1.07
Hungary	EMEA	59 220	3 190	5 200	21.21	0.68	95	0.74
Australia	Australia NZ	19 089	3 020	1 898	6.27	1.77	417	0.27
Netherlands	EMEA	20 193	2 977	1 018	6.60	3.87	525	0.68
Sweden	EMEA	17 089	2 738	939	6.57	3.39	193	0.37
Philippines	Asia Ex-Jp.	59 082	2 588	6 853	23.04	0.39	100	0.42
Indonesia	Asia Ex-Jp.	36 350	2 560	4 630	14.82	0.55	214	0.24
Denmark	EMEA	13 274	2 357	984	5.57	3.47	146	0.47
SouthAfrica	EMEA	41 718	2 327	4 586	17.99	0.51	161	0.41
Finland	EMEA	13 490	2 147	551	6.10	4.94	130	0.53
Argentina	Americas	49 243	2 037	5 107	24.81	0.40	215	0.45
Poland	EMEA	33 785	2 002	3 108	17.53	0.71	259	0.55
Venezuela	Americas	50 418	1 999	4 812	25.48	0.42	173	0.51
Colombia	Americas	29 865	1 977	3 045	15.44	0.65	118	0.32
Peru	Americas	22 619	1 795	2 333	12.63	0.78	39	0.20
Ukraine	EMEA	43 161	1 429	3 638	33.36	0.38	64	0.35
Malaysia	Asia Ex-Jp.	18 882	1 248	2 392	15.54	0.52	163	0.53
Romania	EMEA	16 496	1 177	1 753	14.48	0.70	59	0.35
Thailand	Asia Ex-Jp.	17 378	1 116	2 401	15.80	0.47	167	0.44
Israel	EMEA	9 205	1 065	1 045	9.27	0.99	181	0.73
Bulgaria	EMEA	18 003	1 037	1 857	19.58	0.58	9	0.18
Kazakhstan	EMEA	20 696	1 013	1 875	21.80	0.54	25	0.12
Norway	EMEA	6 542	956	311	6.59	4.40	248	0.50
Czech Rep.	EMEA	10 527	943	888	11.84	1.19	83	0.43
Slovak Rep.	EMEA	9 773	905	770	11.06	1.25	42	0.46
Iceland	EMEA	7 521	828	1 063	9.21	0.78	13	0.94
Slovenia	EMEA	5 011	784	430	6.46	2.03	24	0.53
Latvia	EMEA	8 862	667	1 084	13.97	0.63	10	0.37
Lithuania	EMEA	5 850	656	690	9.49	1.03	17	0.40
Panama	Americas	7 085	649	1 005	11.30	0.65	13	0.36
Egypt	EMEA	3 691	648	865	6.04	0.86	203	0.80
Qatar	EMEA	6 927	631	918	11.83	0.70	65	0.35
Vietnam	Asia Ex-Jp.	8 184	611	1 201	13.69	0.51	69	0.50
Croatia	EMEA	8 059	610	1 039	14.07	0.63	31	0.54
Ecuador	Americas	4 804	605	551	8.07	1.09	16	0.23
Dubai (UAE)	EMEA	6 511	597	830	12.27	1.02	157	0.42
HongKong	Asia Ex-Jp.	1 705	586	125	2.91	4.69	66	0.27
Chile	Americas	4 601	582	485	7.96	1.24	31	0.11
NewZealand	Australia NZ	3 107	538	348	5.76	1.64	65	0.39
Switzerland	EMEA	1 440	506	96	2.85	5.27	219	0.37
Lebanon	EMEA	2 031	475	340	4.29	1.40	57	1.35
SaudiaArabia	EMEA	2 474	472	281	5.30	1.70	36	0.05
Estonia	EMEA	2 997	420	398	7.39	1.07	2	0.08
Cyprus	EMEA	1 866	315	236	5.94	1.43	20	0.88
Tunisia	EMEA	1 999	274	316	7.40	0.87	21	0.46
Total/Average(*)		2 313 956	213 524	165 089	11.70*	1.80*	861	0.58

Source: http://www.dtcc.com and Datastream/Thomson Reuters.

Table 5: Trade Information Warehouse Data

This table reports the average yearly gross (Panel A) and net (Panel B) notional amount on CDS contracts outstanding in USD equivalents of the U.S. sovereign reference entities among the 1,000 mostly traded contracts as of 31 December 2012. All numbers are reported in million USD. Panel C indicates the ratio of gross to net notional amount outstanding and Panel D lists the average yearly number of contracts live in the Depository Trust & Clearing Corporation's (DTCC) Trade Information Warehouse (Warehouse). Panel E lists the net notional amount on CDS contracts outstanding in million USD equivalents to the average yearly number of contracts. The notional values are represented as US dollar equivalents using the prevailing foreign exchange rates. The sample period starts on 31 October 2008 and ends on 31 December 2012. The values are reported in descending order according to the sovereign's name. Source: www.dtcc.com.

	Panel A: Gross Notional ('000,000)						Panel B: Net Notional ('000,000)						Panel C: Ratio Gross/Net					
Country	2008	2009	2010	2011	2012	Average	2008	2009	2010	2011	2012	Average	2008	2009	2010	2011	2012	Average
California	.	4 253	7 928	9 994	8 831	7 803	.	698	885	981	787	840	.	6.01	9.20	10.22	11.34	9.24
Florida	.	2 688	3 855	4 651	4 412	4 030	.	298	296	263	284	284	.	9.49	13.31	17.82	15.73	14.57
Illinois	.	.	2 061	3 146	4 078	3 213	.	.	329	608	493	494	.	.	6.28	5.27	8.36	6.68
New Jersey	.	1 989	3 075	4 349	4 234	3 789	.	516	440	466	353	424	.	3.86	7.42	9.42	12.02	9.33
New York	.	2 333	2 922	3 317	3 289	3 021	.	282	348	432	370	365	.	8.32	8.49	7.70	8.89	8.35
Texas	.	1 938	2 363	2 710	2 323	2 422	.	394	221	186	219	224	.	4.95	13.29	14.64	10.87	12.28
New York City	.	3 004	4 423	5 697	5 317	4 818	.	756	528	370	439	493	.	4.05	8.87	16.06	12.56	11.20
Massachusetts	.	.	1 682	1 697	1 628	1 677	.	.	171	175	184	177	.	.	9.87	9.70	8.87	9.48
United States	4 537	8 716	13 156	25 581	23 262	17 115	1 296	1 987	2 441	4 575	4 406	3 263	3.51	4.32	5.43	5.60	5.35	5.11

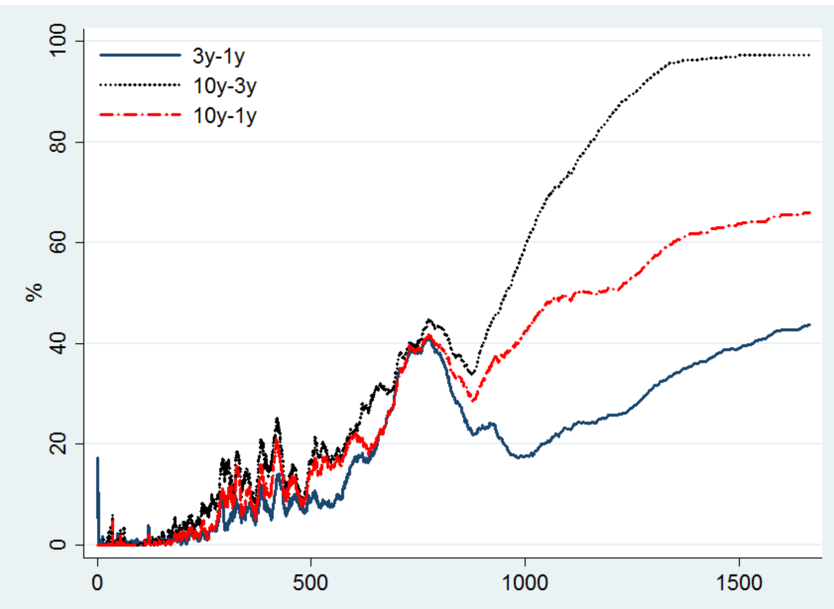
	Panel D: # Contracts						Panel E: Ratio Net Notional/Contracts ('000,000)					
Country	2008	2009	2010	2011	2012	Average	2008	2009	2010	2011	2012	Average
California	.	232	599	975	867	674	.	3.37	1.59	1.01	0.91	1.69
Florida	.	161	274	319	317	279	.	1.97	1.10	0.82	0.90	1.12
Illinois	.	.	152	409	451	358	.	.	2.19	1.48	1.09	1.52
New Jersey	.	120	215	395	354	311	.	4.32	2.33	1.18	1.00	1.64
New York	.	104	194	259	217	201	.	2.71	1.87	1.68	1.71	1.93
Texas	.	81	96	155	151	129	.	4.92	2.39	1.20	1.46	1.95
New York City	.	171	262	357	362	303	.	4.78	2.07	1.04	1.21	1.95
Massachusetts	.	.	112	115	110	114	.	.	1.52	1.52	1.67	1.56
United States	124	241	479	1 114	1 226	737	10.43	8.47	5.09	4.29	3.60	5.57

Source: http://www.dtcc.com

Figure 1: The Slope of the Credit Spread Curve

Graph 1a plots the fraction of decreasing CDS pairs as a function of the CDS level in sliding windows of 400 basis points for the segments 3y-1y, 10y-3y and 10y-1y. The 72,200 curves are sorted by the 5-year premium. Source: Markit. For instance, the left-most points plots the fraction of decreasing CDS pairs against the average CDS premium among the 400 curves with the lowest 5-year spread level. The next point does the same for curves 2 to 401, and so on, up to the right-most point representing curves 71,801 to 72,200. Figure 1b shows the average slope level in basis points as a function of CDS level, in sliding windows of 400 curves. Source: Markit.

(a)



(b)

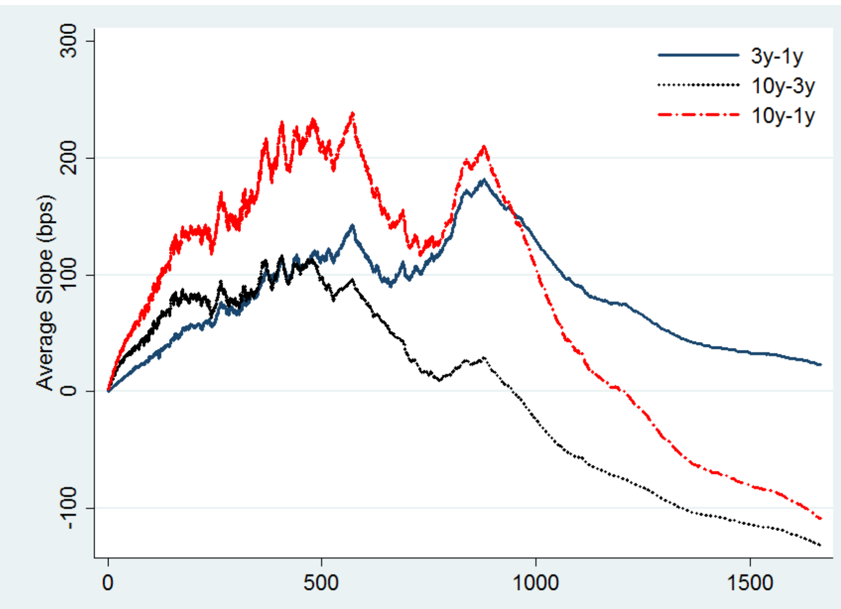
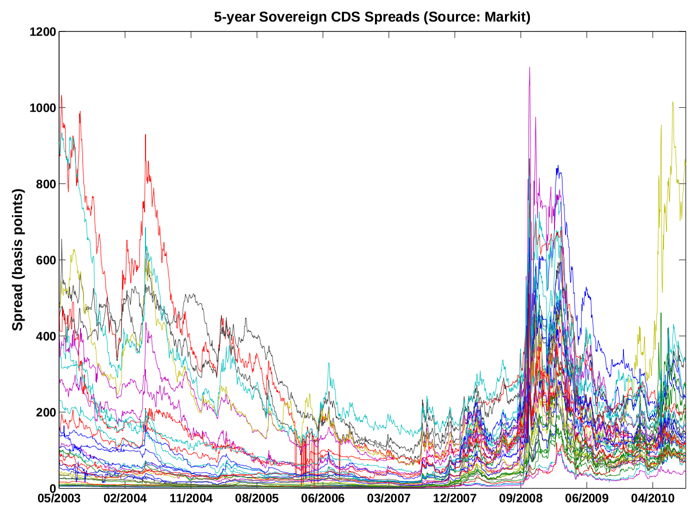


Figure 2: Co-Movement of Sovereign CDS Spreads and Risk Aversion

Graph 2a illustrates the historical 5-year CDS spread for 38 countries spanning five geographical regions over the time period May 9th, 2003 until August 19th, 2010. Graph 2b plots the historical average 5-year CDS spread of the 38 countries in the sample over the same time period. This plot is inspired by the illustration in Pan and Singleton (2008). Source: Markit.

(a)



(b)

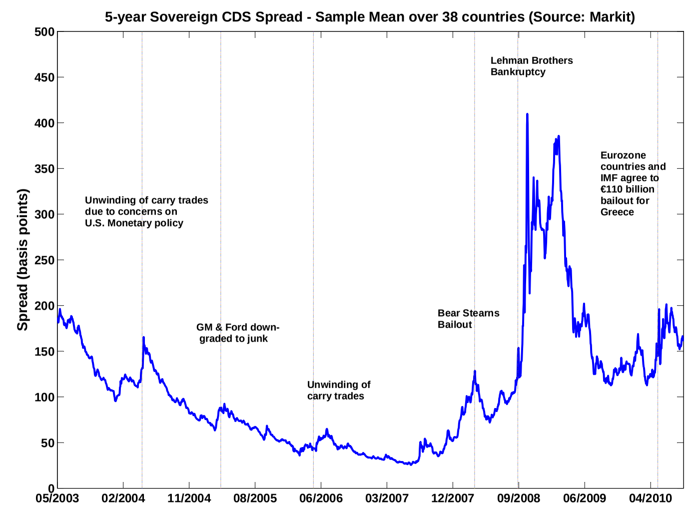
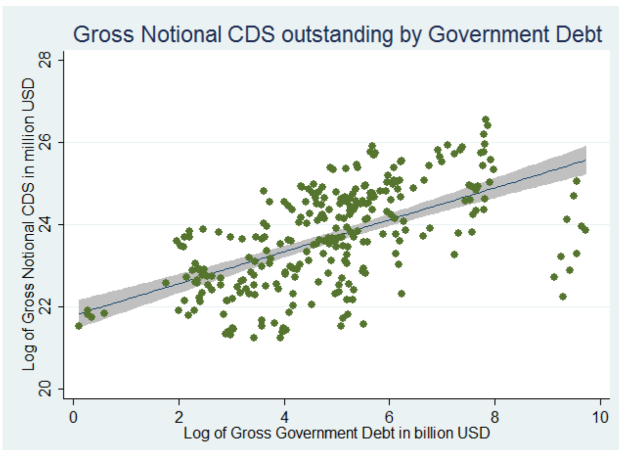


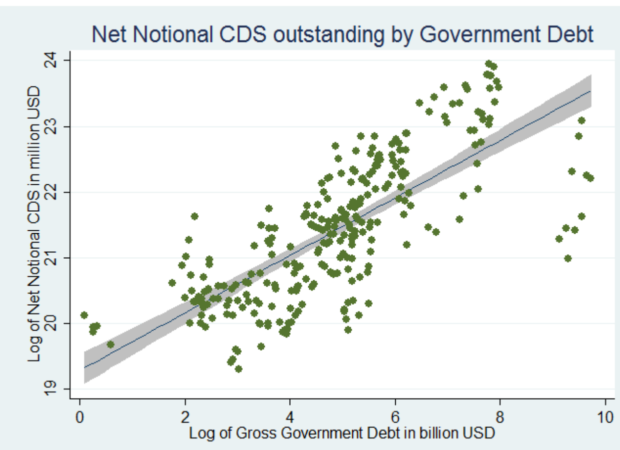
Figure 3: Trade Information Warehouse Data

The following graphs plot the logarithm of the average yearly gross notional amount of CDS outstanding in million USD (3a), the logarithm of the average yearly net notional amount of CDS outstanding in million USD (3b), the logarithm of the average yearly number of CDS contracts outstanding (3c) and the logarithm of the average yearly CDS spread (3d) by the yearly gross amount of Government debt (in billion USD). The CDS gross and net notional amount outstanding as well as the number of contracts is taken from the 1,000 mostly traded reference entities in the DTCC database. CDS spreads are from Thomson Reuters Datastream and the gross amount of government debt is from World Economic Outlook database. The notional values are represented as US dollar equivalents using the prevailing foreign exchange rates. Source: www.dtcc.com.

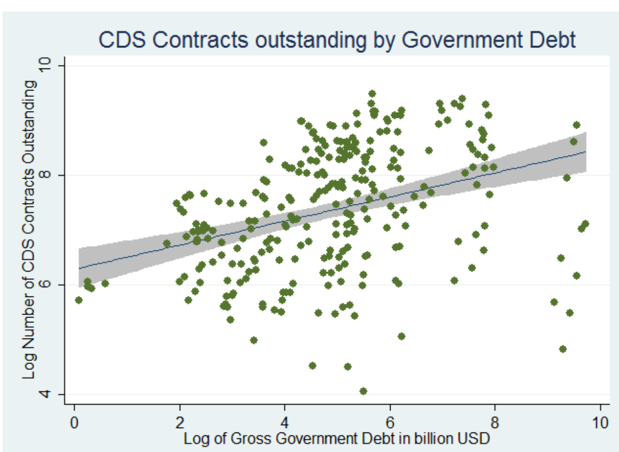
(a)



(b)



(c)



(d)