Credit Default Swaps and the Market for Sovereign Debt

Iuliana Ismailescu and Blake Phillips*

Abstract

We analyze the determinants and effects of credit default swap (CDS) trading initiation on sovereign bonds. For high default risk countries, CDS initiation provides significant price efficiency benefits in the underlying market. CDS initiation also reduces average risk premiums, with reductions in borrowing costs likewise increasing with default risk. CDS trading initiation is more likely following increases in local equity index volatility, the volatility risk premium, or index spreads for regional or global CDS markets and decreases in a country's ability to service foreign debt. Our results are robust to selection bias controls based on these factors.

JEL Classification: G12, G14, G15, G20
Key words: sovereign bond, market efficiency, borrowing costs, credit default swap, credit derivative

---

* Ismailescu: Pace University, One Pace Plaza, New York, NY 10038 USA. tel. (212) 618-6524. e-mail: iismailescu@pace.edu; Phillips: School of Accounting and Finance, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, N2L 3G1, Canada, tel. (519) 888 4567, e-mail: brphilli@uwaterloo.ca This paper was previously circulated under the title *Savior or Sinner? Credit Default Swaps and the Market for Sovereign Debt.* We thank Viral Acharya, John Buonaccorsi, Yalin Gunduz, Raymond Kan, Nikunj Kapadia, Hossein Kazemi, Carmen Stefanescu, Tony Wirjanto and session participants at the 21st Annual Derivatives Securities and Risk Management Conference, the 2011 Financial Management Association European and North American Conferences, the 2011 Northern Finance Association Meetings, the 4th Annual Conference on Extreme Events, the 2012 FMA Applied Finance Conference and the 3rd World Finance Conference for useful comments and suggestions.

1. Introduction

Once lauded as one of the most significant and important financial innovations of the last decade, credit default swaps (CDS) have recently come under increasing criticism.[1] In May 2011, concerns over negative CDS effects in the sovereign bond market led German regulators to ban naked CDS positions of Eurozone sovereign bonds. On July 2, 2011, the European Union Parliament voted in favor of a similar ban on sovereign CDS positions. Given the surprisingly little academic analysis on the interaction between the sovereign bond and CDS markets, the potential repercussions of such regulatory measures on the underlying bond market are difficult to assess. Industry and academic experts have suggested that it is unlikely that CDS trading could have a significant impact on sovereign bond yields due to the relatively small proportion of notional value protected by CDS contracts.[2] Beyond these observations, our understanding of the potential effects of CDS trading on the sovereign debt market is limited.[3]

In this paper, we utilize an event-study framework and analyze the impact of CDS trading initiation on sovereign bonds issued by 41 countries, from both developed and emerging markets. The generalized effects we analyze potentially differ from the specific effects of speculative CDS trading on troubled assets (that were the subject of the Eurozone bans). However, our analysis is a logical first step in advancing our understanding of the interaction between these two markets. Our contribution to the existing literature is to analyze the impact of

---

[1] See for example Acharya and Johnson (2007) and Stultz (2010) who discuss the criticisms and merits of CDS derivatives.

[2] See for example the expert testimony of Robert Pickel, Executive Vice Chairman, International Swaps and Derivatives Association Inc. before the U.S. House of Representatives, April 29, 2010. In that testimony, Pickel notes that sovereign default protection via CDS contracts totalled $2 trillion USD, or 6% of the overall global sovereign bond market. See also Duffie (2010).

[3] Corporate CDS research is more prevalent. For example, Ashcraft and Santos (2009) find that, in aggregate, CDS initiation has little effect on the cost of debt for corporations, but do note economically significant adverse effects for risky and informationally-opaque firms. Longstaff, Mithal and Neis (2005), Norden and Weber (2004) and Blanco et al. (2005) all document that the CDS market leads the corporate bond market in price discovery. We contrast the corporate and sovereign debt markets and discuss this literature in greater detail in Section 2.1.

CDS trading initiation on two key sovereign debt market characteristics not previously considered: price efficiency and borrowing costs. Specifically, we address the following questions: 1) What is the effect of CDS trading on the efficiency with which new information is impounded in sovereign bond prices? 2) Controlling for risk-free term structure and default risk effects, how does CDS trading initiation impact the cost of debt for global governments?

We employ separate models to examine these questions. First, we draw on Westphalen (2001) and Collin-Dufresne et al. (2001) and model sovereign bond spreads as a function of local and global business climates, risk-free yield curve characteristics and the local currency-USD exchange rate. We then follow Hou and Moskowitz (2005) and calculate the delay in which new information is incorporated into bond prices by contrasting the R^2 from variants of the pricing model that separately include and exclude 5 lags of each price factor. The higher the R^2 of the model including lagged price factors relative to the base model, the greater the delay with which new information is incorporated into bond prices. This process allows us to evaluate CDS price efficiency effects separately for each price factor. Comparing the delay measure before and after CDS trading initiation, on average, price efficiency improves in excess of a matched control for both local and global business climate proxies. These results contrast prior literature which finds that CDS traders react predominantly to global price factors.[4]

Second, to measure risk premium effects associated with CDS trading initiation, we relate bond spreads to a CDS trading initiation indicator variable and controls previously shown to be determinants of bond yields. We find that, on average, borrowing cost decrease by approximately 70 basis points (bps) contrasting the 6 month period before and after CDS trading initiation.

[4] See, for example, Longstaff et al. 2011.

CDS trading initiation effects can manifest via a series of channels. First, CDS contracts allow heterogeneously informed investors to hedge country-level adverse selection costs, facilitating greater investor participation and improving liquidity in international debt markets. Second, CDS initiation creates risk sharing opportunities between investors, increasing their ability to speculate and hedge in the underlying market while reducing the uncertainty of obtaining a desired payoff. Benefits associated with hedging adverse selection costs and risk sharing are greater for higher default risk countries as the risk associated with sub-investment grade debt has likely limited participation for the largest proportion of investors.

Partitioning the sample by credit rating,our tests reflect that CDS trading initiation related improvements in price efficiency are isolated to bonds in the high default risk partition, ranked B or lower by Standard and Poor's. Likewise, CDS related reductions in borrowing costs are most pronounced for high default risk bonds, with improvements increasing monotonically across the four considered credit risk partitions. On average, bonds in the AAA-A partition realize a 20 bps reduction in borrowing costs relative to bonds in the B-CCC partition, for which borrowing costs decline by approximately 100 bps.

A potential concern when interpreting the previously discussed results is endogeneity biases resulting from the non-random CDS trading initiation decision. If factors that influence CDS trading initiation likelihood jointly influence bond characteristics, features common to bonds at the time of CDS trading initiation could be spuriously attributed as initiation effects. To mitigate these concerns, we utilize a logit model to identify factors that are common to bonds at the time of CDS trading initiation. We find that increases in local equity market volatility, the volatility risk premium and the spreads of regional and global CDS indexes and decreases in a country's ability to service USD-denominated debt are the strongest predictors of sovereign CDS initiation. Our results are robust to inclusion of these factors as additional controls via the Heckman (1997) two-stage selection bias process.

In sum, we find that the impacts of CDS trading initiation on sovereign bonds are broadly positive but depend, at least in part, on country-level characteristics. In general, CDS trading initiation improves the quality of the sovereign debt market, enhancing price informativeness. Price efficiency benefits accrue to markets for which frictions limiting information flow and investor participation are likely most severe. Our results also suggest that borrowing cost reductions are more pervasive, but are similarly most pronounced for high risk countries. Examining trading volume trends at the time of CDS trading initiation, we find that on average, liquidity is unaffected. However, we find a significant improvement in liquidity for high default risk countries.

These results are broadly consistent with sovereign CDS trading initiation mitigating barriers to investor participation for high risk countries via expansion of the available risk-return space and creation of hedging opportunities. However, they contrast findings for the corporate bond market, reflecting differential effects for markets dominated by unique investor sets. For example, investment companies comprise a leading share of trades in the corporate bond market in contrast to central bank and sovereign government trading activity dominating the sovereign bond market. These results should be of interest to global financial market regulators contemplating the use of bans in the sovereign CDS market. Constraints on CDS trading have the potential to reverse the benefits we note and reduce the overall quality of the sovereign debt market.

The remainder of the paper is organized as follows. Section 2 reviews the related literature and presents our hypotheses in greater detail. In Section 3 we describe the data and report summary statistics. Section 4 examines the determinants of CDS trading initiation likelihood which is a precursor to our primary analysis. In Section 5 we report our results and in Section 6 we provide concluding comments.

2. Hypotheses and Related Literature

2.1. Context and Empirical Findings in the Literature

A considerable body of literature is dedicated to the examination of the relation between the CDS, corporate bond and equity markets. In the context of information flows, Hull et al. (2004) and Ismailescu and Kazemi (2010) report that credit rating announcements are anticipated by the CDS market. Similarly, Longstaff et al. (2005), Norden and Weber (2004) and Blanco et al. (2005) show that the CDS market takes a lead role in debt market price discovery relative to investment-grade corporate bonds.

Our paper is more closely related to a small, developing literature that examines the effect of CDS trading initiation on the underlying bond market, which yields mixed conclusions. Das et al. (2012) find that corporate bond markets become less efficient, experience greater pricing errors and realize *lower* liquidity following CDS trading initiation. Ashcraft and Santos (2009) examine the impact of CDS trading initiation on the cost of corporate debt and fail to find any evidence of a reduction in borrowing costs for the average borrower. However, they do document a significant adverse effect for higher risk and informationally-opaque firms, which they relate to a reduction in the usefulness of the lead bank's retained share to resolve information asymmetry problems. In contrast to these papers, Saretto and Tookes (2013) use CDS trading initiation as a proxy for the relaxation of the firm's credit supply constraints and find that firms with traded CDS contracts are able to maintain higher leverage ratios and longer debt maturities. Massa and Zhang (2012) find that CDS initiation reduces the need for investors to liquidate bond positions, decreasing fire sale risk and *improving* bond liquidity.

The focus of our analysis is sovereign debt, which differs in several key aspects from the corporate, investment-grade debt commonly examined in the previously discussed literature. First, sovereigns are among the largest borrowers in the world, with greater liquidity and larger debt issues than their corporate counterparts. Correspondingly, sovereign issuers have greater activity in the CDS market (Ammer and Cai, 2011). Thus, to the extent that CDS trading initiation effects may exist, they are likely more pronounced, or perhaps differ in the sovereign debt market due to less binding liquidity constraints. Second, countries in financial distress do not enter bankruptcy and assets are not liquidated. In the event of default, the debt contract is restructured, typically resulting in substantial haircuts for debt holders (Shleifer, 2003). Thus, the risk structure of sovereign debt is quite unique to the corporate context. Third, corporate debt is predominantly held by insurance companies (Massa and Zhang, 2012), in contrast sovereign debt is more commonly held by central banks and sovereign governments for non-speculative purposes. Different investor sets with unique incentives are likely to respond differently to the availability of CDS markets. Finally, the credit ratings of the bonds in our sample range from AAA to CCC. This greater range in credit risk provides the opportunity for broader and unique cross-sectional analysis than was possible in prior analysis, which has typically focused on investment-grade debt.

Research focused on the impact of CDS trading on the sovereign bond market is relatively sparse. Ammer and Cai (2011) examine the relationship between CDS premiums and sovereign bond yields for nine emerging markets and find that sovereign bond spreads lead CDS premiums more often than found for investment-grade corporate bonds. Chan-Lau and Kim

(2004) undertake a similar analysis, examining the lead-lag relationships between sovereign bond indices, sovereign CDS premiums and national stock indexes and report mixed results. Our contribution to this literature is to examine the effect of CDS trading initiation on two characteristics of the sovereign debt market not previously considered: price efficiency and borrowing costs. These characteristics speak broadly to the effect of CDS trading initiation on underlying market quality and the aggregate effect on the cost of debt for global governments.

2.2. Channels of CDS Trading Initiation Effects and Related Hypotheses

CDS trading initiation effects on sovereign debt may occur via a series of channels, which give rise to testable hypotheses. First, there is substantial evidence that country-level information asymmetries influence the international portfolio allocations of investors.[5] Investors tend to favor investment opportunities in countries with which they are familiar and potentially possess an informational advantage. Yuan (2005) shows that the ability to hedge adverse selection costs encourages greater information seeking by investors, leading to increased liquidity and price informativeness in the context of benchmark securities. Further, Shiller (1993) suggests that macro securities (such as sovereign CDSs) may complete the market by allowing investors to hedge systematic factors. CDS contracts may have a similar effect, allowing heterogeneously informed investors to hedge adverse selection costs in the sovereign bond market, facilitating greater investor participation and liquidity. In support of this thesis, Bongerts, De. Jong and Driessen (2011) find that CDS protection sellers earn a liquidity premium in the context of corporate CDS contracts. Second, CDS trading initiation may expand the investment opportunity set available to investors. As shown theoretically by Detemple and

[5] See for example, among others, Brennan and Cao (1997), Kang and Stultz, (1997) and Van Nieuwerburgh and Veldkamp (2009).

Selden (1991) and Ross (1976) in the context of equities and the options market, introducing derivatives may facilitate risk sharing between investors, expanding the available return space. Specifically, derivatives can increase the ability of investors to speculate and hedge in the underlying asset while reducing uncertainty in the cost of obtaining a desired payoff (Grossman, 1988). In this context, CDS contracts may encourage participation by a larger segment of investors with heterogeneous risk preferences, resulting in a more certain and liquid sovereign bond market. These first two effects should be most marked for high default probability countries, as the associated risk likely excludes the largest number of investors, and for these assets the largest expansion of the return space is possible.

It should be noted that there are also potential adverse effects resulting from CDS trading initiation. Stein (1987) argues that the entry of new investors potentially lowers the informativeness of prices, reducing the ability of pre-existing investors to infer asset value. The overall effect can destabilize prices and be welfare reducing. Additionally, for existing investors there are potential advantages to trading in the CDS as opposed to the sovereign bond market. Notably, the opacity of the over-the-counter (OTC) CDS market potentially makes it the preferred venue for informed or insider traders seeking to hide their trades (Acharya and Johnson, 2007). Similarly, Gorton and Pennacchi (1993) suggest that reference securities have the potential to crowd out other securities, resulting in redistribution effects which could lower participation and liquidity in the underlying market. The overall effect of CDS trading initiation will reflect the aggregate influence of these various channels.

3. Data Description

We obtain CDS data from Markit, a leading vendor of credit pricing data that provides daily CDS spreads on over 3,000 reference entities. Collected from more than 70 global banks and brokers that act as CDS market makers, the data undergoes a rigorous cleaning process prior to formation of daily composite quotes. Contracts are available in different maturities, documentation clause levels, and currencies. We use daily spreads for 5-year, USD-denominated, senior tier CDS contracts with the Cum (With) Restructuring or Old Restructuring (CR) clause, as contracts of this type are the largest and most liquid.[6] We focus on USD-denominated contracts as, without exception for sovereign entities, contracts in this currency initiate trading prior to all other currencies. The Markit dataset commences on January 1, 2001 and concludes on September 30, 2010.

In the absence of a consensus listing date on a recognized exchange, we treat the day that a reference entity first appears in the Markit dataset as the date of CDS trading initiation. The initiation of coverage in the Markit dataset is similarly used by Das et al. (2012) and Massa and Zhang (2012) to indicate CDS trading availability for corporate CDS contracts. Markit requires a minimum of three spread observations for each respective reference entity and maturity. Thus, the first appearance of a contract in the Markit dataset represents the date when CDS trading became adequately widespread to consistently meet the reporting threshold.

Given that the true start of OTC trading is unobservable, a natural concern is potential mis-alignment between coverage in the Markit database and the true initiation of CDS trading for each country. To validate the CDS initiation dates, we reference the International Financing Review which reports weekly CDS indicative prices for sovereign contracts in the period

[6] For more information about the documentation clauses, see ISDA Credit Derivatives Definitions published in February 2003.

preceding the Markit sample. Referencing the period of 1998 to 2000, five countries (Brazil, China, Greece, Hungary and Mexico) had spotty but reasonably consistent coverage abutting the start of the Markit dataset, suggesting that CDS trading for these countries was available to some degree prior to the initiation date reflected in the Markit dataset. In the interest of conservatism we exclude these five countries from our analysis; however we obtain consistent results if these countries are included.

The initiation date we use represents the date when CDS spreads became public, and thus, reflects the date we would expect information flows across debt markets to become most pronounced. It is important to note that any potential inaccuracy in the estimated initiation date, if anything, biases against the results we report. For further robustness, we compared the CDS initiation dates suggested by the Markit dataset to those suggested by two alternative CDS data providers, CMA and Thomson-Reuters (available in Datastream). Initiation dates were either consistent across data providers or appeared earlier in the Markit dataset. Given the more comprehensive nature of the Markit dataset we elected to utilize it as our CDS data source.

Sovereign bond data is obtained from Datastream. To avoid potential confounding effects associated with variation in bond covenants and to match the currency denomination of the CDS contracts, we focus on straight, fixed-coupon, USD-denominated sovereign bonds traded in international markets. The bond data available includes notional amount outstanding, maturity, the daily stripped spread (defined as the difference between the bond yield and the yield of a comparable-maturity US T-bond) and trading volume (for the majority of bonds).

We limit our analysis to countries that have CDS contracts written on their sovereign bonds and at least one bond trading during the three months preceding and following the date of CDS initiation. These criteria result in a sample of 177 bonds issued by 41 countries from both developed and emerging markets. Table I summarizes, by country, the start date of the CDS data series, the number of bonds, the mean and standard deviation for the bond stripped-spreads and the average market value of the bond issues during the six-month period surrounding the CDS trading initiation. The Standard and Poor's (S&P) credit rating at the time of the CDS introduction is also reported.[7] The average bond stripped-spread is 326 bps with a standard deviation of 70 bps. On average, the market value of a sovereign bond issue during this period is 746 million USD. The largest bond issues outstanding are those of the United Kingdom (approximately three billion USD), while the smallest are Dominican Republic's, with an average of 17 million USD outstanding. The market values of the two German bonds outstanding during this period were not available. Average credit ratings in our sample range from AAA to CCC, including 23 investment-grade and 18 sub-investment-grade rated countries.

4. Determinants of CDS Initiation Likelihood and Selection Bias Controls

As previously discussed, a concern with the event-study approach utilized in this paper is the potential to spuriously attribute characteristics common to bonds at the time of CDS trading initiation as initiation effects. For example, if CDS trading commonly occurs following increases in the volatility in the price of the underlying bond, then the effects we attribute as related to CDS trading initiation may result instead from shifts in uncertainty regarding asset value. It should be noted that CDS initiations typically occur on different dates for each country (see Table 1), which provides an inherent cancelling of uncommon trends.

[7] Throughout the paper, sovereign credit rating is the foreign currency rating reported in the Standard and Poor's Sovereign Rating and Country Transfer and Convertibility Assessment Histories (2009).

Selection biases of this type are well recognized in the equity option introduction literature, where option listing is non-random and has been shown to be dependent on characteristics of the underlying stock (Mayhew and Mihov, 2004). To mitigate selection bias concerns, a common approach is to utilize a control sample drawn from stocks eligible for option listing, but not yet listed, which match on factors shown to influence the option listing decision.[8] In this manner, option introduction effects can be isolated from effects attributable to characteristics common to stocks which are typically **s**elected for option listing. To control for selection bias in our models we follow the same underlying premise, utilizing the Heckman (1979) procedure and in some specifications also implementing a difference-in-difference approach as additional endogeneity controls.

To identify characteristics common to bonds selected for CDS trading initiation, following Mayhew and Mihov (2005) and Danielsen et al. (2007) who undertake similar analyses in the context of equity options, we estimate a logit model of 364 pooled, quarterly observations (Equation (1)) for all 5-year sovereign CDS contracts in the Markit database not yet trading. This model is a precursor to the Heckman (1997) procedure, but the results are of interest unto themselves, as the determinants of CDS trading initiation are not well understood.

$$L(TRADE) = \beta_0 + \sum_{n=1}^{k} \beta_n F_{n,t-1} + \varepsilon_t \qquad (1)$$

L(TRADE) is the log-odds ratio that a country will be selected for initiation of CDS trading and F_n is a matrix of country-level and global determinants of CDS trading initiation.

[8] See for example, Mayhew and Mihov (2005) and Phillips (2011).

As candidate countries for CDS initiation we consider all countries with sovereign CDS contracts included in the Markit CDS dataset as of September 30th, 2010. As previously discussed, we treat the first day of trading of the 5-year maturity contract as the CDS initiation date. The dataset includes 79 sovereign CDS initiations between 2001 and 2008. Ideally, our sample should include all countries eligible for CDS initiation but not yet trading, however eligibility criteria, should it exist, is not well understood. The absence of any additional CDS initiations after 2008 gives us confidence that our sample includes all countries that reasonably meet potential eligibility thresholds for CDS trading initiation. From this list, we exclude countries present at the start of the dataset for which we cannot determine trading initiation dates (8 countries).

When selecting variables as potential determinants of CDS trading initiation, we make the logical assumption that factors that influence sovereign debt prices also influence CDS contract demand. The variables we include in the logit model are shown to influence sovereign debt prices in either the bond or CDS markets (see Westphalen, 2001; Collin-Dufresne et al., 2001; Longstaff et al., 2011). Country-level variables considered are the return and volatility of the local equity index (*INDEX* and *VOL*, respectively), where volatility is calculated as the sum of squared monthly index returns in quarter *t*. These variables proxy for the strength and robustness of a country's economy which relates to its government's taxation cash flows and correspondingly its ability to service and repay debt. As an additional proxy of local market strength we include the exchange rate of the local currency relative to the USD (*ER*) to capture global purchasing strength and the ability of the government to repay debt denominated in foreign currency. Finally, we include total foreign currency reserves (FORRES) and credit rating (*CREDIT*) as proxies for creditworthiness. For eight countries in our sample Datastream sparingly reports the equity index data between 2001 and 2008. Eliminating them results in a final sample of 63 countries.

CDS trading initiation may also be tied to hedging demand by bond holders. To proxy for hedging demand we include total external debt standardized by GDP (*ExDebt/GDP*). Liquidity in the underlying market could serve as an additional proxy for hedging demand, or alternatively investors may be drawn to the CDS market when liquidity in the underlying market is low or decreasing. Unfortunately we are unable to consider the effect of liquidity in the bond market as a determinant of CDS trading initiation due to data constraints. Datastream provides trading volume data at the time of CDS trading initiation for approximately 67% the bonds in our sample. However the logit model includes all countries with traded CDS, regardless of the availability of underlying bond data. Imposing the requirement of trading volume data on the logit model sample restricts the sample to approximately 25% of its original size. Nonetheless, for robustness we replicate our models with this reduced sample and discuss the results below.

Longstaff et al. (2011) show that sovereign CDS contracts are priced predominantly based on global factors, thus hedging demand and speculation in CDSs may similarly be driven by these factors.[9] To proxy for the strength of global markets we use the return to the global MSCI index. As further proxies for future economic conditions, we also include the first two principal components of a set of US T-Bonds (90 day, 1-year, 2-year, 5-year, 7-year and 10-year maturities). It is commonly held that these two factors, associated with the level (*YL*) and slope (*YS*), govern the default-free term structure.[10] To capture perceptions of global asset risk, we

[9] Extending the work of Longstaff et al. (2011), Augustin (2012) finds that the influence of local relative to global factors on CDS prices varies with the slope of the term spread. When the spread curve is upward sloping, global factors dominate CDS prices with local factor becoming more important when the term structure inverts.

[10] See Dittmar and Yuan (2008) and Litterman and Scheinkman (1991) for examples of this approach. The third principal component is commonly associated with the curvature of the term structure, but over the timeframe of our sample the correlation between the second and third principal component is greater than 95%. Thus, the slope and curvature of the term structure do not convey unique information in our setting, and we consider only the slope.

include the equity risk premium (*EQU*), volatility risk premium (*VOLPRM*) and the default spread (*DEF*). Finally, we include global and regional CDS spread indexes (*GLOBE* and *REG*, respectively) which have been orthoganalized relative to the other determinant variables to capture risk perceptions unique to the CDS market. Where applicable, all values are expressed in USD. Detailed descriptions and sources of the determinant variables appear in the Appendix.

The correlation matrix of the determinant variables is presented in Table II. Correlations are typically low with the exception that global index return is positively associated with a steeper term structure and higher volatility risk premiums and is negatively associated with the equity risk premium. High correlations were also found between the slope of the term structure and the equity and volatility risk premiums. These associations are correspondingly taken into consideration in future models.

The standardized slope estimates from the logit models are presented in Table III. The dependent variable is an indicator variable set to 1 in the quarter of CDS initiation and the country is removed from the sample following the initiation quarter. Ex-ante, we hypothesize that both the level and the trend in the determinant variables may influence CDS contract demand. Thus, in unreported preliminary models we separately consider the level and change in each factor. Typically, the factor change as opposed to its level is a more significant predictor of sovereign CDS trading initiation likelihood. With the exception of the default spread (*DEF*) and the equity risk premium (*EQU*), slope estimate significance increases for all of the determinant variables between the level and trend models. Thus, we use the levels of *DEF* and *EQU* in our models.

In Model (1) we consider all of the determinant variables simultaneously. The fit of the model, reflected by a maximized pseudo R^2 of 0.30 and 79% of observations classified correctly, is comparable or superior to similar prior analyses. For example, Mayhew and Mihov (2005) report 72.8% of observations classified correctly in a logit model which examines the determinants of equity option introduction. External debt data was unavailable for 9 countries in the sample, so only 54 countries are included in this preliminary model.

The dominant factor predicting CDS initiation likelihood is the volatility of the local equity index followed by the global and regional CDS indexes. CDS initiation is more likely when uncertainty regarding local market strength is increasing and average CDS spreads globally and regionally are rising, consistent with investors seeking to hedge increasingly uncertain cash flows. Following market uncertainty, the general credit worthiness of the country and its ability to service foreign debt are the next most important determinants of CDS initiation likelihood (positive and significant coefficient on local currency exchange rate with the USD and negative and significant coefficient on credit rating and foreign currency reserves). Perhaps surprisingly, the size of total debt is not an important determinant of CDS initiation (insignificant coefficient on external debt standardized by GDP). For robustness, in unreported tests we also consider the change and level of raw, unstandardized external debt as well as GDP and the dollar value of sovereign bond debt as alternative proxies for investor hedging demand and find the same result. In short, increases in default likelihood and uncertainty regarding debt repayment ability, and not the overall size of the market, drive CDS trading initiation.

Given the lack of significance of total debt as a determinant of CDS initiation likelihood, to maximize sample size we exclude it from future models. Model (2) replicates Model (1) excluding total external debt and considering the full sample. Results are highly similar between the two models. Via iterative substitution we then consider alternative models cognisant of the correlations reported in Table II (i.e. considering models excluding various sets of the previously discussed correlated variables). Model (3) is an example of one such iteration. Finally, via iterative substitution we maximize the significance of individual coefficients, the pseudo R^2 and the Akaike information criterion of the model, reporting the optimized model output in Model (4). Results are highly similar across models, with the exception that the influence of the volatility risk premium in predicting CDS trading initiation likelihood is higher in Model (4), providing additional support for the importance of market uncertainty for CDS demand.

In unreported robustness tests we replicate the models including the level and change in average turnover for all bonds issued by the country of interest as additional determinant variables. Turnover is calculated as the dollar value of trading volume standardized by total market value in the prior quarter. We find that turnover is not a significant predictor of CDS initiation; these inferences, however, may be impaired by the reduced sample size. The influence of liquidity on our results is discussed in greater detail in the next sections.

5. Empirical Analysis

5.1. Price Informativeness Analysis

We start our empirical analysis by examining the impact of CDS trading initiation on the speed with which risk factors are impounded in sovereign bond prices. Drawing on Westphalen (2001) and Collin-Dufresne et al. (2001), at the daily frequency, we model the change in sovereign bond spreads as a function of the return and volatility of the local MSCI equity index, the global MSCI equity index, the level and slope of the yield curve and the exchange rate of the local currency to the USD. [11] These variables are as previously defined with the exception of

[11] In support of the use of exchange rate as a default risk proxy, Jahjah and Yue (2004) document a link between exchange rate policy, sovereign bond spreads and default likelihood. We are constrained from using more direct measures of default likelihood, such as leverage or total sovereign debt as these proxies are only available at an annual frequency.

index volatility which is calculated following Avramov et al. (2006) and Jones et al. (1994) who use the absolute residual from the regression of the index return on twelve lags of the index return and day of the week indicator variables. Our focus on these factors is motivated by the need for a parsimonious model, based on variables that are available at a daily frequency and are known to influence sovereign bond prices. We utilize daily returns as in our sample 97% and 81% of bond and CDS returns, respectively, are non-zero, suggesting that information arrival in these markets is typically, at least, daily in frequency.

To measure the speed with which these factors are incorporated in sovereign bond spreads, we follow Hou and Moskowitz (2005), who study cross-firm variation in the lagged response of equity prices to market news. In the context of sovereign debt, for each bond *i*, we estimate the daily frequency, time-series regression:

$$\Delta SP_{i,t} = \sim_i + {}_i^{I} INDEX_{j,t} + {}_i^{W} WORLD_t + {}_i^{V} \Delta VOL_{j,t} + {}_i^{Y1} \Delta YL_t + {}_i^{Y2} \Delta YS_t + {}_i^{E} \Delta ER_{j,t} + \pounds_{i,t} \qquad (2)$$

where *ΔSP* is the change in the sovereign bond spread, *j* is the issuing country and *t* denotes time. In six separate models (one for each price factor with the exception of *ER* and one considering all factor simultaneously, termed the JOINT model), we then augment this model to separately include five lags of each price factor or five lags of all the risk factors simultaneously.[12] In this manner, the change in price informativeness for each price factor is evaluated separately allowing inferences regarding which price factors contribute the greatest to

[12] We do not evaluate the change in price informativeness related to exchange rate as this variable is constant for countries with currencies pegged to the USD (Panama) and exhibits high serial correlation for Lebanon, El Salvador and Qatar. Phillips (2011) and Acharya and Johnson (2007) similarly utilize the Hou and Moskowitz (2005) model employing five daily lags of price factors when evaluating the price efficiency implications of derivatives.

efficiency changes, specifically local relative to global factors. Examination of the source of efficiency gains is motivated by the extant literature on the location of price discovery and the factors influencing CDS prices. As previously discussed, prior literature has shown that the CDS market leads the bond market in price discovery and CDS prices are influenced predominantly by global factors. Thus, as price discovery shifts from the bond to CDS market, price efficiency in relation to global factors may increase differentially, or even at the cost of local market factors.

Comparing the R^2 obtained from the base model (Equation (2)) relative to the augmented models, which include lagged values for one price factor (or all factors simultaneously), we calculate the delay in spread adjustment to each price factor as:

$$D_{rsq} = 1 - \frac{R^2_{base}}{R^2_{augmented}} \tag{3}$$

The faster new information is incorporated into bond spreads, the smaller the difference between the R^2 of the augmented and base models, as lagged price factors add little by the way of explanatory power. Thus, as the speed of spread adjustment increases, the D_{rsq} delay measure decreases. To provide a sense of the model explanatory power, the mean and standard deviation of the R^2 from Equation (2) is 39% and 24%, respectively, calculated by bond over the 3-month period prior to the initiation of CDS trading. When five lags of index return are added to the model, the average R^2 increases to 46% with a standard deviation of 21%. These statistics suggest that the model has reasonable explanatory power and that significant cross-sectional variation in predictive power across bonds exists as lagged factor values are added to the model.

For each bond, we separately calculate D_{rsq} values for the 3-month period bracketing CDS trading initiation. We seek to utilize a proximal timeframe relative to the initiation of CDS trading to minimize potential endogenous factors and mirror the timeframe of analysis common in the literature.[13] The difference in the pre and post-initiation delay measures captures the effect of CDS trading on sovereign bond price efficiency. The inclusion of the contemporaneous price factors in each model allows us to control for endogenous factors which may influence price efficiency coincidental with the initiation of CDS trading. Further, the use of differences in delay allows us to implicitly control for cross-country variations in efficiency and factor sensitivities.

5.1.1. Price Informativeness Univariate Results

Table IV reports the mean change in spread adjustment efficiency, for each price factor and the JOINT model in aggregate and by default risk partition. The change in spread adjustment delay is calculated separately for each bond, with equal weighted means across bonds reported. Results are similar if weights are adjusted to give each country equal weight in the mean calculations. First, focusing on the raw changes in the aggregate sample, it can be observed that, on average, an improvement in spread adjustment efficiency (negative change in delay) is realized for all of the price factors. However, only efficiency improvements in relation to volatility of the local equity index, the global equity index return and the JOINT model are statistically significant at the 10% level (t-statistics -2.11, -1.78 and -2.20, respectively). To provide a sense of scale, drawing on the unreported D_{rsq} values and focusing on the JOINT model, across all bonds the average D_{rsq} decreased from 0.5440 to 0.4915 following CDS trading initiation, representing a 10% improvement in yield adjustment efficiency at the daily frequency. The *WORLD* and *VOL* factors realized similar magnitude efficiency gains.

[13] Dittmar and Yuan (2008) use similar timeframes when they analyze the effects of sovereign bond issuance on the corporate bond market. They evaluate a range of 1 to 7 weeks following sovereign bond issuance. We extend this period slightly to 12 weeks and conduct robustness analysis over the same time range.

It is possible that the efficiency changes we note reflect time-series trends in sovereign bond characteristics (i.e. sovereign bonds may be endogenously improving in efficiency over time). To mitigate this concern, we create a time-series matched control sample for each country. Separately for each bond we calculate the change in spread adjustment efficiency for all other bonds in the sample over the same window of analysis (i.e. 3 months before and after CDS trading initiation for the test bond). Bonds for countries for which CDS trading initiation occurred within 3 months of the test country are excluded.[14] Thus, the time matched control sample captures the average change in price efficiency for all bonds not undergoing CDS trading initiation. To control for endogenous changes in sovereign bond market price efficiency, we employ a difference-in-difference approach, calculating the difference in the change in efficiency for the bond which realizes CDS trading initiation effects to the change in efficiency for the time matched control sample. The mean difference-in-difference change in delay (which we term excess change) is also reported in Panel A of Table IV. The raw and excess change in spread adjustment delay results are highly similar; if anything, the excess change results are stronger, suggesting endogenous time trends in sovereign bond efficiency are not biasing our results.

As previously discussed, given the potential for CDS contracts to mitigate information asymmetry and risk preference related implicit investment barriers, CDS initiation effects may vary in the cross-section of these factors. The next step of our analysis is to explore how price efficiency effects vary with country-level credit rating (used to jointly proxy for default risk and financial market openness). The results of the sub-sample analysis are reported in Panel B of Table IV. To form four similarly sized partitions, we divide each major rating category into two sub-groups: investment-grade ratings into AAA-AA and A-BBB partitions, and sub-investment-

[14] The control sample includes bonds for countries with and without a traded CDS. As we examine the change in efficiency, if bonds with a traded CDS are inherently less or more efficient, this systematic difference will be controlled for in the first difference of the process.

grade ratings into BB and B-CCC partitions. This partition process yields credit rating sub-samples of 14 countries in the AAA-AA partition and 9 countries in each of the other three partitions. Virtually without exception, statistically significant improvement in price efficiency is isolated to the B-CCC credit rating partition, which realizes gains across all five price factors and in the JOINT model.[15] Similarly, the magnitude of the improvement is typically greater for the B-CCC credit rating partition relative to the other partitions. For example, contrasting the B-CCC and the AAA-AA partitions, the average improvement in the JOINT model is 0.0864 relative to 0.0171, respectively. To provide a sense of scale, for the B-CCC partition, the average D_{rsq} decreased from 0.6665 to 0.5663 following CDS trading initiation, representing a 15% improvement in yield adjustment efficiency at the daily frequency (based on the JOINT model).

In summary, we find that price efficiency effects related to CDS trading initiation vary significantly across country-level attributes. On average price efficiency gains are noted for the aggregate sample across two of the five price factors and in the JOINT model. However, sub-sample analysis indicates that statistically significant efficiency gains are, in fact, generally isolated to high default risk countries. Consistent with our hypotheses, CDS trading initiation effects are most pronounced for countries with greater investor demand to hedge adverse selection costs and expand the risk-return space.

5.1.2. Price Informativeness Multivariate Results

Although useful to provide a general sense of the price efficiency effects of CDS trading initiation, there are a number of concerns that potentially impede interpretation of the results

[15] The one exception is improvement in price efficiency in relation to the WORLD factor for the AAA-AA partition, but the magnitude of the improvement is half the magnitude of the improvement realized for the B-CCC partition.

presented in the previous section. First, selection for CDS trading initiation is non-random and if factors which motivate trading initiation are correlated with price efficiency then the relations we document may be spurious. Second, the t-test statistics reported assume that spread observations for different bonds from the same country are independent when this is likely not the case. Finally, given the relatively small size of our sample, country or bond-level characteristics not related to CDS trading initiation may be coincidentally influencing price efficiency.

To control for potential selection bias we utilize the Heckman (1997) two-stage model. For guidance in the application of this approach, we follow the process and suggestions outlined by Lennox, Francis and Wang (LFW, 2012). The first stage model is as presented in Table III. LFW emphasize that to correctly control for endogeneity, one or more of the independent variables need to be correlated with the dependent variable in the first stage but be unrelated to the dependent variable in the second stage. In our models, those variables are local equity index volatility, the local exchange rate with the USD and the regional and global CDS indices. Each of these variables is significantly related to the CDS initiation indicator variable in the first stage with p-values less than 1%. The logit model including just these variables as predictors of CDS initiation likelihood has a pseudo-R^2 of 25% which is statistically unique from zero (p-value < 0.0001 based on the likelihood ratio Chi-square test, H_o Beta=0). These values are comparable to exogenous variable strength tests in the literature.[16] As reported in Table V, these variables are unrelated to the change in spread adjustment efficiency; t-statistics for the coefficients of these variables are typically less than 1.0.

The objective of the second stage regression is to validate that the change in spread efficiency varies across default risk partitions while controlling for selection bias. To this end, we relate the change is spread adjustment efficiency to a credit rating rank variable (*Rating*

[16] See for example, Feng, Li and McVay, 2009.

Rank) assigned a value of 1 through 4 based on the credit rating partitions of AAA-AA, A-BBB, BB and B-CCC, respectively. If spread efficiency improvements are greater for higher risk countries, we expect the coefficient on *Rating Rank* to be negative and significant (i.e. the decrease in spread adjustment delay is greater for bonds with higher default risk). As the dependent variable is an estimated quantity from the process described by Equation (3), heteroskedasticity is a concern. To correct for potential heteroskedasticity induced by variance in the observations of the dependent variable we follow Lewis and Linzer (2005) and calculate t-statistics utilizing White (1980) heteroskedastic consistent standard errors. Standard errors are also clustered by country to control for potential lack of independence in residuals for bonds issued by the same country. Our results are unaffected if time fixed effects are added to the model. Model estimates with the change in spread efficiency from the JOINT model as the dependent variable are presented in Panel A. The dependent variables in Panel B are the change in spread efficiency for the individual price factors.

As advocated by LFW, all variables considered in the first stage are likewise considered in the second stage regression with the addition of the inverse mills ratio (IMR) calculated from Model (4) in Table III. Our results are insensitive to the model used to generate the IMR. To control for potential multicolinearity induced by inclusion of IMR with the variables used in its estimation, we test model stability by varying the variables included in the second stage. Several variants of this iterative process are reported in Panel A of Table V (Models (2) to (6)), excluding variables most highly correlated with IMR (see Table II). Inclusion of selection bias controls, if anything, strengthens our results, increasing the magnitude of the coefficient on *Rating Rank* and increasing its significance. Without exception, in the reported and unreported iterations of the model, the coefficient on *Rating Rank* is negative and significant at the 5% level.

The logit model robustness tests reported in Section 4 suggest that liquidity has little influence on the likelihood of CDS initiation; regardless it is a logical control to include in our models. The change in turnover between the quarters preceding and following CDS initiation, excluding the initiation quarter, is used as an additional control to proxy for liquidity. Turnover data is available for 66% of the bonds in our sample (117 out of 177). To ensure that limiting the sample to bonds with available turnover data is not imposing additional selection bias, we first replicate Model (6) for the reduced sample.[17] Results are highly similar, the coefficient for *Rating Rank* in the reduced sample is -0.054 (t-statistic -2.26 in Model 7), which is statistically indistinguishable from the coefficient in the full sample (-0.058). When the liquidity control is added in Model (8), the *Rating Rank* coefficient is unaffected and improves in significance. As would be expected, liquidity significantly predicts price efficiency; bonds with a larger increase in turnover realize greater reductions in price adjustment delay (t-statistic -17.43). Other than turnover, the control variables in all the models are generally insignificant. The one exception is increases in the equity risk premium are typically associated with increases in price efficiency. This relation potentially results from more active trading in debt markets in periods of heightened risk.

In Panel B, we replicate Model (6) in Panel A utilizing the change in spread adjustment efficiency from the individual factor models as separate dependent variables. This allows us to potentially make inferences regarding the source of the efficiency gains noted for the JOINT model. Price efficiency gains are largest in relation to the term spread level factor but otherwise gains are similar across price factors. These similarities suggest that no specific information source becomes impounded into spreads more efficiently (i.e. efficiency gains are similar for

[17] The liquidity robustness tests focus on Model 6. Our results are insensitive to the model utilized in the robustness tests.

local relative to global price factors). The default risk partition results are similarly robust to inclusion of the liquidity control.

5.2. Borrowing Costs

Next, we examine if CDS trading related improvements in sovereign bond price efficiency translate into reductions in borrowing costs. As previously discussed, we expect borrowing costs effects to be particularly pronounced for informationally-opaque, high default risk countries for which information asymmetries are likely most severe. To investigate the effects of CDS trading initiation on borrowing costs, we utilize a pooled, time series regression model relating bond spreads to a CDS trading initiation indicator and control variables:

$$SP_{it} = \beta_0 + \beta_1 CDS_{it} + \beta_2 MAT_{it} + \beta_3 X_{it} + \beta_4 Y_t + \beta_5 Z_{t-1} + \varepsilon_{it} \qquad (4)$$

where SP_{it} is the average stripped bond spread of bond *i* in quarter *t*, and CDS_{it} is an indicator variable that takes the value of one after CDS initiation for the country of bond *i*, and zero before. The model is estimated over the period of 2 quarters preceding and following CDS trading initiation, excluding the initiation quarter. If CDS trading initiation is related to a reduction in borrowing costs, we expect a negative and significant coefficient for CDS_{it}, with the magnitude of the effect captured by the absolute value of the coefficient.

In order to isolate CDS trading initiation effects from coincidental influences and selection biases, our models include domestic (*X*) and international factors (*Y*) that have been identified as determinants of sovereign bond spreads, and factors predictive of CDS trading initiation (*Z*) identified in Section 4.[18] The domestic factors are: 1) *ΔER*, the change in local

[18] See Westphalen (2001) and Collin-Dufresne et al. (2001) who examine the determinants of bond yields.

currency-USD exchange rate; 2) *CREDIT*, Standard and Poor's foreign currency credit rating at CDS initiation; 3) Δ*FORRES*, the change in country foreign currency reserves; 4) *VOL*, the volatility of the country return index; and 5) *ExDebt*/*GDP*, the external debt per GDP ratio. The international factors include: 1) Δ*YL* and Δ*YS*, the changes in the first two principle components of a set of US T-Bonds; and 2) *WORLD*, the global index return. The selection bias controls are the changes in: 1) the local currency-USD exchange rate; 2) country foreign currency reserves; 3) volatility of the country return index; and 4) country credit rating, all lagged by one quarter. These variables are as previously described and defined in the Appendix. In addition, in order to control for the effect of bond maturity on yields, we include *MAT*, an indicator variable that takes the value of 1 if the bond has more than ten years to maturity, and zero otherwise. These data are available for 37 countries in our sample. As in past models, we cluster standard errors by country.

By necessity the selection bias control process varies between the price efficiency and borrowing cost models for several reasons. First, Equation (4) includes observations before and after CDS trading initiation. However, the IMR is defined only in the pre-initiation period as the underlying first stage model predicts CDS trading initiation likelihood. Although the IMR cannot be included in the model, its joint determinants (the variables significant in Model (4) of Table III) are included to similarly control for selection bias. Second, the CDS index data in our models is derived from the Markit database which commences in 2001. Thus, given the timing of CDS trading initiation, the bonds issued by 16 countries in our sample lack complete CDS index coverage in the pre-initiation period. Requiring CDS index availability significantly reduces the sample, making inferences within the risk partitions impossible. For the bonds with complete CDS index data, correlations between the CDS initiation indicator variable and the indexes are very low (0.0689 for the global and 0.0095 for the regional CDS index, respectively). The low values of these correlations give us confidence that the indexes do not materially affect sovereign borrowing costs.[19]

As in past models, we report results including and excluding the selection bias controls (Models 1 and 2, respectively). For robustness, we then replicate Model (2) in aggregate for the reduced sample of bonds for which liquidity data is available (Models 3 and 4).

5.2.1. Borrowing Cost Aggregate Analysis

The borrowing cost results for the aggregate sample are reported in Panel A of Table VI. On average, in Model (1) we find a statistically significant (1% level) reduction in borrowing costs of 74 bps following CDS trading initiation. Inclusion of the selection bias controls (Model 2) does not alter our conclusions. The size and significance of the CDS indicator coefficient is virtually unaffected, -73.83 relative to -72.72 in Models (1) and (2), respectively. Focusing briefly on the control variables, we find that the cost of debt increases with bond maturity, depreciation of the local currency, and uncertainty regarding local economic strength (measured by the volatility of local equity index returns). Yields typically decline with an improvement in credit rating or an increase in local equity index returns.

We next consider the potential influence of liquidity on the change in borrowing costs associated with CDS trading initiation. As previously noted, approximately two thirds of the bonds in our sample have complete trading volume data in Datastream. To control for potential additional selection bias due to characteristics common to bonds which report trading volume data, we replicate Model (2) in Table VI for the reduced sample of bonds with available turnover

[19] For robustness, in unreported tests we find that in aggregate, borrowing costs are unaffected by the inclusion of the CDS indexes when model (2) is replicated for the reduced sample of bonds with complete CDS index data.

data. Results are highly similar between the two models; coefficient for the CDS indicator is -72.72 in Model (2) and -65.88 in Model (3) for the full and liquidity reduced samples, respectively. Addition of the liquidity control (Model (4)) has virtually no effect on the CDS indicator variable (-65.88 and -63.97 with and without the liquidity control, respectively).

5.2.2. Borrowing Cost Credit Risk Partition Analysis

Next we test if the effects of CDS trading initiation on borrowing costs vary with default risk. In Panel B of Table VI, we partition our sample by the previously defined four credit risk partitions and replicate Models (1) and (2) from Panel A. The statistical significance of the CDS coefficient is relatively consistent across the four credit rating partitions, but the economic significance varies quite widely. Consistent with our discussed hypotheses, the smallest reduction in the cost of debt is realized by AAA-AA rated bonds (approximately 21 bps), with a reasonably monotonic increase in yield reductions across the other risk partitions. Bonds in the B-CCC category realize average reductions in borrowing costs in excess of 125 bps. The credit rating partition results are similarly robust to inclusion of the liquidity proxy (unreported). For example, the coefficient on the CDS indicator in the AAA-AA and B-CCC partitions for the liquidity sub-sample are -17 and -100 relative to values in the full model of -22 and -113, respectively (all significant at the 5% level).

6. Discussion and Concluding Remarks

To summarize our results, we find that, spread adjustment efficiency improves for the underlying bond following CDS trading initiation and these improvements are most marked for high default risk countries. Second, borrowing costs of all issuers decline following CDS trading initiation, with the biggest reductions attained by countries with the highest default risk. These results imply that increased informational efficiency induced by the CDS trading initiation is associated with a reduction in the cost of debt for the countries for which information asymmetries are the most pronounced.

These findings support our ex-anti expectations and the expectations stated in Ashcraft and Santos (2009), but are inconsistent with their results, which show that high risk firms are adversely affected by CDS trading initiation, while less risky and transparent firms realize benefits in the form of small reductions in borrowing costs. Further, our results strongly contrast results reported by Das et al. (2012) who report widespread reductions in price efficiency and reductions in liquidity for corporate bonds following initiation of CDS trading. Reflective of the mixed results in this literature, our results are more consistent with Massa and Zhang (2012) who find that CDS trading initiation is related to increases in liquidity and reductions in borrowing costs for the underlying bonds. However, in their setting CDS initiation effects are more pronounced for investment grade bonds. All of these papers focus on the corporate bond market, suggesting divergent effects of CDS trading initiation between the sovereign and corporate debt markets.

Differing effects are not entirely unexpected. First, liquidity constraints are less binding for sovereign bonds which, as previously discussed, trade in a significantly more liquid market than their corporate counterparts. To gain a sense of liquidity effects of CDS trading initiation in our sample, we relate turnover to a CDS trading initiation indicator and control variables for a reduced sample of 96 bonds with quarterly turnover data available the year surrounding CDS trading initiation. Specifically, we replicate Model (3) in Table VI with turnover as the dependent variable with 4 quarterly observations per bond (2 before and 2 after CDS trading initiation, excluding the initiation quarter). The results summarized in Table VII show that, on average, CDS trading initiation has no perceptible effect on liquidity in the underlying market. For bonds in the B-CCC credit risk partition, however, sovereign bond market liquidity almost doubles following CDS introduction. Thus in our setting, the set of bonds that realize the largest improvements in price efficiency and borrowing costs also realize the largest liquidity improvements. This relation is consistent with increased hedging opportunities and expansion of the available risk-reward space associated with CDS trading attracting greater investor participation in higher risk bonds. In contrast, Massa and Zhang (2012) attribute effects to reduced fire sale risk induced by investment mandates of insurance companies, which are much less significant players in sovereign markets.

Second, Ashcroft and Santos (2009) examine the effect of CDS trading on corporate bond borrowing costs in the primary markets; we analyze the cost of debt for sovereign issuers in the secondary markets. A significant body of literature has documented that new issues of debt or equity, whether IPOs or seasoned offerings, tend to be underpriced in primary markets.[20] Commack (1991) and Spindt and Stolz (1992) identify the primary market dealers' diversity of opinion regarding the value of the bond issue as an important determinant of bond underpricing. Signaling theory argues that managers of good firms use underpricing as a way to signal the credit quality of their firms, while bad firms will not find it in their interest to do so. If CDS trading provides new and better information about an issuer' credit risk (see Blanco et al., 2005; Longstaff et al., 2005), agreement among market dealers about the value of bond issues following CDS trading initiation may result in a correction in the primary bond markets. The lemon theory effect on either good or bad firms may diminish, which may cause lower

[20] Ibbotson (1975) is the first study showing underpricing of new equity issues. It was followed by Beatty and Ritter (1986), Loughran et al. (1994), and Hoberg (2007), among many others. Cammack (1991), Spindt and Stolz (1992), and Goldreich (2007) investigate the underpricing in Treasury primary markets. See Weinstein (1978), Wasserfallen and Wydler (1988) and Cai, Helwege, and Warga (2007) for underpricing in corporate bond markets.

underpricing for creditworthy issuers and higher underpricing for high risk issuers. This process may explain Ashcraft and Santos (2009) findings, which are less applicable in our setting.

Taken collectively, these results suggest that the impact of credit derivatives in the sovereign bond market is broadly positive. Debt markets become more informative, at least for informationally-opaque countries for which it likely matters the most, and on average borrowing costs are reduced, likewise most substantially for higher default risk countries. Broad reaching bans on naked CDS positions, which likely represent the majority of CDS trading, may have potentially adverse and unintended implications on the quality of the sovereign debt market, reversing the benefits we document.

Appendix

This appendix provides additional details regarding the determinant variables used as predictors of sovereign CDS trading initiation likelihood in section 4.

1. **Local Stock Market Return (*INDEX*).** The local stock market return is the quarterly total return including dividends for the equity index of each country. The data is obtained from Datastream, with MSCI or S&P IFC as the underlying source of each index.

2. **Local Stock Market Volatility (*VOL*).** We calculate local stock market volatility in two ways. In the efficiency and borrowing cost models, volatility is calculated as the absolute residual from the regression of the index return on twelve lags of the index return and day of the week indicator variables. As daily local index returns are not available for a portion of the additional countries considered in the CDS initiation likelihood tests, for the logit models in Section 4 volatility is calculated as the sum of squared monthly returns, by quarter, for the local stock market index (*INDEX*).

3. **Exchange Rate (*ER*).** Exchange rates are expressed as units of local currency to the USD and are obtained from Bloomberg.

4. **Foreign Currency Reserves (*FORRES*).** The USD value of foreign currency holdings are collected from Datastream with the World Bank as the underlying source. Defined as Foreign Exchange Reserves, they include foreign banknotes, bank deposits, treasury-bills,

short and long-term government securities, ECUs and other claims usable in the event of a balance of payment need.

5. **Sovereign Credit Rating (*CREDIT*).** The foreign currency credit rating is obtained from the Standard and Poor's Sovereign Rating and Country Transfer and Convertibility Assessment Histories (2009). The ratings are assigned a numeric value, where AAA=1, AA=2 through C=9. The plus or minus sign following a letter rating is associated with a decline or, respectively, an increase of 0.33 in the numerical value associated with the letter rating. For example, the numerical value assigned to AA+ is 1.67. The numerical value assigned to AA- is 2.33.

6. **Gross Domestic Product (*GDP*).** Gross domestic product in USD, seasonally and inflation adjusted, is collected from Datastream with the World Bank as the underlying source.

7. **Global Index Return (*WORLD*).** Global index return is the total return to the MSCI Global Equity Index.

8. **Equity Risk Premium (*EQU*).** As a proxy for the equity risk premium we follow Longstaff et al. (2011) and use the price-earnings ratio for the S&P 100 index obtained from Datastream.

9. **Volatility Risk Premium (*VOLPRM*).** The volatility risk premium is calculated as the difference between the VIX index (expected volatility) and realized volatility calculated as

in Garman and Klass (1980). The S&P 500 index open, close, low and high values used in the Garman-Klass calculation are obtained from Datastream. The VIX index corresponding to the S&P 500 index is obtained from the Chicago Board Option Exchange website.

10. **Default Spread (*DEF*).** The default spread is calculated as the difference in yields between the BBB and AAA rated US corporate bond index yields obtained from the Federal Reserve Bank of St. Louis.

11. **Regional (*REG*) and Global (*GLOBE*) CDS Spreads.** For each country, we calculate the regional CDS spread as the equal-weighted average CDS spread for all countries in that region, excluding the spread for that country. We use five broad regions: Asia, Middle East, Eastern Europe, Western Europe and Latin America. Canada and the United States, being the only North American countries, are included in the Western Europe region. The regional and global indexes are then orthoganalized by regressing them on the other determinant variables. The residuals from these regressions are then used as the measures of the regional and global CDS spreads.

12. **Turnover**. Turnover is calculated as the dollar value of trading volume standardized by market value of the bond issue lagged one quarter. USD denominated sovereign bond trading volume and market value data are obtained from Datastream.

References

Acharya, V. and T. Johnson. 2007. Insider trading in credit derivatives. *Journal of Financial Economics* 84, 110-141.

Augustin, P. 2012. The term structure of CDS spreads and sovereign credit risk. Working paper, Stockholm School of Economics.

Ammer, J. and F. Cai. 2011. Sovereign CDS and bond dynamics in emerging markets: Does the cheapest-to-deliver option matter? *Journal of International Financial Markets, Institutions and Money* 21, 369-387.

Ashcraft, A. and J. Santos. 2009. Has the CDS market lowered the cost of corporate debt? *Journal of Monetary Economics* 56, 514-523.

Attinasi, M., C. Checherita and C. Nickel. 2010. What explains the surge in Euro area sovereign spreads during the financial crisis of 2007-09? Working paper, European Central Bank.

Avramov, D., T. Chordia and G. Amit. 2006. The impact of trades on daily volatility. *Review of Financial Studies* 19, 1241-1277.

Beatty, R.P. and J. Ritter, 1986. Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics* 15, 213-233.

Blanco, R., S. Brennan and I. Marsh. 2005. An empirical analysis of the dynamic relationship between investment-grade bonds and credit default swaps. *Journal of Finance* 60, 2255-2281.

Bongaerts, D., F. De Jong and J. Driessen, 2011, Derivative pricing and liquidity risk: Theory and evidence from the credit default swap market, Journal of Finance 66, 203-240.

Brandt, M. and K. Kavajecz. 2004. Price discovery in the U.S. treasury market: The impact of orderflow and liquidity on the yield curve. *Journal of Finance* 59, 2623-2654.

Brennan, M. and H. Cao. 1997. International portfolio investment flows. *Journal of Finance* 52, 1851-1880.

Cai, N., J. Helwege and A. Warga, 2007. Underpricing in the corporate bond market. *Review of Financial Studies* 20, 2021-2046.

Cammack, E. 1991. Evidence on bidding strategies and the information in Treasury Bill actions. *Journal of Political Economy* 99, 100-130.

Chan-Lau, J. and Y. Kim. 2004. Equity prices, credit default swaps and bond spreads in emerging markets. Working paper, International Monetary Fund.

Collin-Dufresne, P., R. Goldstein and S. Martin. 2001. The determinants of credit spread changes. *Journal of Finance* 56, 2177-2207.

Danielsen, B., B. Van Ness and S. Warr. 2007. Reassessing the impact of option introductions on market efficiency: A less restrictive test for event-date effects. *Journal of Financial and Quantitative Analysis* 42, 1955-1980.

Das, S., M. Kalimipalli and S. Nayak. 2012. Did CDS trading improve the market for corporate bonds? Working paper, Santa Clara University.

Detemple, J. and L. Selden. 1991. A general equilibrium analysis of option and stock market interactions. *International Economic Review* 32, 279-303.

Dittmar, R., and K. Yuan, 2008. Do sovereign bonds benefit corporate bonds in emerging markets? *Review of Financial Studies* 21, 1983-2014.

Duffie, D. 2010. Is there a case for banning short speculation in sovereign bond markets? *Financial Stability Review* 14, 55-59.

Duffie, D., L. Pedersen, and K. Singleton. 2003. Modeling sovereign yield spreads: A case study of Russian debt. *Journal of Finance* 58, 119–59.

Feng, M., C. Li and S. McVay. 2009. Internal control and management guidance. *Journal of Accounting and Economics* 48, 190-209.

Garman, M. and Klass, J. 1980. On the estimation of security price volatilities from historical data. *Journal of Business* 53, 67-78.

Goldreich, D., 2007. Underpricing in discriminatory and uniform-price Treasury auctions. *Journal of Financial and Quantitative Analysis* 42, 443-466.

Gorton, G., and G. Pennacchi. 1993. Security baskets and index-linked securities, *Journal of Business* 66, 1–27.

Grossman, S. 1988. An analysis of the implications for stock and futures price volatility of program trading and dynamic hedging strategies. *Journal of Business* 43, 617-633.

Heckman, J. 1997. Instrument variables: A study of implicit behavioral assumptions used in making program evaluations. *Journal of Human Resources* 32, 441-462.

Hoberg, G., 2007. The underwriter persistence phenomenon. *Journal of Finance* 62, 1169–1206.

Hou, K. and T. Moskowitz. 2005. Market frictions, price delay, and the cross section of expected returns. *Review of Financial Studies* 18, 982-1020.

Hull, J., M. Predescu and A. White. 2004. The relationship between credit default spreads, bond yields and credit rating announcements. *Journal of Banking and Finance* 28, 2789-2811.

Ibbotson, R.I., 1975. Price performance of common stock new issues. *Journal of Financial Economics* 2, 235-272.

Ismailescu, I. and H. Kazemi. 2010. The reaction of emerging markets credit default swap spreads to sovereign credit rating changes. *Journal of Banking and Finance* 34, 2861-2873.

Jahjah, S. and V. Yue. 2004. Exchange rate policy and sovereign bond spreads in developing countries. Working paper, International Monetary Fund.

Jones, C., G. Kaul and M. Lipson. 1994. Transactions, volume and volatility. *Review of Financial Studies* 7, 631-651.

Kang, J. and R. Stultz. 1997. Why is there a home bias? An analysis of foreign portfolio equity ownership in Japan. *Journal of Financial Economics* 46, 3-28.

Kopecki D. and D. Harrington. 2009. Banning “naked” default swaps may raise corporate funding costs, Bloomberg News, January 24,
http://www.bloomberg.com/apps/news?pid=newsarchive&sid=awJDsS9.OHjc

Lennox, C., J. Francis and Z. Wang. Selection models in accounting research. *The Accounting Review* 87, 589-616.

Lewis, J. and D. Linzer, 2005, Estimating regression models in which the dependent variable is based on estimates, *Political Analysis* 13, 345-364.

Litterman, R., and J. Scheinkman. 1991. Common factors affecting bond returns. *Journal of Fixed Income* 1, 54-61.

Longstaff, F., S. Mithal and E. Neis. 2005. Corporate yield spreads: Default risk or liquidity. *Journal of Finance* 60, 2213-2253.

Longstaff, F., J. Pan, L. Pedersen and K. Singleton. 2011. How sovereign is sovereign credit risk? *American Economic Journal: Macroeconomics* 3, 75-103.

Loughran, T., J. Ritter and K. Rydqvist, 1994. Initial public offerings: international insights. *Pacific-Basin Finance Journal* 2, 165-199.

Massa, M. and L. Zhang. 2012. CDS and the liquidity provision in the bond market, Working paper, INSEAD.

Mayhew, S. and V. Mihov. 2004. How do exchanges select stocks for option listing? *Journal of Finance* 59, 447-463.

Mayhew, S. and V. Mihov. 2005. Short sale constraints, overvaluation and the introduction of options. Working paper, Texas Christian University.

Norden, L. and M. Weber, 2004. Informational efficiency of credit default swaps and stock markets: The impact of credit rating announcements. *Journal of Banking and Finance* 28, 2813-2843.

Phillips, B. 2011. Option introduction, short-sale constraints and market efficiency: A new perspective. *Journal of Banking and Finance* 35, 430-442.

Ross, S. 1976. Options and efficiency. *Quarterly Journal of Economics* 90, 75-89.

Saretto, A. and H. Tookes. 2013. Corporate leverage, debt maturity and credit default swaps: The role of credit supply. *Review of Financial Studies* 26, 1190-1247.

Shiller, R. 1993. *Macro Markets.* Oxford University Press.

Shleifer, A. 2003. Will the sovereign debt market survive? *American Economic Review* 93, 85-90.

Spindt, P.A. and R.W. Stolz, 1992. Are US Treasury bills underpriced in the primary market? *Journal of Banking and Finance* 16, 891-908.

Standard and Poor's, 2009. Sovereign rating and country transfer and convertibility assessment histories. June 2009.

Stein, J. 1987. Informational externalities and welfare-reducing speculation. *Journal of Political Economy* 95, 1123-1145.

Stultz, R. 2010. Credit default swaps and the credit crisis. *Journal of Economic Perspectives* 24, 73-92..

Van Nieuwerburgh, S. and L. Veldkamp. 2009. Informational immobility and the home bias puzzle. *Journal of Finance* 64, 1187-1215.

Wasserfallen, W. and D. Wydler, 1988. Underpricing of newly issued bonds: Evidence from the Swiss capital market. *Journal of Finance* 5, 1177-1191.

Weinstein, M.I., 1978. The seasoning process of new corporate bond issues. *Journal of Finance* 33, 1342-1355.

Westphalen, M. 2001. The determinants of sovereign bond credit spreads changes. Working paper, Universite de Lausannne.

Yuan, K. 2005. The liquidity service of benchmark securities. *Journal of European Economic Association* 3, 1156–1180.

Table I

Bond and CDS Data Summary Statistics

Table I summarizes the sovereign bond sample. The number of bonds, the mean and standard deviation of bond stripped-spreads (bond spread in excess of a maturity matched US T-bill) and average bond market value are reported for the 6 month period bracketing CDS trading initiation. The last column reports the Standard and Poor's (S&P) credit rating at the time of the CDS introduction. Table I is continued on the following page.

Country	Start of CDS data	No. of bonds	Bond spread Mean (bps)	Bond Spread Std (bps)	Bond market value (millions)	S&P credit rating at CDS initiation
Australia	4/30/03	1	86.63	29.31	362.06	AAA
Austria	5/29/01	9	69.45	14.56	536.06	AAA
Bahrain	2/9/04	1	87.39	14.17	512.66	A
Belgium	1/31/01	5	76.03	19.69	664.68	AA
Canada	1/1/03	4	22.74	11.21	1952.23	AAA
Chile	2/1/02	2	174.81	30.49	655.21	A
Colombia	3/22/01	11	645.98	176.61	251.65	BB
Costa Rica	7/29/03	8	339.59	71.19	283.92	BB
Croatia	1/4/01	1	230.90	12.71	303.83	BBB
Cyprus	2/1/02	1	79.65	32.15	316.62	A
Denmark	11/26/02	9	19.83	12.73	525.76	AAA
Dominican Republic	6/30/03	2	665.48	110.42	16.87	B
Ecuador	6/6/03	2	1326.78	147.13	1032.78	CCC
Egypt	3/21/02	3	365.62	84.14	843.40	BBB
El Salvador	4/30/03	5	383.99	121.76	596.76	BB
Finland	7/1/02	4	51.96	28.33	1161.33	AAA
Germany	7/2/02	2	45.33	44.10		AAA
Ghana	5/15/08	1	436.62	27.25	792.81	B
Guatemala	7/29/03	3	421.45	36.93	312.30	BB
Indonesia	12/13/01	1	581.64	128.71	379.99	CCC
Israel	4/23/01	4	150.68	81.30	331.74	A

Table I continued

Country	Start of CDS data	No. of bonds	Bond spread Mean (bps)	Bond Spread Std (bps)	Bond market value (millions)	S&P credit rating at CDS initiation
Italy	1/31/01	11	86.33	49.43	1908.76	AA
Jamaica	5/22/03	6	880.02	178.12	326.83	B
Lebanon	3/25/03	11	594.89	149.38	370.55	B
Malaysia	4/23/01	1	219.82	17.31	1674.79	BBB
New Zealand	7/31/03	7	105.51	118.65	255.21	AA
Pakistan	6/29/04	1	318.15	25.89	512.14	B
Panama	2/1/02	6	390.05	69.93	512.85	BB
Peru	2/1/02	1	359.57	21.31	77.62	BB
Philippines	3/22/01	6	637.71	111.78	867.59	BB
Portugal	2/7/02	2	34.89	9.88	1071.50	AA
Qatar	9/5/01	3	304.61	74.99	1441.74	BBB
Russia	9/18/01	11	867.98	190.09	1392.41	B
Slovakia	5/24/01	2	155.81	22.79	334.48	A
South Africa	1/11/01	2	323.40	49.23	475.58	BBB
Spain	2/26/01	4	85.28	32.18	1063.97	AA
Sweden	5/29/01	4	74.47	27.50	478.85	AA
Thailand	2/28/01	2	175.51	53.91	480.32	BBB
Turkey	1/19/01	9	770.95	186.05	745.21	B
United Kingdom	3/31/06	1	10.33	9.84	2912.64	AAA
Venezuela	2/26/01	5	695.01	226.26	1087.35	B
Mean			325.68	69.74	745.58	

Table II

CDS Initiation Determinant Variable Correlation Matrix

Table II reports the correlation matrix of the CDS initiation determinant variables. *INDEX*, *VOL* and *ER* are the local MSCI index return, local MSCI index volatility and the local currency USD exchange rate. *FORRES* is the USD value of foreign currency holdings and *CREDIT* is the numerical value assigned to the Standard and Poor's foreign currency credit rating. World is the return to the MSCI global index, *YL* and *YS* are the first two principal components of a set of US T-Bonds (90 day, 1-year, 2-year, 5-year, 7-year, and 10-year maturities). *EQU* is the equity risk premium, *VOLPRM* is the volatility risk premium, *DEF* is the default spread, *REG* and *GLOBE* are the orthoganalized regional and global sovereign CDS spread indexes and *IMR* is the Inverse Mills Ratio obtained from the logit model relating a CDS initiation quarter indicator to the determinant variables. Detailed descriptions of the determinant variables appear in the Appendix.

	INDEX	ΔVOL	ΔER	ΔFORRES	ΔCREDIT	WORLD	ΔYL	ΔYC	ΔEQU	VOLPRM	DEF	REG	GLOBE	IMR
INDEX	1													
ΔVOL	0.058	1												
ΔER	-0.082	0.080	1											
ΔFORRES	0.087	-0.032	0.039	1										
ΔCREDIT	-0.012	0.040	-0.032	-0.034	1									
WORLD	-0.162	-0.016	0.066	0.014	-0.070	1								
ΔYL	0.074	0.112	0.004	-0.006	-0.072	0.142	1							
ΔYC	-0.131	-0.014	0.147	-0.011	-0.072	0.569	0.287	1						
ΔEQU	0.110	0.078	-0.081	0.040	-0.059	-0.513	0.068	-0.492	1					
VOLPRM	-0.061	-0.016	-0.004	-0.052	-0.054	0.764	0.236	0.448	-0.452	1				
DEF	-0.091	0.029	0.355	-0.032	0.079	-0.145	-0.208	0.119	-0.214	-0.212	1			
REG	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1		
GLOBE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1	
IMR	-0.022	-0.331	-0.347	0.144	0.246	0.046	0.024	0.069	0.053	0.080	-0.197	-0.654	0.347	1

Table III

The Determinants of CDS Trading Initiation

Table III reports standardized coefficient estimates and p-values from the logit model of CDS trading initiation as a function of global and country-specific factors. The determinant variables are quarterly in frequency and are lagged by one period in the model. *ExDebt/GDP* is total external debt standardized by GDP in USD, all other variables are as defined in Section 4 and are described in detail in the Appendix. The model is estimated from a pooled sample (409 observations) of all countries that initiate trading in the Markit dataset between February, 2001 and September 2010.

Model	(1)		(2)		(3)		(4)	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
Local Variables								
$INDEX_{t-1}$	0.04	0.81	-0.03	0.83	-0.04	0.74		
ΔVOL_{t-1}	1.01	0.001	1.09	0.001	1.15	0.001	1.10	0.001
ΔER_{t-1}	0.34	0.04	0.43	0.007	0.43	0.006	0.41	0.004
$\Delta FORRES_{t-1}$	-0.26	0.06	-0.27	0.06	-0.26	0.06	-0.26	0.06
$\Delta CREDIT_{t-1}$	-0.37	0.04	-0.41	0.03	-0.41	0.03	-0.42	0.03
$\Delta ExDebt/GDP_{t-1}$	0.09	0.52						
Global Variables								
$WORLD_{t-1}$	0.17	0.49	0.19	0.41	0.06	0.75		
ΔYL_{t-1}	-0.26	0.26	-0.02	0.92				
ΔYC_{t-1}	-0.07	0.68	-0.32	0.14	-0.04	0.81		
ΔEQU_{t-1}	-0.02	0.89	-0.20	0.30	-0.34	0.11		
$VOLPRM_{t-1}$	-0.20	0.38	-0.21	0.35	-0.18	0.36	-0.32	0.11
DEF_{t-1}	-0.11	0.59	-0.07	0.63	-0.06	0.69	-0.20	0.24
REG_{t-1}	0.86	0.001	0.87	0.001	0.87	0.001	0.88	0.001
$GLOBE_{t-1}$	-0.43	0.004	-0.39	0.005	-0.39	0.005	-0.39	0.005
N (Countries)	54		63		63		63	
Pseudo R^2	0.30		0.30		0.30		0.30	
% classified correctly	79.1		79.4		78.7		78.5	
% classified incorrectly	20.5		20.4		21.0		21.2	
% tied	0.3		0.2		0.3		0.3	

Table IV

Price Informativeness Univariate Analysis

Table IV reports the change in sovereign bond spread adjustment delay associated with CDS trading initiation. Spread adjustment delay is measured as one minus the ratio of the R^2 values from the base and augmented variants of a time-series factor model. In the base variant, the change in the bond striped-spread is regressed on the five factors described below plus the local currency USD exchange rate. The augmented variant of the model additionally includes five lagged values of one price factor as additional independent variables, calculated separately for each price factor and collectively (JOINT). The price factors are as follows: *INDEX* is the return to the issuing country's MSCI index, *WORLD* is the return to the global MSCI index, *VOL* is the volatility of the issuing country's MSCI index, measured as the residual from the regression of index return regressed on twelve lags of the index return and day of week indicator variables. *YL* and *YS* are the first two principle components of a set of US T-Bills (90 day, 1-year, 2-year, 5-year, 7-year, and 10-year maturities). The change in spread adjustment delay for each price factor is calculated as the difference in the delay measure calculated over the period 3-months before relative to 3-months after CDS trading initiation. T-statistics are reported in parentheses with significance at 1, 5, and 10% level is denoted by ***, **, and *, respectively. Panel A reports results for the aggregate sample and Panel B reports sub-sample results for partitions formed based on default risk proxied by the county's S&P credit rating. Excess change in efficiency in Panel A is calculated as the efficiency change difference between the test country and a time series matched control sample. In Panel B, the number of countries in each partition is reported with the number of bonds presented in brackets.

Panel A. Mean Change in Spread Adjustment Delay

	INDEX	WORLD	ΔVOL	ΔYL	ΔYC	JOINT
Raw Change	-0.0217	-0.0294	-0.0275	-0.0174	-0.0244	-0.0364
	(-1.52)	(-2.11)	(-1.78)	(-0.86)	(-1.24)	(-2.20)
Excess Change	-0.219	-0.0397	-0.0280	-0.0189	-0.0199	-0.0367
	(-1.60)	(-3.04)	(-1.77)	(-0.95)	(-0.98)	(-2.21)

Panel B. Mean Change in Spread Adjustment Delay by Default Risk

Rating group	Grade	N	INDEX	WORLD	ΔVOL	ΔYL	ΔYS	JOINT
1	AAA-AA	14 (67)	-0.0101	-0.0381	-0.0196	-0.0034	0.001	-0.0171
			(-0.57)	(-2.18)	(-1.19)	(-0.15)	(0.01)	(-1.05)
2	A-BBB	9 (19)	0.0132	0.0334	0.0394	0.0990	0.0123	-0.0231
			(0.35)	(0.75)	(0.75)	(1.44)	(0.20)	(-0.37)
3	BB	9 (48)	-0.0103	-0.0404	-0.0155	-0.0541	-0.0244	-0.0298
			(-0.39)	(-1.27)	(-0.45)	(-1.45)	(-0.61)	(-0.75)
4	B-CCC	9 (43)	-0.0863	-0.0677	-0.1188	-0.1190	-0.0991	-0.0864
			(-2.17)	(-1.85)	(-3.66)	(-2.39)	(-1.86)	(-2.65)

Table V

Price Informativeness Multivariate Analysis

Table V reports cross-sectional OLS regression results relating the change in spread adjustment delay (ΔD_{rsq}) associated with CDS trading initiation to control variables. The dependent and independent variables are as previously defined in Tables II and IV with the exception of *ΔTurnover* that is the change in the dollar value of trading standardized by the market value of bonds outstanding, measured between the two quarters preceding and following the quarter of CDS trading initiation. The dependent variable in Panel A is the change in spread adjustment delay from the model which jointly considers all five factors simultaneously. In Panel B, the dependent variables are the change in spread adjustment delay related to the individual factors. Standardized coefficients are reported with associated t-statistics in brackets calculated with heteroskedasticity-consistent standard errors clustered by country.

Panel A: JOINT Model

	Dependent Variable: Change in Spread Adjustment Delay for Bond *i* in Quarter *t* ($\Delta D_{rsq,i}$)							
Sample	Full (N=177)						Liquidity (N=117)	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rating Rank	-0.042	-0.058	-0.052	-0.057	-0.053	-0.058	-0.054	-0.054
	(-2.23)	(-2.64)	(-2.33)	(-2.69)	(-2.63)	(-2.74)	(-2.26)	(-2.56)
$INDEX_{t-1}$	-0.001		-0.002	0.003	-0.001	0.002	-0.005	-0.004
	(-0.57)		(-0.11)	(0.16)	(-0.09)	(0.12)	(-0.27)	(-0.25)
ΔVOL_{t-1}	-0.013		-0.040		-0.041	-0.032	-0.007	-0.007
	(-1.01)		(-1.50)		(-1.43)	(-1.10)	(-0.22)	(-0.22)
ΔER_{t-1}	-0.006		-0.036		-0.037	-0.041	-0.024	-0.023
	(-0.21)		(-0.91)		(-0.97)	(-1.07)	(-0.71)	(-0.68)
$\Delta FORRES_{t-1}$	-0.032		-0.017	-0.010	-0.016	-0.011	0.001	-0.001
	(-1.49)		(-0.93)	(-0.59)	(-0.83)	(-0.67)	(0.08)	(0.02)
$\Delta CREDIT_{t-1}$	-0.031		-0.006	-0.013	-0.005	-0.004	-0.044	-0.045
	(-1.96)		(-0.27)	(-0.61)	(-0.20)	(-0.17)	(-1.39)	(-1.40)
$WORLD_{t-1}$	0.004		0.001	0.004				
	(0.13)		(0.04)	(0.11)				
ΔYL_{t-1}	0.020		0.031	0.006	0.033	0.025	-0.012	-0.012
	(0.71)		(0.90)	(0.18)	(0.91)	(0.65)	(-0.33)	(-0.35)
ΔYC_{t-1}	0.015		0.010	-0.019	0.010	0.003	0.029	0.029
	(0.45)		(0.30)	(-0.62)	(0.32)	(0.09)	(0.61)	(0.61)
ΔEQU_{t-1}	0.048		0.049	0.040	0.049	0.042	0.059	0.059
	(2.33)		(2.22)	(1.84)	(2.04)	(1.90)	(1.38)	(1.38)
$VOLPRM_{t-1}$	-0.043		-0.031	-0.021	-0.030	-0.020	-0.013	-0.013
	(-1.29)		(-0.97)	(-0.76)	(-1.22)	(-0.80)	(-0.03)	(-0.03)
DEF_{t-1}	-0.007		0.006	0.011	0.007	0.014	-0.006	-0.006
	(-0.30)		(0.25)	(0.39)	(0.26)	(0.55)	(-0.28)	(-0.30)
REG_{t-1}	0.065		0.004					
	(1.42)		(0.06)					
$GLOBE_{t-1}$	0.008		0.026		0.027			
	(0.25)		(0.68)		(0.91)			

IMR $_{t-1}$		-0.139	-0.178	-0.123	-0.187	-0.177	-0.043	-0.040
		(-1.59)	(-1.05)	(-1.36)	(-1.52)	(-1.46)	(-0.28)	(-0.63)
ΔTurnover								-0.028
								(-17.43)
R^2	0.13	0.06	0.14	0.11	0.14	0.13	0.17	0.20

Panel B: Individual Factor Models

Dependent Variable: Change in Spread Adjustment Delay for Bond *i* in Quarter *t* ($\Delta D_{rsq,i}$)					
Factor	INDEX	WORLD	ΔVOL	ΔYL	ΔYS
Rating Rank	-0.051	-0.052	-0.064	-0.093	-0.058
	(-2.14)	(-2.34)	(-2.53)	(-3.55)	(-1.73)
INDEX$_{t-1}$	-0.012	-0.005	-0.017	0.033	0.027
	(-0.67)	(-0.29)	(-0.93)	(1.42)	(1.37)
ΔFORRES $_{t-1}$	-0.026	0.007	-0.008	0.004	0.014
	(-0.98)	(0.34)	(-0.59)	(0.20)	(0.66)
ΔCREDIT $_{t-1}$	-0.018	0.012	-0.009	0.013	0.020
	(-0.85)	(0.79)	(-0.35)	(0.71)	(0.78)
ΔYL $_{t-1}$	0.019	0.019	0.025	-0.003	0.006
	(0.65)	(0.70)	(0.78)	(-0.10)	(0.21)
ΔYC $_{t-1}$	0.001	-0.010	-0.023	0.010	0.021
	(0.07)	(-0.43)	(-0.91)	(0.25)	(0.47)
ΔEQU $_{t-1}$	0.021	0.031	0.025	0.022	0.028
	(1.27)	(1.44)	(1.40)	(1.25)	(1.47)
VOLPRM $_{t-1}$	-0.010	0.001	-0.007	-0.002	-0.016
	(-0.43)	(0.02)	(-0.28)	(-0.08)	(-0.66)
DEF $_{t-1}$	0.006	0.023	0.033*	0.022	0.029
	(0.32)	(1.21)	(1.78)	(1.15)	(1.52)
IMR $_{t-1}$	-0.089	-0.17**	-0.108	-0.149	-0.13
	(-1.18)	(-2.24)	(-1.29)	(-2.33)	(-1.60)
R^2	0.11	0.16	0.17	0.11	0.06

Table VI

Borrowing Costs Analysis

Table VI reports the results of pooled, time series regressions relating sovereign bond stripped spreads to a CDS trading initiation indicator and control variables. The model is estimated for the entire sample (Panel A) and for four credit rating partitions (AAA-AA, A-BBB, BB, B-CCC, Panel B). CDS is an indicator variable set to 1 in the period following CDS trading initiation. MAT is an indicator variable that takes the value of 1 if a bond has more than 10 years to maturity and zero otherwise. ΔTurnover is the change in turnover between quarters where turnover is calculated as total dollar value of trading volume standardized by total market value of the bond issue in the prior quarter. All other variables are as previously described in Section 4 and defined in the Appendix. The sample spans the period 2 quarters before and following CDS trading initiation, excluding the quarter of initiation. N is the number of countries, followed in parentheses by the number of bonds. T-statistics are reported in parentheses, calculated with standard errors clustered by country.

Panel A. Full Sample

	Dependent Variable: Bond Stripped Spread$_t$			
N	37 (163)	37 (163)	29 (92)	29 (92)
Model	(1)	(2)	(3)	(4)
CDS_t	-73.83	-72.72	-65.88	-63.97
	(-3.05)	(-3.18)	(-2.14)	(-2.10)
MAT_t	62.45	66.37	79.29	74.01
	(2.01)	(2.27)	(2.00)	(1.74)
ΔER_t	0.17	0.18	0.20	0.20
	(5.11)	(5.17)	(5.06)	(5.14)
$CREDIT_t$	45.93	44.67	48.01	48.56
	(15.85)	(14.99)	(19.58)	(18.72)
$\Delta FORRES_t$	0.01	0.01	0.01	0.01
	(2.87)	(2.32)	(1.92)	(2.13)
VOL_t	0.03	0.02	0.02	0.02
	(3.26)	(2.11)	(1.46)	(1.58)
$ExDebt/GDP_t$	0.21	0.26	0.40	0.40
	(0.84)	(1.05)	(1.86)	(1.83)
ΔYL_t	-0.21	-0.25	-0.46	-0.42
	(-0.88)	(-1.25)	(-1.95)	(-1.95)
ΔYS_t	0.27	0.14	0.06	0.08
	(0.80)	(0.61)	(0.22)	(0.32)
$WORLD_t$	-0.04	-0.03	-0.001	-0.004
	(-1.84)	(-1.09)	(-0.03)	(-0.13)
VOL_{t-1}		0.03	0.03	0.03
		(1.94)	(1.69)	(1.60)
ΔER_{t-1}		0.07	0.10	0.08
		(0.49)	(0.67)	(0.61)
$\Delta FORRES_{t-1}$		0.01	0.01	0.01
		(0.66)	(1.00)	(1.03)
$\Delta CREDIT_{t-1}$		-0.99	-11.17	-8.74
		(-0.03)	(-0.33)	(-0.27)
$\Delta Turnover_{t-1}$				-10.67
				(-12.44)
R^2	0.75	0.75	0.79	0.80

Panel B. Credit Rating Partitions

	Dependent Variable: Bond Stripped Spread$_t$							
Sample	AAA-AA		A-BBB		BB		B-CCC	
N	13 (57)	13 (57)	8 (17)	8 (17)	8 (42)	8 (42)	8 (47)	8 (47)
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
CDS_t	-21.33	-22.15	-56.58	-59.30	-94.09	-70.08	-125.23	-113.65
	(-3.80)	(-3.18)	(-3.31)	(-2.65)	(-2.30)	(-1.66)	(-3.61)	(-3.12)
MAT_t	48.34	50.65	188.02	169.14	55.65	54.59	-2.98	6.16
	(4.43)	(4.41)	(7.19)	(7.78)	(1.34)	(1.39)	(-0.05)	(0.13)
ΔER_t	22.67	37.56	0.72	0.56	2.65	-0.65	0.25	0.25
	(1.52)	(1.79)	(1.78)	(1.33)	(1.53)	(-0.74)	(3.94)	(3.92)
$CREDIT_t$	15.88	10.20	25.27	30.75	86.98	65.24	94.05	105.85
	(1.54)	(1.04)	(1.50)	(1.92)	(2.48)	(1.72)	(1.61)	(1.48)
$\Delta FORRES_t$	-0.01	-0.01	0.01	0.01	0.09	0.05	-0.01	-0.02
	(-1.78)	(-1.36)	(1.36)	(0.75)	(0.68)	(0.57)	(-0.88)	(-2.24)
VOL_t	-0.01	-0.01	-0.06	-0.06	0.05	-0.03	0.01	0.03
	(-1.18)	(-1.07)	(-2.79)	(-4.34)	(2.79)	(-1.32)	(0.74)	(1.88)
$ExDebt/GDP_t$	-0.12	-0.17	-2.27	-1.76	4.47	3.88	-0.95	-0.61
	(-0.96)	(-1.54)	(-1.77)	(-1.70)	(2.24)	(2.02)	(-0.50)	(-0.28)
ΔYL_t	-0.13	-0.09	-0.12	-0.17	-0.08	-0.46	-0.72	-0.39
	(-1.88)	(-1.51)	(-0.44)	(-0.64)	(-0.36)	(-1.17)	(-1.34)	(-0.71)
ΔYS_t	0.03	0.04	-0.11	-0.17	0.08	-0.41	0.96	1.17
	(0.43)	(0.51)	(-1.99)	(-1.93)	(0.27)	(-1.16)	(1.62)	(2.41)
$WORLD_t$	0.01	0.01	-0.01	0.01	-0.04	0.01	-0.06	-0.12
	(1.57)	(1.34)	(-0.10)	(0.32)	(-3.87)	(0.74)	(-1.66)	(-2.35)
VOL_{t-1}		-0.01		-0.04		0.08		-0.01
		(-2.31)		(-4.24)		(1.93)		(-0.28)
ΔER_{t-1}		33.37		0.33		2.12		-0.24
		(2.18)		(0.92)		(2.06)		(-3.81)
$\Delta FORRES_{t-1}$		0.01		0.02		-0.11		0.04
		(0.12)		(1.41)		(-1.10)		(3.30)
$\Delta CREDIT_{t-1}$		47.55		21.51		-77.87		35.62
		(2.97)		(1.36)		(-0.77)		(1.14)
R^2	0.22	0.24	0.59	0.64	0.48	0.55	0.47	0.49

Table VII

Liquidity Effects

Table VII reports the results of pooled, time series regressions relating sovereign bond turnover to a CDS trading initiation indicator and control variables. The model is estimated for the entire sample (Full) and four credit rating partitions (AAA-AA, A-BBB, BB, B-CCC). CDS is an indicator variable set to 1 in the period following CDS trading initiation. Controls mirror those used in Model (2) of Table VI. The sample spans the period 2 quarters before and following CDS trading initiation excluding the quarter of initiation. N is the number of countries, followed in parentheses by the number of bonds. T-statistics are reported in parentheses, calculated with standard errors clustered by country.

	Dependent Variable: $Turnover_t$				
Sample	Full	AAA-AA	A-BBB	BB	B-CCC
CDS_t	0.3629	-0.0012	-0.0029	-0.0390	1.9635
	(0.77)	(-0.47)	(-0.94)	(-1.91)	(2.85)
Controls	YES	YES	YES	YES	YES
N	29 (92)	11 (33)	6 (9)	5 (20)	7 (30)
R^2	0.1513	0.1700	0.3282	0.1887	0.2259