How Sovereign is Sovereign Credit Risk? Global Prices, Local Quantities[☆]

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Abstract

The sovereign default insurance market is concentrated and strongly intermediated, with fluctuations in insurance *prices* being dominated by common, global sources of risk. Yet, we find that insurance *quantities* are primarily explained by country-specific factors. Using net positions in sovereign default insurance contracts for 60 countries from October 2008 to September 2015, we find that the stock of a country's debt, and the size of its economy, explain 75% of cross-country differences in net insured interest. Debt issuance significantly explains variation in its dynamics. Our findings are informative for the regulatory debate on the market for sovereign default insurance.

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1. Introduction

The global stock of public debt, valued at over $50 trillion (IMF, 2018), is the basis for an active insurance market that offers protection against sovereign default risk. Longstaff et al. (2011) document that the sovereign insurance premiums, also known as credit default swap (CDS) spreads, are primarily driven by global risk factors, and suggest that their findings are consistent with risk pricing by a marginal investor with a global portfolio. Their intuition is consistent with the findings of He et al. (2017), who show that financial intermediaries have pricing power for the cross-section of multiple assets, including sovereign bonds.

Given the prominence of a small number of intermediaries in setting asset prices, one may intuitively expect that positions in the sovereign default insurance market also share a significant global component, since prices and quantities are jointly determined in equilibrium, and the 10 largest counterparties account for almost 90% of all transactions (Giglio, 2014). However, in spite of abundant research on sovereign default insurance prices, surprisingly little is known about the drivers of positions in the sovereign default insurance market. This is remarkable, since the benefits of such insurance products are subject to fierce debates among prominent academics (Duffie, 2010b; Portes, 2010). In light of the scant evidence on positions in sovereign default insurance contracts, we take a step to fill this gap.

Contrary to expectations based on prices, we show that global sources of risk are only of minimal importance in driving the aggregate positions in sovereign default insurance contracts. This evidence is based on data regarding net positions for a sample of 60 developed and emerging countries from October 2008 to June 2015. Our data comes from the Depository Trust and Clearing Corporation (DTCC), and covers more than 92% of the total sovereign default insurance market at any point in time. Our focus is on net notional amounts of CDS outstanding, a quantity measure of net insured interest. As a direct indicator of the maximum amount of risk transfer, the net notional amount outstanding represents the economically most meaningful measure (Oehmke and Zawadowski, 2017) and reflects the relevant quantity to be associated with clearing prices. We show that country-specific (i.e., local) characteristics are the key determinants in understanding both the cross-sectional differences in net notional amounts of sovereign CDS outstanding, as well as their dynamics. We illustrate our findings in four steps.

In a first step we show, using principal component analysis, that the first common component explains less than 10% of the variation in net insured interest. Moreover, the modest amount of common variation in positions is largely driven by technical considerations related to the rebalancing of contracts and to the reporting structure of the data by the DTCC. Since CDS contracts expire and roll into new contracts on standardized maturity dates, we associate 2%–3% of their common variation with changes in positions taking place on these dates. Furthermore, we find that part of the remaining common variation is associated with currency fluctuations in the U.S. dollar, since the DTCC reports contract positions of any currency in USD equivalents. Eliminating the influence of these mechanical factors reduces the proportion of the common variation explained by the first common factor to 6%. We repeat the factor analysis for sovereign default insurance prices, and find that the first principal component explains as much as 57% of the weekly variation in CDS spreads. We also confirm that the above technical considerations hold little importance for the common component of prices.

To ensure that this finding is specific to the dynamics of positions in sovereign default insurance contracts, we quantify the explanatory power of the first principal component for the variation in prices and quantities for a wide range of other derivative and spot assets, including corporate default insurance contracts, equity options and stocks, exchange-traded funds on country stocks, and foreign exchange and government bond futures. A graphical illustration of our findings is presented in Figure 1.[1] One salient feature evident across these different asset classes is that greater commonality in returns is associated with greater commonality in quantities. Nonetheless, the evidence for positions in sovereign CDS contracts stands out as an exception. In Figure 1.b, we plot the ratio of the explanatory power by the first principal component extracted from the variation in prices and quantities for the different assets. The commonality in prices is more than 8 times larger than that in quantities for sovereign insurance contracts, while this ratio is less than 3 for corporate default insurance contracts, and less than one for equity options.

In a second step, we investigate which country-specific characteristics explain the cross-country dif-

[1] We describe the details about the data composition and sources in the Internet Appendix Section A-III.

ferences in net notional amounts of sovereign CDS outstanding. We find that aggregate government debt and the size of its economy explain about 75% of the cross-sectional variation in net insured interest. Our estimates suggest that a 10% increase in aggregate debt is associated with an increase in net notional amounts of CDS outstanding of 1.5%. In addition, we provide evidence that domestic and international debt contain distinct information for cross-country differences in aggregate contract positions. This is consistent with differences in contractual features in insurance contracts of developed (DM) and emerging market (EM) countries, which distinguish between domestic and foreign reference obligations in determining what can trigger a credit event.

Next, in a third step, we find that a battery of global risk factors borrowed from Longstaff et al. (2011) are statistically insignificant in explaining the dynamics of net notional amounts outstanding and contain little explanatory power. Instead, we attribute a prominent role to country-quarter fixed effects, which are significantly related to the variation in a country's domestic debt and gross domestic product.

In a final step, we exploit the cross-country heterogeneity in sovereign bond issuances to pinpoint the economic importance of country characteristics in driving the dynamics of the positions of net notional amounts of CDS outstanding. We build a sample of 3,428 debt issuances by 57 countries from November 2008 to June 2016, and find that net insured interest in sovereign default risk increases on issuance dates, and that a \$100 million increase in debt is associated with an increase of around \$13.5 million in net notional amount outstanding. It is noteworthy that the statistical significance is driven by the issuance of international debt, which is an eligible reference obligation for *all* sovereign insurance contracts, while domestic debt is eligible primarily for CDS contracts written on debt issuances of *developed* economies. We also find that a country's CDS spread is not significantly affected by debt issuances, which is suggestive of a disconnect between sovereign default insurance prices and their quantities.

The rest of the paper proceeds as follows. In Section 2, we survey the related literature. We discuss the data and present descriptive statistics in Section 3. We examine the anatomy of the sovereign CDS market in Section 4. The economic drivers of the cross-sectional differences in net notional amounts outstanding and their dynamics are investigated in Section 5. We conclude in Section 6.

2. Literature Review

Prior research on sovereign credit risk has primarily focused on understanding the drivers of sovereign credit spreads. One important finding of many studies on the topic is that common risk factors (mostly associated with the U.S. economy) play a dominant role in explaining the dynamics of the prices of sovereign default insurance contracts (Pan and Singleton, 2008; Longstaff et al., 2011; Ang and Longstaff, 2013).[2] Further sources of commonality in CDS spreads have been shown to originate from trading motives for regulatory capital relief (Lando and Klingler, 2018), while Anton et al. (2018) document a relation between the commonality in the dealer quotes of sovereign CDS spreads and CDS return correlations. Since the sovereign insurance market is highly concentrated among a few broker-dealers (Giglio, 2014; Siriwardane, 2018), it is plausible that global risk factors influence prices through a risk premium channel, as shown by He et al. (2017) for the cross-section of sovereign bond returns. Whether and how global sources of risk also affect positions in sovereign default insurance contracts is, however, less clear. Indeed, research on default insurance quantities is scant, and focuses mainly on the corporate sector.

Oehmke and Zawadowski (2017) study the determinants of corporate CDS trading volume and net notional amounts outstanding and conclude that corporate CDS markets emerge as alternative trading venues for hedging and speculation, partially as a result of bond market fragmentation (Oehmke and Zawadowski, 2015). Boyarchenko et al. (2018) further examine the trading motives for corporate CDS by U.S. financial institutions. Several studies focus on the impact of particular events on individual or aggregate trading positions, such as the Greek default (Halaj et al., 2017), or the CDS Small Bang regulatory overhaul (Gündüz et al., 2016). Other papers examine CDS transaction level data, but focus on questions related to liquidity (Shachar, 2012; Biswas et al., 2015), risk-bearing capacity (Siriwardane, 2018), network structures (Peltonen et al., 2014; D'Erricoa et al., 2018), and counterparty risk (Du et al.,

[2] Our review focuses on the literature on credit default swap spreads, for which Augustin (2014) and Augustin et al. (2014) provide a survey. Other important references include Remolona et al. (2008); Mauro et al. (2002); Geyer et al. (2004); Uribe and Yue (2006); Reinhart and Rogoff (2008); Hilscher and Nosbusch (2010); Dieckmann and Plank (2011); Jeanneret (2015); Gilchrist et al. (2012); Acharya et al. (2014); Gennaioli et al. (2012); Borri and Verdelhan (2012); Augustin (2018).

2016; Cetina et al., 2018). Our research is complementary to their work since we focus on the sovereign default insurance market.

Sovereign insurance contracts are inherently different from corporate insurance contracts because of differences in contractual features (credit event triggers), default probabilities and recovery rates, and the absence of a formal bankruptcy court. Sovereign CDS contracts are the most liquid single-name CDS contracts, and the underlying reference obligations are typically more liquid and less fragmented than their corporate counterparts. The scope of substitutability between the sovereign bond and CDS markets is also vastly different, as the net notional amounts outstanding represent on average only 8% of total general government debt outstanding, while this figure is seven times as large (50%) as its counterpart for the U.S. corporate market (Oehmke and Zawadowski, 2017).

Lando and Klingler (2018) offer a theory for trading in sovereign default insurance contracts, but focus on explaining insurance prices for safe-haven countries. Acharya et al. (2018) examine position-level data on sovereign CDS contracts of German financial institutions and show that they use the insurance market to extend sovereign risk exposures. In contrast to their work, we take a macro-economic perspective and examine the aggregate sovereign default insurance market. Berg and Streitz (2016) provide an early overview of positions in sovereign CDS contracts for a short period from 2010 to 2012, and their focus is on the impact of rating changes on trading volume.

3. Data Sources and Descriptive Statistics

We present a novel dataset on weekly aggregate positions in single name sovereign CDS contracts for a sample of 60 countries from October 2008 until June 2015, spanning all major geographical regions. Our focus is on the *net notional amount of sovereign CDS outstanding* (henceforth net notional, *NN*), which represents the aggregate net protection bought by net buyers (or equivalently, the aggregate net protection sold by net sellers) for a given reference entity. The net notional amount of CDS outstanding reflects the maximum possible transfer of funds between net sellers and net buyers of CDS protection that could be required upon the occurrence of a credit event.[3] It quantifies the net insured interest, and is therefore analogous to the open interest in futures or options markets. Importantly, net open interest is the relevant quantity for the determination of the market clearing price of CDS contracts in equilibrium, and the settlement price in case of a credit event auction (Chernov et al., 2013; Gupta and Sundaram, 2015; Du and Zhu, 2017).[4] Hence, the net notional amount of CDS outstanding is economically the most meaningful measure of aggregate risk transfer, as is also noted by Oehmke and Zawadowski (2017).

We manually collect the data from the website of the Depository Trust and Clearing Corporation (DTCC), a company specializing in the clearing and settlement of OTC derivatives and other financial instruments. The DTCC started publishing weekly reports on single name CDS positions on October 31, 2008.[5] More specifically, the DTCC posts weekly the aggregate number of traded contracts, gross and net notional amounts of CDS outstanding in USD equivalents, for the 1,000 most heavily traded reference entities.[6] These weekly reports are based on the information available in the Trade Information Warehouse (TIW), a centralized global trade repository that consolidates trade reporting, post-trade processing, payment calculation, credit event processing, and central settlement. Figure A-1 in the Internet Appendix indicates that our sample captures between 92% and 97% of the aggregate amount of sovereign notional amounts of CDS outstanding throughout our sample period. The coverage ratio ranges between 96% and 100%, if we also account for positions in contracts written on sovereign states and state-governed entities. This suggests that we do not need to correct our tests for censored reporting, in contrast to the examination of corporate CDS positions by Oehmke and Zawadowski (2017).

We complement data on sovereign CDS positions with information on general government debt. In light of the large discrepancies in government debt statistics across publicly available data sources, we

[3]As long as there is a non-negative recovery rate on the underlying debt instruments and absent counterparty risk, the net transfer of funds would be lower.

[4]Garleanu et al. (2009) make a corresponding argument in the option market, employing the net open interest for the determination of the equilibrium option prices.

[5]Since 2016, these data are no longer freely accessible.

[6]Statistics on positions in credit derivative contracts involve many different components, such as gross and net notional amounts of CDS outstanding, novations/assignments, terminations, and market risk transfer activity, in contrast to trading in exchange-traded derivatives such as equity options, which are adequately summarized by volume and open interest. We provide a detailed discussion of all these terms in the Internet Appendix Section A-I.

use the homogeneously constructed quarterly debt data reported by the Bank for International Settlements (BIS). We use debt from the general government sector, comprising of central, state and local governments, and social security funds. As conventional sovereign CDS contracts, especially in EM economies, are written on foreign long-term debt, we collect data on both international ("euro bonds" or foreign denominated bonds) and domestic debt securities, as well as on total general government debt.[7] We employ quarterly gross domestic product (*GDP*) and foreign exchange rate reserves from the International Monetary Fund (IMF) International Financial Statistics. Finally, we obtain CDS price and liquidity information from Markit. Most other country characteristics and macro-economic fundamentals are obtained from Thomson Reuters Datastream. As sovereign risk may be tied to the development of financial institutions (Gennaioli et al., 2012), we also gather each country's stock market capitalization and inflation data from the World Bank. A detailed data description is available in the Internet Appendix Table A-2.

3.1. Summary Statistics - Net Notional Amounts of CDS Outstanding

Initially, we extract information on 64 countries from October 2008 until June 2015, spanning 346 weeks of data ($\approx$ 6.5 years). We disregard four countries due to limited data availability, yielding a total of 20,012 weekly observations for 60 countries. Of these, 47 have continuous information on net notional amounts of CDS outstanding throughout the sample period.[8] Among the other countries, Switzerland and Cyprus have the lowest number of observations with 65 and 177 weeks of data, i.e., a bit more than three years.

Aggregate summary statistics are reported in Table 1. Country-level statistics are presented in the Internet Appendix Table A-3. The average USD equivalent in sovereign NN is equal to \$3.55 billion, ranging from a low of \$0.08 billion to a high of \$27.05 billion. The largest market in terms of NN is

[7]The BIS defines international debt securities as those issued in a market other than the local market of the country in which the borrower resides. Domestic debt securities are defined as debt securities issued in the local market of the country in which the borrower resides, regardless of the currency in which the security is denominated. As international debt is available for all countries, while total and domestic debt are not, we fill missing information with annual debt data from the International Monetary Fund International Financial Statistics.

[8]We exclude Hong Kong, Ecuador, and Morocco, as these countries have only 1, 12, and 35 weeks of data, respectively. Tunisia is dropped from the sample because of sparse debt data, which we need for the analysis. We eliminate three duplicate entries for Hungary on March 30, 2012, April 6, 2012, and April 13, 2012.

Italy, with an average of \$21.34 billion, while the country with the lowest average NN of \$0.25 billion is Cyprus. The standard deviation of NN is \$4.61 billion. Figures 2.a and 2.b illustrate the fluctuations over time in the cross-sectional distribution of NN. Figures 2.c and 2.d rank all countries by the average size of NN, focusing on the largest 10 and 25 countries, respectively. Sovereign NNs are, on average, higher in DM economies, the average of \$5.73 billion being about 2.5 times greater than the average of \$2.36 billion in EM economies.

3.2. Summary Statistics - Country-specific Control Variables

Table 1 (Table A-3 in the Internet Appendix for statistics at the country level) highlights that the U.S. is the most indebted country in terms of total debt (\$12.78 trillion), even though it has issued only \$3.93 billion of international debt. On the other hand, Estonia is the least indebted country in terms of aggregate debt (\$1.87 billion), for which the international component accounts for \$1.7 billion. In general, the greater the amount of total debt, the lower the fraction that is international. We graphically illustrate the time series evolution of the aggregate and international debt stocks, including the cross-sectional country rankings, in Figure 3. The average quarterly debt-to-GDP ratio is 39%, and 26% and 63% in EM and DM countries, respectively. The least indebted countries are Estonia, Dubai, Egypt, and Vietnam, with debt-to-GDP ratios of 1% to 2%, while the two most indebted countries are Japan, Lebanon, and Greece, based on average debt-to-GDP ratios of 181%, 142%, and 107%, respectively. The sovereign NN represent about 8% (2%) on average (median) of the total general government debt, while this ratio corresponds to 11% and 2% in EM and DM economies, respectively. These statistics contrast with those from the U.S. corporate CDS market, for which the average (median) sovereign NN as a fraction of total bond issuance is 50% (26.1%) (Oehmke and Zawadowski, 2017).

Additional country-level statistics are reported (on a quarterly basis) in Table 2. The average sovereign CDS spread level is 259 basis points (bps), while it is 335 bps and 121 bps in EM and DM countries. CDS volatilities are, on average, slightly higher in DM economies, which is reflective of a high uncertainty during the European debt crisis. Country averages for CDS spreads range from 23 bps for Norway to 1,786 bps for Greece. The average CDS depth is 6.60, as measured by the number of dealer quotes used in the computation of the mid-market CDS spread (Qiu and Yu, 2012).

The average country has foreign exchange reserves of $140 billion, which is larger in EM economies ($160.63 billion), and lower in DM countries ($100.91 billion). Inflation is, on average, 3.74%, with a standard deviation of 5.94%. It is lower in the panel of DM countries (1.48%) and higher in EM countries (4.98%). Financial markets are more developed in DM economies, as the average stock market capitalization is $1.80 trillion relative to $350 billion in developing economies, with an overall average of $0.87 trillion.

4. Commonalities in Sovereign CDS Positions

We first examine the factor structure in CDS spreads and compare it to that in NN. It is well documented that sovereign CDS spreads co-move significantly over time, and that a single factor explains as much as 96% of the spread variation at the daily frequency, and between 60% to 70% at the monthly frequency (Pan and Singleton, 2008; Longstaff et al., 2011; Augustin, 2018). We find similar results at the weekly frequency for the 47 countries with continuous sovereign NN data throughout the sample period. Panel A in Table 3 shows that the first principal component of the correlation matrix of weekly changes in CDS spreads explains about 57% of the time series variation, and the cumulative explanatory power of the first three principal components is 70%. The first common factor explains 64% of the variation for both the 17 countries in the DM and 30 countries in the EM sub-samples, respectively.

We find a significantly weaker factor structure in CDS quantities, as is reported in Panel B of Table 3. Performing the same exercise on the correlation matrix of weekly changes in sovereign NN, we find that the first principal component explains about 10% of their variation, while the first five factors explain no more than 26%. The magnitude of the explanatory power of the first principal component for changes in NN is 19% for DM countries. For EM economies, instead, the explanatory power of the first factor is 11%.[9]

[9] The DM group is primarily made up of countries from Europe. Thus, we suspect a linkage between this result and the regulatory framework for capital requirements in Europe, where banks used to benefit from an implicit subsidy through zero capital requirements for holdings of sovereign government bonds of Eurozone member countries (Kirschenmann et al., 2017).

A part of the common variation in sovereign NN explained by the first principal component is driven by the institutional structure of CDS markets and the seasonality in the data. The conventional single-name CDS contract has standardized quarterly coupon payment dates. Every three months, the conventional contract will thus expire, and a new on-the-run single-name CDS contract will “roll” into a new standard maturity date: Single-name CDS contracts roll on March 20, June 20, September 20, and December 20. This standardization, intended to enhance liquidity, may lead to common variation in NN around the roll dates. We check for such seasonality in CDS positions by projecting weekly changes in sovereign NN for each country i, ($\Delta\%\,\mathrm{NN}_{i,t}$), on country fixed effects, γ_i, and the dates when the on-the-run contract expires and rolls into a new on-the-run CDS contract. More specifically, we run the following regression:

$$\Delta\%\,\mathrm{NN}_{i,t} = c + \gamma_i + b_1\,\mathrm{March20Roll} + b_2\,\mathrm{June20Roll} + b_3\,\mathrm{Sep20Roll} + b_4\,\mathrm{Dec20Roll} + \varepsilon_{i,t}, \qquad (1)$$

where March20Roll, June20Roll, Sep20Roll, and Dec20Roll define the quarterly roll date indicators, which are one during the week of the roll, and zero otherwise. The results in Table 4 lend importance to the roll dates, which are all statistically significant at the 1% significance level, and explain 2%–4% of the time series variation, depending on whether we use the full sample of 60 countries, or the sub-sample of 47 countries, for which we have uninterrupted information on NN.

To measure the true commonality in sovereign NN that is not driven by market microstructure effects, we perform a principal component analysis on the correlation matrix of the weekly changes of the residuals $\varepsilon_{i,t}$ from Equation (1). Panel C in Table 3 indicates that the fraction explained by the first common factor is reduced by an amount that is roughly equal to the explanatory power of the roll date indicators in the panel regression with NN. As a result, the first principal component of the “de-seasonalized” net notional only explains 7% of their variation. In unreported results, we find in contrast that stripping out the roll effects from CDS spread changes has only a marginal effect on the explanatory power of the first principal component, which decreases from 56.87% to 56.12%.

A second feature of the CDS positions data that influences our analysis is that DTCC reports all CDS positions in USD equivalents. Thus, a strengthening of the USD may mechanically increase the commonality in NN. In unreported results, we find that the Friday-to-Friday EUR/USD exchange rate has a negative correlation of -43% with the residuals from the regression in Equation (1). Stripping out the EUR/USD exchange rate effect from each country's net notional amount outstanding further reduces the variation of changes in the NN, as explained by the first principal component to 6%.

A tight factor structure with a limited number of common components in CDS spread dynamics may seem intuitive, as it incorporates time-varying risk premia (Pan and Singleton, 2008; Augustin and Tédongap, 2016). The CDS market is concentrated among a limited number of financial intermediaries (Giglio, 2014; Siriwardane, 2018), which significantly impact asset prices (Adrian et al., 2014; He et al., 2017), especially for OTC-intermediated assets (Haddad and Muir, 2018). The high market concentration may similarly suggest a tight factor structure in the dynamics of CDS positions. Thus, our finding that the first principal component explains only 6% of these dynamics, after we account for quarterly roll dates and currency effects in the reporting by the DTCC, is surprising. Our findings are even more puzzling in light of the results in Figure 1, which suggests that the significant discrepancy in commonality between prices and quantities is confined only to the sovereign CDS asset class.

5. Determinants of Sovereign Net Notional Amounts of CDS Outstanding

We next examine the determinants of sovereign NN. First, we focus on the cross-country differences in the sovereign NN. Second, we examine its time-series dynamics. Third, we examine an important economic channel to reconcile the first two results.

5.1. Cross-Sectional Determinants

With little guidance on the determinants of positions in sovereign default insurance contracts, we examine, to the extent possible, the determinants that have been shown to be relevant for similar positions in corporate default insurance contracts (Oehmke and Zawadowski, 2015, 2017). To explain the cross-country differences in sovereign NN, we start with each country's insurable interest, namely the aggregate general government debt, which is available at a quarterly frequency.

Sovereign debt differs materially from corporate debt, since it lacks a formal contract enforcement mechanism (Panizza et al., 2009). As a result, governments sometimes issue international debt in foreign jurisdictions that allow for greater enforcement. Domestic debt, on the other hand, is more exposed to inflation risk (Reinhart and Rogoff, 2011). Sovereign CDS contracts also differ from their corporate counterparts with respect to the kind of obligations that can trigger a credit event. For example, the payout on contracts linked to Standard Western European countries can be triggered by a credit event involving any debt security, regardless of its currency or jurisdiction in which it was issued. In contrast, for Standard Latin America or Standard Emerging European and Middle Eastern sovereign single name contracts, the eligible reference obligations are precluded from being issued in domestic currency or under domestic law. For these reasons, we allow the sensitivity of the NN to the amount of debt to vary according to the nature of the debt. While the BIS data we employ do not identify CDS-eligible debt securities, they distinguish between domestic and foreign debt, a first-order approximation to the eligibility of debt for triggering a payment on a CDS contract. We thus examine the independent information provided by the amount of a country's domestic and international debt for sovereign NN of emerging and developed economies.[10]

As we study the levels of NN, we also control for the size of each country's economy using its gross domestic product. We specify the following benchmark panel regression:

$$\ln(\text{NN})_{i,t} = a + b_1 \ln(\text{Domestic Debt})_{i,t} + b_2 \ln(\text{Int Debt})_{i,t} + b_3 \ln(\text{GDP})_{i,t} + \varepsilon_{i,t}, \tag{2}$$

where we aggregate the NN at a quarterly frequency to match the quarterly debt and GDP data. The logarithmic transformation of all variables improves the distributional behavior of the sample and allows

[10]Our sample is comprised of three groups of countries, as far as debt composition between international and domestic debt is concerned: Three countries with no international debt, 12 countries with no domestic debt, and 48 countries that issued both. This dispersion in debt composition suggests that independent information is provided by the two variables.

us to interpret the regression coefficients as elasticities.[11] We report the results in Table 5, with standard errors clustered by country. We confirm in unreported results that our findings are robust for double clustering by country and quarter.

The univariate regression results reported in column (1) indicate a statistically significant relation between NN and total amount of general government debt: The slope coefficient of 0.152 implies that a 10% increase in the aggregate debt is associated with a 1.5% increase in sovereign NN. Additionally, the adjusted R^2 of this univariate regression implies that total government debt explains 27% of the cross-sectional variation in NN. Thus, more debt goes hand in hand with a higher insured amount.

In columns (2) and (3) of Table 5, we separately compare the relation of NN to domestic and international general government debt. International debt is an eligible reference obligation for all CDS contract types, while domestic debt is not. We find that both quantities are statistically significant: The economic magnitude of the estimated coefficients for international and domestic debt suggest that a 10% increase in domestic and international debt is associated with a 0.5% and 0.6% increase in NN, respectively. The two variables jointly explain 34% of the cross-sectional dispersion in net insured interest.

In column (4) of Table 5, we report results from an empirical specification that also controls for the size of an economy by using its GDP. We find that the slope coefficient for domestic debt is reduced, indicating that domestic debt may partially proxy for country size, as the coefficient for domestic debt is reduced, while that for international debt hardly changes. The coefficient for GDP is 0.496, positive and statistically significant. The three variables explain as much as 66% of the cross-country dispersion in NN. The addition of time-fixed effects in column (5) to account for observable (and unobservable) common macro-economic or financial factors increases the adjusted R^2 only marginally to 67%, and the estimated coefficients are not significantly affected. This finding shows that the majority of the variation in the panel of NN is explained by country-specific characteristics, rather than by common time-varying factors, such as the the ones driving the variation in CDS spreads, as documented by Longstaff et al.

[11] We transform each variable x into a variable $y = \ln(1 + x)$, as some countries have zero international debt or foreign exchange rate reserves.

(2011).

In Figure 4, we graphically illustrate the strong cross-sectional component of the panel by plotting the predicted and realized NN from the results in column (6) of Table 5. This specification is based on time series averages of country-specific variables, and it confirms the statistically significant relation between NN and both domestic and international debt, and GDP. After controlling for the size of an economy and country leverage (domestic and international debt), we explain about three quarters (adjusted R^2=75.2%) of the cross-country dispersion in NN. The U.S. is an outlier on this graph, due to its significant amount of debt compared to the world economy, and the dominant position of the large U.S. banks that do not benefit from hedging their U.S. Treasury bond positions. In unreported regressions, we show that allowing for a separate U.S. dummy increases the adjusted R^2 to 80%.

We separately examine the relation of NN to domestic and international debt for EM and DM economies in columns (7) and (8) of Table 5. In these specifications, we control for the fact that some countries select into issuing only one type of debt, using an indicator that is equal to one for the 3 (12) countries that issue only domestic (international) debt, and zero otherwise. In addition, in column (8), we control for the independent information provided by the U.S. We find that both domestic and international debt are significantly associated with NN for DM countries, while only international debt is significant in explaining cross-country variation in NN. This supports a direct link between insured and insurable interest, as domestic debt is typically not an eligible security for EM default insurance contracts, while both types of debt are eligible for DM countries. In Subsection 5.3, we further show that debt issuances are followed by increases in net notional outstanding and that this result is driven by bonds that are included in the CDS reference obligations.[12]

Similar to Oehmke and Zawadowski (2017), we examine the levels of contract positions, since they find that "neither net CDS nor the trading motives (e.g., speculation or the basis trade) naturally scale

[12]The statistical insignificance of GDP in column (8) is due to a high correlation (collinearity) between GDP and domestic debt for the DM sub-sample, while both measures are only weakly correlated in the EM sub-sample. In an unreported regression specification, we replace the domestic debt variable in column (8) with the residuals of its projection onto GDP, and show that both (the orthogonalized) domestic debt and GDP are significant. Thus, the residual component of domestic debt contains incremental information to the size of the economy in explaining the level of NN.

with assets or outstanding bonds." In column (9) of Table 5, we nevertheless report the results from a specification that scales the left- and right-hand side variables by a country's GDP. Thus, we regress the NN-to-GDP ratio on the domestic debt-to-GDP and the international debt-to-GDP ratios. The results of this specification capture the explanatory power of aggregate debt, after country size is taken into consideration. The adjusted R^2 is 19%. Moreover, only the international debt-to-GDP ratio is statistically significant, suggesting that the international debt-to-GDP ratio is, on average, more informative about cross-country differences in NN-to-GDP than the domestic debt-to-GDP ratio.

We next examine the role of additional country characteristics for explaining cross-country differences in NN and report the results in Table 6. Our focus is on variables associated with a country's financial health/default risk, CDS market liquidity, and the state of a country's development. For the specification in column (1), we add the aggregate amount of foreign exchange reserves (measured in billions of dollars, then log-transformed). The coefficient is negative – consistent with the intuition that countries that hold larger reserves are less likely to default, hence requiring less insurance – and significant in later specifications. In column (2), we control for the level of default risk using the CDS spread, credit risk volatility using the quarterly sum of the daily squared percentage changes in CDS spreads, and CDS liquidity, as market participation may depend on the liquidity of the CDS market (Sambalaibat, 2013; Oehmke and Zawadowski, 2015). We measure CDS liquidity using the number of dealer quotes used in the computation of the mid-market spread (Qiu and Yu, 2012). CDS liquidity is statistically significant at the 1% level and positively correlated with the NN. The estimated coefficient of 0.902 translates into a 15% increase in net insured interest for a 20% increase in liquidity. As the sovereign CDS contract is quoted by six to seven broker dealers, our finding suggests that net insured interest is, on average, almost ten percent higher if a country is covered by one additional dealer.[13] Countries that are riskier, on average, have higher NN, as suggested by the positive coefficient on the CDS spread. Similarly, credit risk volatility is positively linked to net insured interest in sovereign credit risk. These

[13]The CDS coverage may be larger for a country because it has a greater sovereign NN. When we regress the NN-to-GDP ratio on the CDS liquidity, the slope coefficient is significant. This is suggestive of a market structure in which financial institutions make markets for CDS contracts of larger countries, supporting the hypothesis of endogeneity of the variable.

variables are, however, not statistically significant, consistent with Darrell Duffie's testimony to Congress pinpointing a weak relation between the level of CDS spreads and net sovereign insured interest (Duffie, 2010a).

The European sovereign debt crisis has highlighted the fragility of public balance sheets following the bailouts of domestic banks (Acharya et al., 2014). The crisis has also focused attention on the intricate relationship between the financial health of governments and that of their financial sectors (Gennaioli et al., 2012). In addition, investors can use sovereign default insurance as a "proxy hedge" for country risk exposure, or to take synthetic long credit exposures that are less capital intensive. We, therefore, include a country's stock market capitalization in the specification in column (3) of Table 6. We find a significantly positive relation between a country's stock market capitalization and NN. The coefficient implies a 3%–4% higher net insured interest for countries in which the stock market capitalization is 10% larger.

In column (4), we introduce additional market-based risk factors: the domestic stock market return volatility, measured as the sum of daily squared MSCI total stock market returns over the quarter; the volatility of the exchange rate relative to the USD, as sovereign distress episodes are positively correlated with a depreciation of the local currency (Reinhart and Rogoff, 2008); and the level of inflation. None of these variables is statistically significant. Importantly, the debt coefficients change little in magnitude and there is only a marginal improvement in explanatory power beyond a parsimonious specification with only domestic and international debt, and a country's GDP.

5.2. Time-Series Determinants

We next examine the determinants of the dynamics of sovereign NN. Our findings that cross-country differences in sovereign CDS positions are explained by country-specific characteristics may seem intuitive ex-post. Yet, this result is not obvious ex-ante. First, prior research has attributed a dominant role to global risk factors in explaining variation in sovereign CDS spreads (risk premia and default probabilities), in particular U.S. financial market risk (Pan and Singleton, 2008; Longstaff et al., 2011; Ang and Longstaff, 2013). Second, the CDS market is heavily concentrated among a few U.S. broker-dealers

(Giglio, 2014; Siriwardane, 2018). As these institutions represent the main intermediaries, it is plausible that CDS positions are influenced by aggregate risk aversion and global risk factors. Thus, the dynamics of sovereign CDS positions may also be explained by global sources of risk.

We use the same country-specific risk factors that we have used in the analysis of the cross-sectional variation in NN. We use weekly percentage changes in countries' CDS spreads, CDS volatility and liquidity, country-specific stock market returns and their volatilities, as well as their foreign exchange rate returns and volatilities, relative to the USD, as explanatory variables. We absorb the quarterly country variation of lower frequency variables using country-quarter fixed effects, which is tantamount to allowing for country-quarter time trends in the percentage changes of NN.

As in Longstaff et al. (2011), we use several common risk factors to capture the global equity, credit, foreign exchange, and interest rate risk environment. We use the weekly value-weighted return on all NYSE, AMEX and NASDAQ stocks from CRSP in excess of the weekly-Treasury-bill return from Ibbotson Associates, the weekly changes in investment-grade and high-yield spreads, defined as the differences between the Bank of America/Merrill Lynch US BBB and AAA corporate bond yields, and between the BB and BBB yields, respectively, and the weekly changes in the 5-year Constant Maturity Treasury (CMT) spread. In addition, we approximate global hedging demand and risk aversion/risk bearing capacity by the weekly changes in the CBOE VIX implied volatility index, based on S&P 500 option prices. Global funding illiquidity is measured using the weekly changes in the Treasury EuroDollar (TED) spread, the difference between the LIBOR and the 3-month Treasury bill yield. Global risk premia are measured by the monthly percentage changes in the cyclically adjusted price-earnings ratio of the S&P 500 index.

We capture any residual influence and spillover effects by global and regional CDS spreads. We calculate the global (regional) CDS spread for each country by, first, averaging sovereign CDS spreads of all other countries in the world (region). Then, we orthogonalize the average CDS spread with respect to all other explanatory variables, both global and country-specific, and characterize the residuals of the regression as the global (regional) spread. We group all countries into four regions, i.e., Europe, Middle

East and Africa, Asia-Pacific, and Americas. We control for the mechanical changes in NN due to the DTCC reporting in USD-equivalent terms by including the US dollar factor of Lustig et al. (2011), and for their seasonality and roll-over dates by including roll dummies.

In Panel A of Table 7, we report the results from the projection of weekly percentage changes in the sovereign NN on country-specific and global risk factors, country-quarter fixed effects, and indicator variables for the roll dates on March 20, June 20, September 20, and December 20 of each year, with standard errors clustered at the country level. We find that global variables add little explanatory power in explaining the dynamics of sovereign NN. The adjusted R^2s attain a maximum of only 3.1%. This maximum explanatory power is obtained in our baseline specification with just country-quarter fixed effects and the mechanical variation due to the DTCC reporting in USD equivalent amounts and the contracts' roll-over dates, as we show in column (1). The global US dollar factor, which captures the average appreciation of the dollar relative to all other countries, is significant and negatively related to the NN. This is consistent with the interpretation that stronger individual foreign currencies relative to the USD (i.e., a lower US dollar factor) lead to higher USD equivalent amounts of foreign currency CDS contracts. Apart from the TED spread, a proxy for the global funding illiquidity, no other global variable contains statistically significant information for the dynamics of sovereign NN.

The volatility of a country's stock market return and the level of a country's credit risk are among the most important domestic risk factors for explaining the dynamics of NN. A ten percent increase in the domestic stock market volatility is associated with a decrease of approximately 2.4%–3.6% in the NN. Changes in country credit risk are also statistically significant predictors of changes in NN. A 10% increase in a country's CDS spread is associated with an increase of approximately 0.1% in NN. These findings suggest that there is more net insured interest when the level of risk increases, but less when there is more credit risk uncertainty. While all other country-specific risk factors have the expected signs, they are not significant.

To test the relative statistical importance of country-specific and global risks, we separately test for their joint significance. The *Wald*-test statistic for the significance of the local factors is 2.22, significantly different from zero at a 5% significance level, based on a $F(7,59)$ distribution. The test for the joint significance of the global factors is not statistically significant, with a p-value of 0.35. Time variation in NN is thus, primarily attributable to country-specific quarterly variation, and global risk factors do not help in explaining the within-quarter changes in the NN. This conclusion is strengthened by an examination of the quarter-time fixed effects, reported in Panel B of Table 7. We regress these fixed effects on quarterly percentage changes in the domestic and international general government debt, as well as quarterly percentage changes in GDP. We find that both domestic debt and GDP are significantly related to the country-quarter fixed effects, which underscores the fact that a country's leverage and size are significant determinants of the dynamics of sovereign NN.

Overall, our results are consistent with the weak factor structure among CDS positions documented in Section 4. Our findings show that country-specific risk factors explain the dynamics of sovereign CDS positions, and that common financial and macro-economic fundamentals provide little information for the dynamics of NN.

5.3. Bridging the Cross-Sectional and Time-Series Evidence: The Bond Issuance Channel

Even though we are able to attain little explanatory power in the time-series analysis, our cross-sectional results suggest that debt plays a key role in the distribution of NN. We have shown that greater sovereign debt outstanding leads to greater net notional amounts of CDS outstanding; hence, we exploit the heterogeneity in the timing and intensity of bond issuance by different governments to relate CDS trading to the dynamics of general government debt. As domestic and international debt contain independent information for cross-country differences in NN, we explore shocks to the stock of both, separately.

We manually download debt issuance amounts and announcement dates from Bloomberg. We include in our sample all sovereign bond issuances with maturities above one year, as roll-overs of short-term bills are often mechanical, or employed in the context of monetary policy interventions (e.g., U.S.). Only 57 countries issued debt during our sample period, between November 7, 2008 and June 26, 2015.[14] There are 3,428 bond issuances, among which 1,993 represent debt issues that are included in the CDS reference obligations that could trigger a credit event, while 1,435 debt issues are unlikely to do so. In Table 8, we report summary statistics on the sovereign debt issuance, while country-level statistics are available in the Internet Appendix Table A-5.

We find that a country issues, on average, 59 bonds, as reported in column (2) of Table 8, but there is significant heterogeneity across countries, in light of a standard deviation of 81 bonds reported in column (3). The number of bond issuances ranges from 2 (Switzerland) to 392 (U.S.) (Table A-5). As our analysis is at the weekly frequency, we aggregate a country's bond issues within the same week. We identify 2,524 weeks with bond issuances. In column (4), we report that there are on average 41 bond issuance weeks per country, with a standard deviation of 49 weeks. The average issuance size is \$11.92 billion (in USD equivalents), and the bond maturity ranges on average from 4.2 years (Lebanon) to 20.6 years (South Africa).

We estimate the following regression specification:

$$\ln(NN_{i,t+1}/NN_{i,t}) = a + b \cdot Issue\_Amount_{i,t} + \delta^\top X_{i,t} + \gamma^\top Y_t + \alpha_i + \varepsilon_{i,t}, \tag{3}$$

where $Issue\_Amount_{i,t}$ defines the amount of debt issued (in billions of dollars) during the week of the issuance. We expect b to be positive and significant, following the findings in Subsections 5.1 and 5.2. We control for country-specific and global control variables in the vectors $X_{i,t}$ and Y_t, respectively, and include country fixed effects α_i, clustering standard errors by country.[15]

Our findings, reported in Panel A of Table 9, suggest that the addition in the stock of sovereign debt is linked to increases in sovereign insured interest, even using higher frequency data and allowing for coun-

[14] Abu Dhabi, Saudi Arabia and Estonia did not issue any bonds during the sample period. China did not issue any international bond during our sample period.

[15] The domestic control variables include percentage changes in exchange rates and changes in FX volatility, domestic equity returns, percentage changes in domestic equity market volatility, percentage changes in CDS spreads, CDS spread volatility and CDS liquidity. We also control for country credit ratings.

try fixed-effects, absorbing the cross-sectional variation in the sample. We estimate that a debt issue of $1 billion is associated with an increase in NN of 0.6%.[16] This finding is consistent with our cross-sectional regressions that document a complementarity between NN and sovereign debt. The announcement dates are statistically insignificant and, hence, are not reported.

The inclusion of country or time-fixed effects for the specifications reported in columns (3) to (5) absorbs some of the variation in NN, but it does not drive out the statistical significance of the main regression coefficient. For the specification reported in column (6), we restrict the sample to sovereign debt issues that are included as eligible reference obligations in the CDS contracts, while in column (7), we use only debt issues that are not eligible reference obligations for credit event triggers. We find that the result in column (1) is driven by debt that can trigger payouts in CDS contracts. The regression coefficient is larger in magnitude (0.009), and significant at the 10% significance level, suggesting that we lose some power. The coefficient estimate for debt that does not trigger CDS payouts, reported in column (7), is insignificant. In unreported regressions, we find some evidence that the increase in NN is greater for the issuance of short-term debt, which is more exposed to refinancing risk, but the significance is weak.

In Panel B of Table 9, we repeat the analysis, using percentage changes in CDS spreads as the dependent variable. The issuance of debt does not significantly affect changes in CDS spreads, suggesting that the increases in debt outstanding does not embed information on the creditworthiness of the issuer. Moreover, this result further supports the disconnect between the dynamics of prices and quantities in the sovereign CDS market.

6. Conclusion

The market for sovereign default insurance has been a topic of public policy and academic debates. While there is an abundance of research examining the drivers of sovereign credit *spreads*, surprisingly

[16] A similar regression of simple changes in NN on debt issuance yields a coefficient of 0.135. That estimate translates into an increase of $135 million for a $1 billion issue. The average NN-to-debt ratio is approximately 8% (Table 1), which can be related to the our elasticity estimate for debt issuance.

little is known about the *positions* in sovereign default insurance contracts, even though these have been the subject of close regulatory scrutiny aimed at affecting these positions. For example, the current Basel bank capital requirements prescribe sovereign insurance contracts as hedging tools for sovereign counterparty risk, and the European Union has set in place a permanent ban on the purchase of uncovered sovereign default insurance contracts.

We study aggregate net positions in sovereign default insurance contracts for a sample of 60 countries from September 2008 to October 2015. We find that cross-country differences in net positions and their dynamics are primarily explained by country-specific factors. Our results suggest that the stock of domestic and international general government debt, and the size of a country's economy, jointly explain up to 75% of the cross-country differences in net insured interest. We further exploit heterogeneity in the timing and intensity of government debt issuance to show that net insurance positions increase in the presence of such shocks to the stock of government debt. These effects are more pronounced for the issuance of debt which is considered eligible for the trigger of a sovereign credit event.

We find the lack of co-movement in the net insured positions surprising, since prior research has established that variation in sovereign insurance prices is dominated by common sources of risk. Consistent with a heavily concentrated market structure in which financial intermediaries are marginal price setters, we find that the first principal component of the weekly dynamics of insurance prices explains about 54% of their variation. In contrast, the first principal component of net insurance positions explains only up to 6% of their variation. We show that such a discrepancy between commonality in prices and quantities is confined only to the sovereign default insurance market, and is not present in the corporate default insurance market, nor in the various equity and foreign exchange derivatives markets.

Our findings raise two questions that we leave for future research. First, from a theoretical perspective, it would be useful to better understand how a market for highly intermediated assets, such as that for sovereign default insurance, can exhibit a high degree of commonality in prices, while traded quantities appear uncorrelated. Second, the use of more granular data on positions at the contract- and counterparty-level could help distinguish between hedging and speculative trading motives in the sovereign default insurance contracts, and provide further insight into their apparent insensitivity to global sources of risk.

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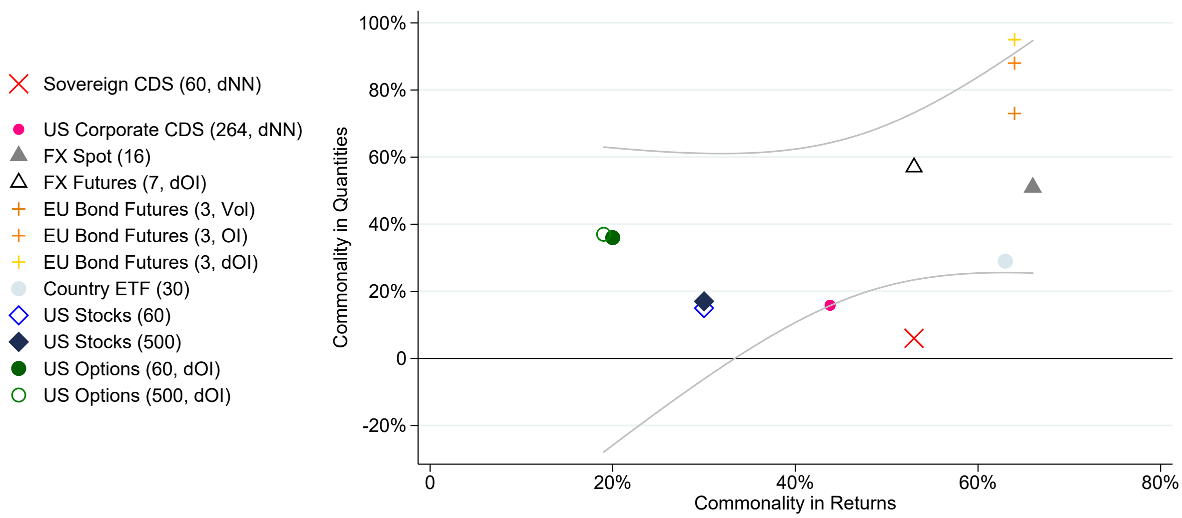
Fig. 1. Commonality in Quantities and Commonality in Returns by Asset Class. In Figure 1.a, we illustrate the relation between commonality in quantities and commonality in returns for different asset classes. For each asset class, commonality is measured as the fraction of common variation explained by the first principal component of returns (x-axis), or the first principal component of changes in quantities (y-axis). As quantities, we use net notional amounts outstanding (sovereign CDS, U.S. corporate CDS), open interest (FX futures, E.U. bond futures, U.S. equity options), volume (FX spot, E.U. bond futures, country ETFs, U.S. stocks). The 95% confidence bands of a linear regression of commonality in quantities on commonality in returns is depicted using gray lines. Section A-III in the Internet Appendix and Table A-6 contain details about the data composition and their sources. In Figure 1.b, we report the ratio of commonality in returns to commonality in quantities.

(1.a)



(1.b)

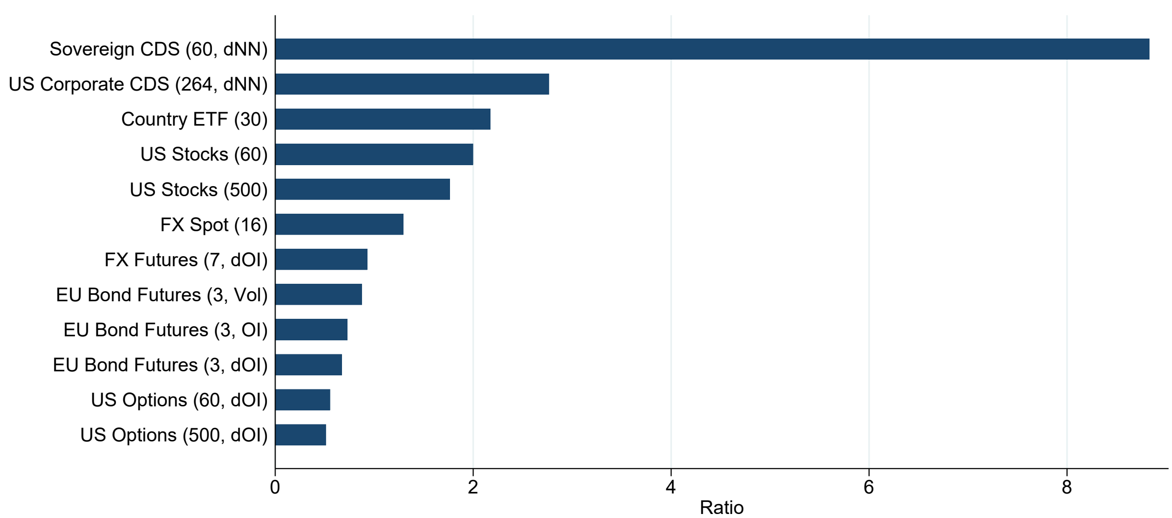
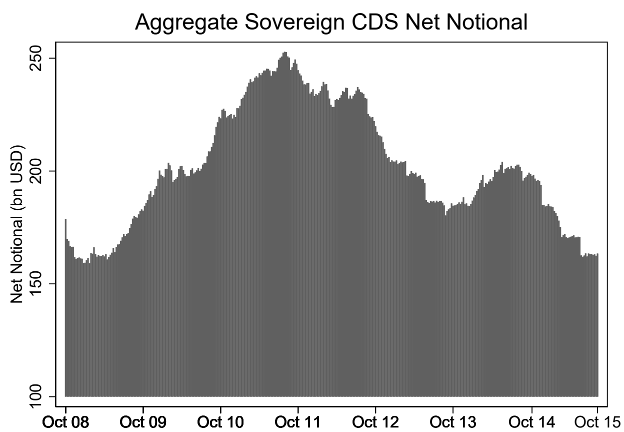
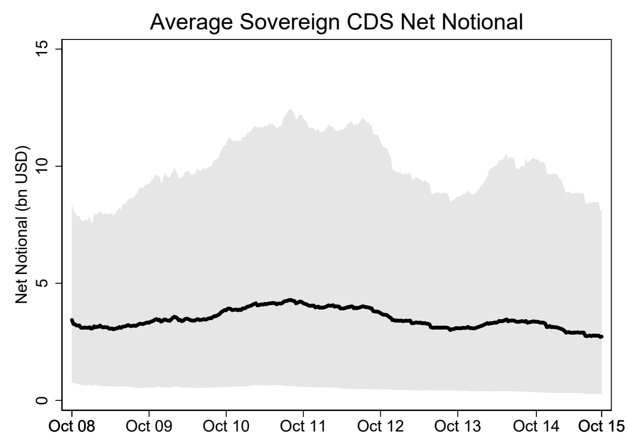


Fig. 2. CDS Net Notional Amounts Outstanding. These figures depict the total and average net notional amounts of CDS outstanding in USD billion equivalents. Figure 2.a illustrates the total weekly sovereign CDS net notional amounts outstanding. Figure 2.b presents the average weekly sovereign CDS net notional amounts outstanding and the inter-quartile range of the cross-sectional distribution (grey shaded area). Figures 2.c and 2.d depict country averages of net notional amounts of CDS outstanding in USD billion equivalents. Figure 2.c displays the cross-sectional distribution of country averages of the net notional amounts of CDS outstanding, explicitly indicating the 10 countries with the highest average CDS net notional amounts outstanding. The vertical dotted line separates the top 10 from the rest of the sample. Figure 2.d displays the cross-sectional distribution of country averages of the net notional amounts of CDS outstanding for the 25 countries with the highest average amounts. The sample period is October 2008 to September 2015. Source: DTCC.

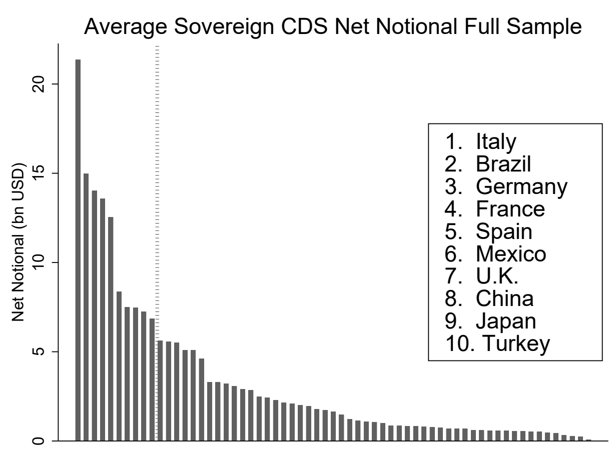
(2.a)



(2.b)



(2.c)



(2.d)

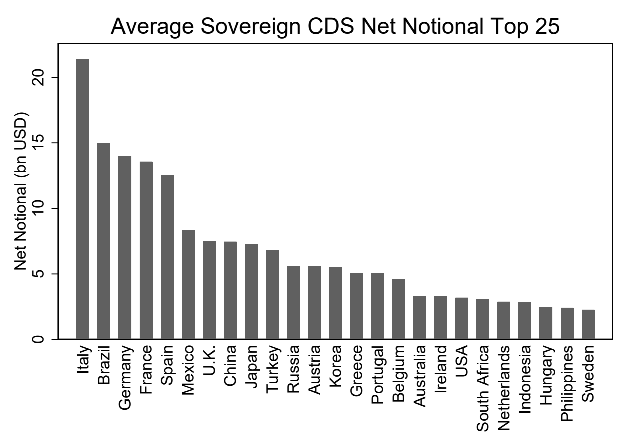
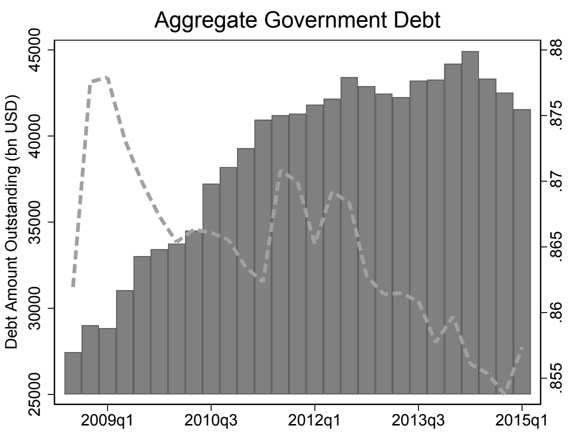
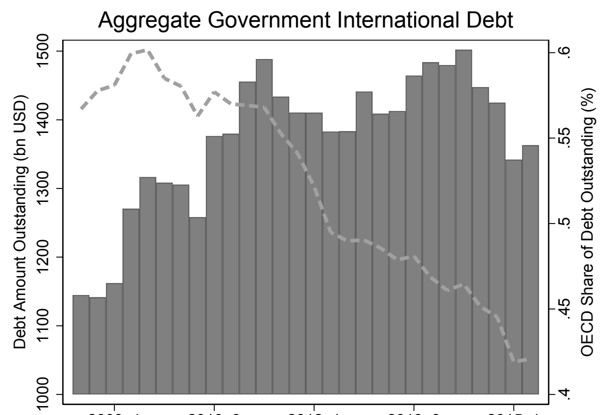


Fig. 3. General Government Debt. Figure 3.a (3.b) depicts the aggregate quarterly total general government debt outstanding, i.e., both domestic and international (international) in USD billion. The dotted line traces the share of the total aggregate (international) debt outstanding accounted for by the debt of the 20 OECD countries. Figure 3.c (3.d) presents country averages of quarterly total general government debt outstanding, i.e., both domestic and international (international) in USD billion, explicitly indicating the the top ten countries by total (international) debt outstanding. The vertical dotted line separates the top 10 countries from the rest of the sample. The sample period is the second quarter 2008 to the second quarter 2015. Source: Bank for International Settlements.

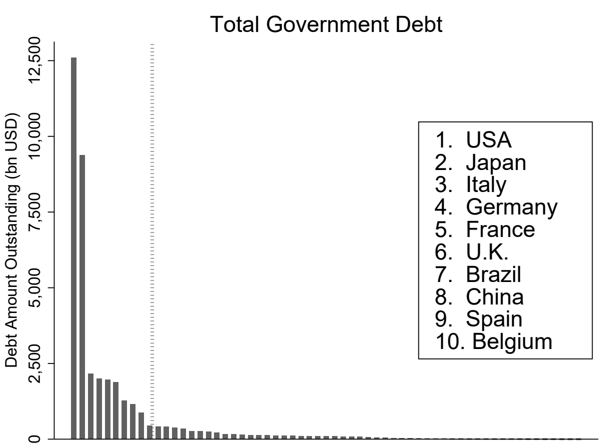
(3.a)



(3.b)



(3.c)



(3.d)

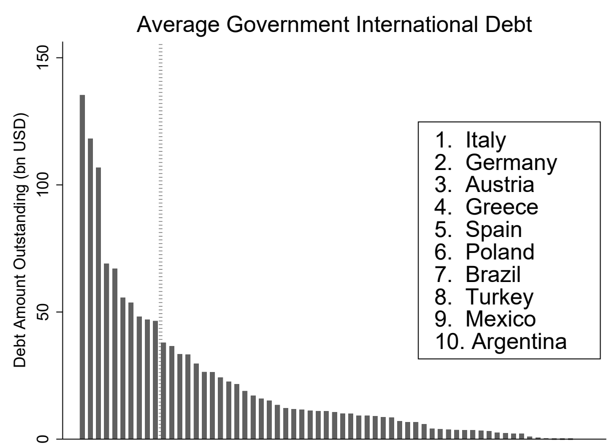


Fig. 4. Predicted vs. Actual Net Notional Amounts of CDS Outstanding. In this figure, we plot the predicted net notional amounts of CDS outstanding against the actual net notional amounts of CDS outstanding using the empirical model:

$$\widehat{\ln(\text{NN})}_i = 5.89 + 0.021\,\ln(\text{Domestic Debt})_i + 0.083\,\ln(\text{Int Debt})_i + 0.498\,\ln(\text{GDP})_i \qquad R^2=0.75,$$

where we control for total domestic general government debt, total international general government debt, and GDP, and where we use a cross-sectional regression based on time-series averages of weekly values. The sample period is the second quarter 2008 to the second quarter 2015. CDS positions data are obtained from DTCC, GDP and debt data are obtained from the IMF and Bank for International Settlements respectively.

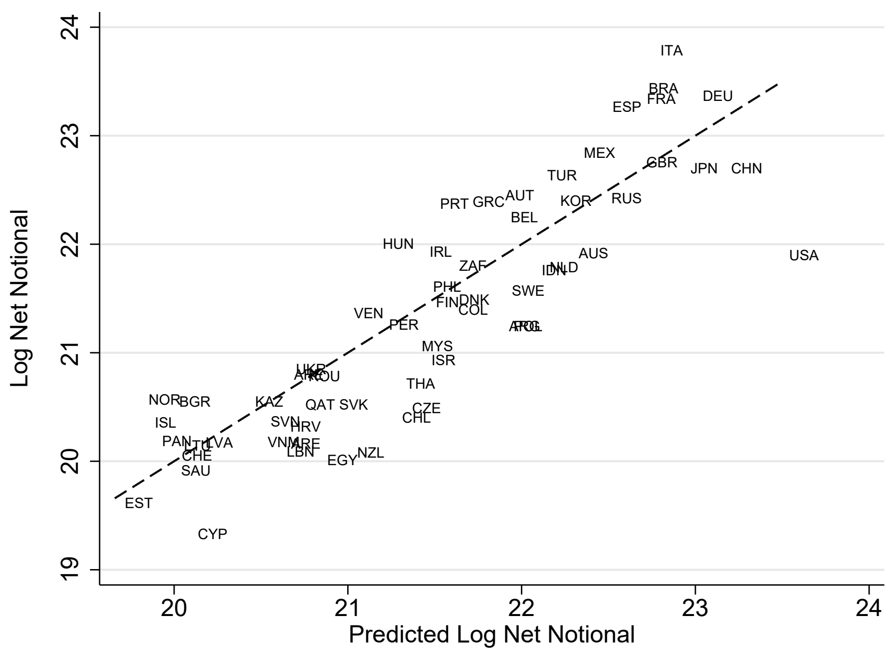


Table 1

Descriptive Statistics. In Panel A of this table reports summary statistics on net notional amounts of CDS outstanding for the 60 sovereign reference entities included in the 1,000 most heavily traded contracts, as reported by the DTCC. We report the mean, standard deviation, minimum, maximum, 25th, 50th, and 75th percentiles of end-of-quarter values. *Net Notional* refers to the combined values for CDS contracts of all maturities, and are measured in USD billions. The variable *Debt* refers to the total amount of domestic and international debt outstanding (for which we also report separate statistics in Panels B and C), and *GDP* is the country's gross domestic product, both variables measured in USD billions. Quantities in currencies other than USD are converted into USD, using the prevailing foreign exchange rate. We report statistics for the ratio of net notional to debt outstanding and the ratio of debt outstanding to GDP. The sample period extends from the fourth quarter of 2008 to the second quarter of 2015. The column titled "N" refers to the number of observations. CDS net notional data are obtained from DTCC, GDP and debt data are obtained from the IMF and Bank for International Settlements respectively.

Panel A: All Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
Net Notional	1,474	3.55	4.61	0.08	0.72	1.72	4.22	27.05
Debt	1,474	687.75	2,117.58	0.00	16.95	100.81	285.32	15,613.88
International Debt	1,474	23.32	29.44	0.00	3.95	12.06	30.66	153.02
Domestic Debt	1,474	664.43	2,117.26	0.00	6.51	85.36	228.64	15,610.02
GDP	1,474	1,076.48	2,427.27	12.82	167.99	286.43	853.81	18,124.73
Net Notional/Debt	1,450	0.08	0.22	0.00	0.01	0.02	0.05	2.93
Debt/GDP	1,474	0.39	0.35	0.00	0.14	0.33	0.53	2.09
Panel B: Emerging Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
Net Notional	954	2.36	3.17	0.08	0.62	1.06	2.32	18.62
Debt	954	141.57	288.21	0.00	8.69	35.88	120.72	1,686.31
International Debt	954	17.54	19.17	0.00	3.83	10.18	26.47	109.46
Domestic Debt	954	124.03	281.18	0.00	0.00	25.20	101.24	1,670.88
GDP	954	588.23	1,341.60	19.53	97.80	205.79	461.65	11,211.93
Net Notional/Debt	930	0.11	0.26	0.00	0.02	0.03	0.07	2.93
Debt/GDP	954	0.26	0.27	0.00	0.07	0.23	0.37	1.51
Panel C: Developed Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
Net Notional	520	5.73	5.87	0.38	1.74	3.36	8.17	27.05
Debt	520	1,689.79	3,319.61	4.91	126.59	287.57	1,859.49	15,613.88
International Debt	520	33.93	40.14	0.00	4.33	18.11	42.61	153.02
Domestic Debt	520	1,655.86	3,325.06	2.72	108.75	199.56	1,791.80	15,610.02
GDP	520	1,972.22	3,489.16	12.82	268.28	528.72	2,318.78	18,124.73
Net Notional/Debt	520	0.02	0.02	0.00	0.01	0.01	0.02	0.22
Debt/GDP	520	0.63	0.35	0.11	0.41	0.57	0.78	2.09

Table 2
Descriptive Statistics. In Panel A of this table, we report summary statistics at the quarterly frequency for the explanatory variables used in the cross-sectional analysis of the net notional amounts of CDS outstanding for the 60 sovereign reference entities included in the 1,000 most heavily traded contracts, as reported in the DTCC. We report the mean, standard deviation, minimum, maximum, 25th, 50th, and 75th percentiles of end-of-quarter values. The variable $CDS\ Spread$ is measured in percentage points and refers to a contract with a maturity of five years. The variable σ^2_{CDS} is the variance of weekly relative changes in CDS spreads, $CDS\ Liquidity$ refers to the average weekly CDS depth (number of contributing dealer quotes), σ^2_{FX} is the variance of weekly exchange rate returns. $Reserves$ represent the country's foreign exchange reserves in USD billions. $Inflation$ is the change in GDP deflator. $Market\ capitalization$ is the total size of the country's stock market, measured in USD trillions, while σ^2_{MKT} is the weekly return variance of a country's stock market index. The variables σ^2_{CDS}, σ^2_{FX}, and σ^2_{MKT} have been multiplied by 100 to ease interpretation. The sample period extends from the fourth quarter of 2008 to the second quarter of 2015. The World Bank does not report data for all countries in every quarter, thus the number of observations for $Inflation$ and $Market\ Capitalization$ is lower than the total number of observations. The number of observations is reported in the column titled "N". We report separate statistics for emerging and developed countries in Panels B and C, respectively. CDS contract data are from Markit, inflation and market capitalization data are from the World Bank. Reserves data are from the IMF. FX data are from Datastream.

Panel A: All Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
CDS Spread	1,471	2.59	5.58	0.13	0.74	1.29	2.55	112.65
σ^2_{CDS}	1,470	0.42	0.49	0.00	0.12	0.27	0.56	6.67
CDS Liquidity	1,471	6.60	1.86	2.04	5.17	6.64	7.83	12.75
σ^2_{FX}	1,471	0.02	0.11	0.00	0.00	0.01	0.03	3.41
Reserves	1,474	139.56	445.35	0.13	13.51	37.41	74.53	4,010.83
Inflation	1,469	3.74	5.94	-24.22	0.85	2.05	5.17	45.94
Market Capitalization	1,364	0.87	2.80	0.00	0.04	0.18	0.57	26.33
σ^2_{MKT}	1,471	0.10	0.16	0.00	0.02	0.05	0.11	1.59
Panel B: Emerging Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
CDS Spread	952	3.35	6.71	0.47	1.07	1.63	3.19	112.65
σ^2_{CDS}	952	0.39	0.49	0.00	0.12	0.26	0.51	6.67
CDS Liquidity	952	6.83	1.98	2.04	5.25	6.89	8.11	12.75
σ^2_{FX}	952	0.03	0.13	0.00	0.00	0.01	0.02	3.41
Reserves	954	160.63	521.31	0.13	13.85	36.23	92.91	4,010.83
Inflation	949	4.98	6.96	-24.22	1.23	3.48	6.94	45.94
Market Capitalization	870	0.35	0.77	0.00	0.02	0.09	0.35	8.19
σ^2_{MKT}	952	0.11	0.16	0.00	0.02	0.05	0.12	1.27
Panel C: Developed Countries								
Variable	N	Mean	STD	Min	25th Pct	Median	75th Pct	Max
CDS Spread	519	1.21	1.65	0.13	0.38	0.65	1.30	12.84
σ^2_{CDS}	518	0.47	0.49	0.01	0.13	0.30	0.64	4.51
CDS Liquidity	519	6.20	1.55	2.68	5.08	6.38	7.31	9.98
σ^2_{FX}	519	0.02	0.03	0.00	0.01	0.01	0.03	0.51
Reserves	520	100.91	248.15	0.80	12.34	43.86	66.06	1,258.17
Inflation	520	1.48	1.84	-5.20	0.67	1.44	2.05	11.39
Market Capitalization	494	1.80	4.39	0.04	0.15	0.34	1.45	26.33
σ^2_{MKT}	519	0.09	0.14	0.00	0.03	0.05	0.09	1.59

Table 3

Principal Component Analysis. In this table, we report summary statistics for the principal component analysis of the correlation matrix of weekly sovereign CDS spread changes (Panel A), the correlation matrix of weekly changes of net (Panel B) notional amounts of CDS outstanding, and the correlation matrix of weekly changes of net notional amounts of CDS outstanding that has been corrected for seasonality effects due to the quarterly on-the-run roll effects on March 20, June 20, September 20, and December 20 (Panel C). There are seven instances of March and June rolls, and six for September and December. The correlation matrices are based on the 47 countries for which we have continuous information on CDS net notional amounts with 349 weeks of data. The sample period is October 31, 2008 to July 3, 2015. Source: DTCC and Markit.

	Full Sample		Developed		Emerging	
Principal Component	Percent Explained	Total	Percent Explained	Total	Percent Explained	Total
			Panel A: Δ *Spread*			
First	56.87	56.87	63.93	63.93	64.25	64.25
Second	9.29	66.16	6.19	70.12	7.57	71.82
Third	3.93	70.09	5.92	76.04	5.34	77.16
Fourth	3.54	73.63	5.05	81.09	3.23	80.39
Fifth	2.27	75.9	3.03	84.12	2.71	83.1
			Panel B: Δ *Net Notional*			
First	10.34	10.34	18.68	18.68	11.29	11.29
Second	4.8	15.14	8.99	27.67	6.19	17.48
Third	4.21	19.35	8.32	35.99	4.97	22.45
Fourth	3.57	22.92	7.24	43.23	4.81	27.26
Fifth	3.52	26.44	6.31	49.54	4.48	31.74
			Panel C: Δ *Net Notional De-Seasonalized*			
First	7.02	7.02	15.78	15.78	7.9	7.9
Second	5.03	12.05	9.12	24.9	6.34	14.24
Third	4.35	16.4	8.65	33.55	5.13	19.37
Fourth	3.77	20.17	7.65	41.2	4.96	24.33
Fifth	3.64	23.81	6.41	47.61	4.62	28.95

Table 4

Sovereign CDS Net Notional Amounts Outstanding – Seasonality Regression. In this table, we report the estimated coefficients from the seasonality panel regression for weekly percentage changes of sovereign CDS net notional amounts outstanding, which are projected on the dates when the on-the-run contract expires and rolls over to a new on-the-run CDS contract. The CDS roll indicator for each of the quarterly roll dates is one during the week of the roll, and zero otherwise. Each calendar year, single-name CDS contracts roll on March 20, June 20, September 20, and December 20. Weekly net notional data are obtained from the DTCC. We report *t*-test statistics based on standard errors clustered by country. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% significance levels, respectively.

	(1)	(2)	(3)	(4)
Mar 20 Roll	-2.309***	-2.310***	-2.483***	-2.483***
	(-8.234)	(-8.220)	(-8.009)	(-7.998)
Jun 20 Roll	-2.597***	-2.597***	-2.689***	-2.689***
	(-7.386)	(-7.380)	(-7.266)	(-7.256)
Sep 20 Roll	-1.483***	-1.484***	-1.573***	-1.573***
	(-5.376)	(-5.377)	(-5.312)	(-5.305)
Dec 20 Roll	-1.934***	-1.933***	-2.158***	-2.158***
	(-6.087)	(-6.077)	(-5.814)	(-5.805)
Constant	0.079**	0.079***	0.092**	0.092***
	(2.390)	(5.662)	(2.577)	(6.118)
Observations	19,731	19,731	16,262	16,262
R^2	0.027	0.032	0.031	0.036
Sov. Fixed Effect	No	Yes	No	Yes
# Sovereigns	60	60	47	47

Table 5
Cross-Sectional Determinants of Net Notional Amounts of CDS Outstanding. In this table, we report the estimated coefficients from the panel regression analysis aimed at investigating the determinants of cross-sectional differences in net notional amounts of sovereign CDS contracts outstanding. All information is aggregated at a quarterly frequency. We regress quarterly levels of sovereign CDS net notional amounts outstanding on country-specific variables and time fixed effects. The explanatory variables are *Total Debt*, *Domestic Debt*, and *International Debt* (general government debt outstanding) in USD billion, and gross domestic product (*GDP*). All variables have been log-transformed to allow for an interpretation of the parameters as elasticities. The indicator *I*(*Only Domestic Debt*) (*I*(*Only International Debt*)) is equal to one for countries that issue only domestic (international) debt, and zero otherwise. The indicator *U.S.* is equal to one for U.S. observations and zero otherwise. We report the adjusted R^2 of the regression. The standard errors are clustered by country with the corresponding *t*-test statistics reported in parentheses. The regression specifications reported in column (5) accounts for quarterly time fixed effects. The results in column (6) are based on country averages. We report similar test results for emerging markets (EM) and developed markets (DM) countries in columns (7) and (8), respectively. For the results in column (9), we scale the right- and left-hand side variables by GDP, i.e., we regress the NN-to-GDP ratio on the ratios of debt-to-GDP. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All	All	All	All	All	All	EM	DM	All
Total Debt	0.152*								
	(1.82)								
Dom. Debt		0.055***	0.051***	0.017**	0.017**	0.020***	0.139	0.530***	
		(7.03)	(6.74)	(2.51)	(2.48)	(3.21)	(1.55)	(3.69)	
Int. Debt			0.062***	0.060***	0.060***	0.083***	0.143***	0.355***	
			(2.76)	(3.47)	(3.54)	(6.99)	(2.75)	(6.51)	
GDP				0.496***	0.499***	0.498***	0.366***	-0.166	
				(7.09)	(7.05)	(7.10)	(3.99)	(-0.94)	
I(Only Dom. Debt)							2.534*	7.389***	
							(1.94)	(5.67)	
I(Only Int. Debt)							3.043		
							(1.41)		
U.S.								-1.081***	
								(-3.92)	
Dom. Debt/GDP									-0.001
									(-0.68)
Int. Debt/GDP									0.037**
									(2.37)
Constant	17.573***	20.218***	18.942***	6.502***	6.533***	5.887***	4.900***	4.135**	0.006***
	(8.36)	(142.66)	(32.27)	(3.63)	(3.62)	(3.24)	(2.88)	(2.14)	(4.44)
Time FE	No	No	No	No	Yes	No	No	No	No
Observations	1474	1474	1474	1474	1474	60	954	520	1474
Adj. R^2	0.265	0.259	0.339	0.662	0.673	0.752	0.707	0.787	0.191

Table 6

Cross-Sectional Determinants of Net Notional Amounts of CDS Outstanding. In this table, we report the estimated coefficients from the panel regression analysis aimed at investigating the determinants of cross-sectional differences in net notional amounts of sovereign CDS contracts outstanding. All information is aggregated at a quarterly frequency. We regress quarterly levels of sovereign CDS net notional amounts outstanding on country-specific variables and time fixed effects. The explanatory variables are *Total Debt*, *Domestic Debt*, and *International Debt* (general government debt outstanding) in USD billion, and gross domestic product (*GDP*), reserves in foreign currencies (*FX Reserves*), the *CDS Spread*, the variance of percentage changes in CDS spreads (σ^2_{CDS}), *CDS Liquidity*, the country's stock *Market Capitalization*, the variance of weekly percentage changes in the country's stock market index (σ^2_{MKT}), *Inflation*, and the variance of changes in the FX rate against the USD (σ^2_{FX}). All variables have been log-transformed to allow for an interpretation of the parameters as elasticities. We report the adjusted R^2 of the regression. All regression specifications account for quarterly time fixed effects, the standard errors are clustered by country with the corresponding *t*-test statistics reported in parentheses. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)	(4)
Domestic Debt	0.016**	0.018***	0.020**	0.015**
	(2.31)	(2.90)	(2.66)	(2.17)
International Debt	0.056***	0.038***	0.042**	0.037***
	(3.46)	(3.03)	(2.35)	(2.96)
GDP	0.573***	0.577***		0.585***
	(4.94)	(5.95)		(5.76)
FX Reserves	-0.084	-0.115**	-0.062	-0.107**
	(-1.30)	(-2.30)	(-1.19)	(-2.20)
CDS Spread		0.081	0.102	0.104
		(1.10)	(1.28)	(1.59)
σ^2_{CDS}		0.044	0.142***	0.026
		(1.14)	(3.41)	(0.64)
CDS Liquidity		0.902***	0.961***	0.909***
		(3.52)	(4.37)	(3.17)
Market Capitalization			0.344***	
			(4.91)	
σ^2_{MKT}				0.034
				(0.79)
Inflation				-0.012
				(-1.29)
σ^2_{FX}				0.011
				(0.54)
Constant	4.945*	3.293	18.955***	3.280
	(1.81)	(1.50)	(27.74)	(1.46)
Time FE	Yes	Yes	Yes	Yes
Observations	1,474	1,470	1,360	1,463
Countries	60	60	60	60
Adj. R^2	0.681	0.732	0.604	0.738

Table 7

Time-Series Determinants of Net Notional Amounts of CDS Outstanding. In this table, we report the estimated coefficients from the panel regression analysis aimed at investigating the dynamics of net notional amounts of CDS contracts outstanding. At a weekly frequency, we regress percentage changes in the level of sovereign CDS net notional amounts outstanding on country specific and global variables. All specifications include country-quarter fixed effects. The explanatory variables include returns to the US dollar currency portfolio (*US Dollar*), and local variables such as changes to the sovereign's CDS spread (*CDS*), changes in the square of CDS percentage changes (σ^2_{CDS}), changes in CDS liquidity (*CDS Liquidity*), return to the country's equity market orthogonalized to returns in the US equity market (Equity$^{\perp}$), changes in square unadjusted equity market return (σ^2_{MKT}), changes in the FX rate (*FX*), changes in the square FX rate (σ^2_{FX}). Global variables include changes in global and regional CDS spreads orthogonalized to the following macro variables: return of the US stock market (*UsRet*), changes in the PE ratio (*PE Ratio*), changes in the VIX (*VIX*), changes in the TED spread (*TED*), changes in the difference between the BBB credit spread and the AAA credit spread (*BBB-AAA*), changes in the difference between the BB credit spread and the BBB credit spread (*BBB-AAA*, *BB-BBB*), and the 5-year constant maturity treasury spread (*5y CMT*). All macro variables are also included as regressors. All changes are percentage changes. Dummies for four yearly roll-over dates are included but not reported. In Panel B, we report the coefficients from the regression of the country-quarter fixed effects on domestic debt, international debt, and GDP. We report the adjusted R^2 of the regression. For all specifications, standard errors are clustered by country. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% significance levels, respectively.

Panel A: Time Series Regression				
	(1)	(2)	(3)	(4)
US Dollar	-0.251***	-0.259***	-0.229***	-0.229***
CDS		0.005	0.006	0.012**
σ^2_{CDS}		-0.036	-0.024	-0.025
CDS Liquidity		0.001	0.001	0.001
Equity$^{\perp}$			-0.001	-0.003
σ^2_{MKT}			-0.241*	-0.241*
FX			-0.028	-0.030
σ^2_{FX}			-0.740	-0.755
Global CDS$^{\perp}$				0.000
Regional CDS$^{\perp}$				-0.010
UsRet				-0.012
PE Ratio				-0.011
VIX				-0.005
TED				-0.007*
BBB-AAA				-0.004
BB-BBB				-0.002
5y CMT				-0.001
Roll Dummies	Yes	Yes	Yes	Yes
FE	CQ	CQ	CQ	CQ
Observations	19,731	19,722	19,722	19,722
Adj. R^2	0.031	0.031	0.031	0.031
Panel B: Country Quarter Fixed Effects Determinants				
Domestic Debt				0.006**
International Debt				0.002
GDP				0.017***
Adj. R^2				0.010
Observations				1,405

Table 8

Debt Issuance Channel - Net Notional Amounts of CDS Outstanding. In this table, we report summary statistics of the sovereign debt issuances by the 57 countries that issued debt between November 7, 2008 and June 26, 2015. The data source is Bloomberg. We report the total number of bond issuances (*Total # Bonds*), the average number of bonds issued per country (*# Bonds Issued, Avg./Country*), the standard deviation of the number of bonds issued across countries, (*# Bonds Issued, Std. across Countr*), the average number of weekly bond issuances per country (*# Weekly Bond Iss., Avg./Country*), the standard deviation of weekly bond issuances across countries (*# Weekly Bond Iss., Std. across Countr.*), the average issuance size in USD billions (*Avg. Iss. Size ($bill.)*), and the standard deviation of issuance size in USD billions (*Std. Iss. Size ($bill.)*). All debt amounts are converted to USD using the prevailing weekly exchange rate. We report statistics separately for bonds that are included as eligible reference obligations in the CDS contract, i.e., debt that can potentially trigger a CDS payout (*CDS Debt*), debt that is unlikely to trigger a credit event (*non-CDS Debt*), as well as the overall sample of bond issuances (*All*).

	(1) Total # Bonds	(2) # Bonds Issued Avg./Country	(3) # Bonds Issued Std./Countr.	(4) # Weekly Bond Iss. Avg./Country	(5) Std. Weekly Bond Iss. Std./Countr.	(6) Avg. Iss. Size (bill. USD)	(7) Std. Iss. Size (bill. USD)
CDS Debt	1,993	36.91	78.25	23.39	43.95	18.24	8.20
Non-CDS Debt	1,435	42.21	51.79	18.42	33.03	3.14	5.30
All	3,428	59.10	81.27	41.37	49.12	11.92	8.40

Table 9

Debt Issuance Channel. In Panel A of this table, we report the results from a panel regression of weekly percentage changes of net notional amounts of sovereign CDS outstanding on the announcement of debt issuance dates multiplied by the size of the debt issuance in USD billions. In Panel B, we use weekly percentage changes of sovereign CDS spreads as the dependent variable. All debt amounts are converted to USD using the prevailing weekly exchange rate. For the specification reported in column (6), we use the sub-sample of issued bonds that are included as eligible reference obligations in the CDS contract, i.e., debt that can potentially trigger a CDS payout. In the specification reported in column (7), we use only non-CDS debt, i.e., debt which is not listed as a reference obligation and, hence, would unlikely trigger a credit event. As domestic control variables, we use percentage changes in exchange rates and changes in FX volatility, the sovereign credit rating, domestic equity returns, percentage changes in domestic equity market volatility, percentage changes in CDS spreads, CDS spread volatility, and CDS liquidity. Quarterly roll date dummies and the dollar factor are included in the absence of time fixed effects. The data frequency is weekly. Standard errors are clustered at the country level. The sample period spans from November 7, 2008 to June 26, 2015. The superscripts *, **, and *** refer to statistical significance at the 10%, 5%, and 1% significance levels, respectively.

Panel A: Changes in Net Notional, Δ NN %							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Issued ($bill.)	0.006***	0.004***	0.005***	0.003***	0.003***	0.009*	0.007
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.005)	(0.009)
Constant	0.067**	0.071***	-0.109***	-5.535***	-0.136	-0.144	-0.128
	(0.030)	(0.014)	(0.033)	(1.720)	(0.707)	(0.705)	(0.708)
R^2	0.030	0.035	0.075	0.080	0.079	0.079	0.079
Roll Dummy	Yes	Yes	No	No	No	No	No
Country FE	No	Yes	No	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	Yes	Yes	Yes	Yes
Local Controls	No	No	No	No	Yes	Yes	Yes
Countries	60	60	60	60	60	60	60
Panel B: Changes in CDS Spread, Δ CDS %							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Issued ($bill.)	0.005	0.006	0.001	-0.000	0.001	-0.001	-0.016*
	(0.005)	(0.006)	(0.002)	(0.002)	(0.002)	(0.010)	(0.008)
Constant	-0.204***	-0.206***	-0.196***	-8.784***	14.039***	14.041***	14.039***
	(0.047)	(0.013)	(0.044)	(1.662)	(1.187)	(1.186)	(1.186)
Observations	20,024	20,024	20,024	20,024	19,949	19,949	19,949
R^2	0.000	0.002	0.495	0.497	0.519	0.519	0.519
Country FE	No	Yes	No	Yes	Yes	Yes	Yes
Time FE	No	No	Yes	Yes	Yes	Yes	Yes
Local Controls	No	No	No	No	Yes	Yes	Yes
Countries	60	60	60	60	60	60	60

Internet Appendix

How Sovereign is Sovereign Credit Risk? Global Prices, Local Quantities

A-I. A Law of Motion for CDS Quantities

Statistics on positions in credit derivatives involve many different components, such as gross and net notional amounts of CDS outstanding, novations/assignments, terminations, and market risk transfer activity. This is in contrast to trading in exchange-traded derivatives, such as equity options, which are adequately summarized by volume and open interest. While some of these terms are well-known, it is not necessarily clear how they are related and exactly defined. In this section, we briefly describe and illustrate the different components of CDS quantities available in the Trade Information Warehouse ("TIW") of the Depository Trust and Clearing Corporation (DTCC), with a more detailed discussion In Section A-II. We also derive an accounting identity to understand the dynamicsr of the different terms.

For credit default swaps (CDSs), the *gross notional amount outstanding*, G, refers to the par amount of credit protection bought or sold, across multiple agreements, for the same name and maturity, and is used as the underlying reference amount to derive the insurance premium payments and the recovery amounts in the event of a default. In other words, the gross notional amount represents the cumulative total of past transactions. The *net notional amount outstanding*, N, with respect to any single reference entity and maturity, is the sum of the net protection bought by net buyers (or equivalently net protection sold by net sellers).[1] The difference between gross and net notional amount outstanding is best illustrated by adapting the examples from Oehmke and Zawadowski (2017). Suppose, for example, that counterparty A has purchased $20 million in gross notional amounts of CDS outstanding from counterparty B. Panel A in Table A-1 shows that, in this scenario, both gross and net notional amounts outstanding are equal to $20 million. If, in addition to buying $20 million from counterparty B, counterparty A also sells $20 million to counterparty C, while B sells $20 million to A, and C buys $20 million from A, then the total gross notional amounts of CDS outstanding are equal to $40 million, while the total net notional amounts of CDS outstanding are only equal to $20 million, as is depicted in Panel B of Table A-1. Finally, we show in Panel C that, if the previous scenario is slightly amended with counterparty C also selling $20 million to B, then the total gross amounts of CDS outstanding inflate to $60 million, while the net

[1] The clearing platforms of the Chicago Mercantile Exchange (CME) and the New York Stock Exchange (NYSE) for OTC derivatives use the term *open interest*, defined as the sum of the net notional amount outstanding per contract, which is thus consistent with the net notional amount outstanding, reported by DTCC.

notional amounts of CDS outstanding shrink to \$0 million. The net notional position generally represents the maximum possible transfer of funds between net sellers and net buyers of protection that could be required upon the occurrence of a credit event (as long as there is a non-negative recovery rate on the underlying debt instruments, the net transfer of funds would be lower).[2] Hence, the net notional amounts of CDS outstanding are often considered to be the economically more meaningful measure (Oehmke and Zawadowski, 2017). These examples illustrate that the net notional amount outstanding can never be greater than the gross notional amount outstanding, and that it is proportional to gross notional amount of CDS outstanding by a factor, $0 \leq \alpha_t \leq 1$, such that

$$N_t = \alpha_t G_t, \tag{A-1}$$

which allows us to define a measure of trading intensity $\gamma_t = 1/\alpha_t$, with $0 \leq \alpha_t \leq 1$, representing a summary statistic of trading activity.

The gross notional amount of CDS outstanding may be affected by the practice of *novation*, which is sometimes called *assignment*. Novation, which may be partial, refers to the process by which one counterparty (transferor) agrees to transfer to a third party (transferee) its obligations under an existing transaction they have with another counterparty (remaining party). DTCC states that, since an assignment transaction is the transfer of a pre-existing TIW position to another party, it does not affect the gross notional amounts or the number of contracts. Thus, although not explicitly explained by DTCC, there should be no effect on *aggregate* net notional amounts outstanding either.[3] Duffie et al. (2011) provide a simple example of novation, which we adapt in Panels D.1 and D.2 of Table A-1. Suppose that counterparty A buys \$20 million from counterparty B (such that B sells \$20 million to A). The gross and net notional amounts are both \$20 million. If B wants to exit its position with A and agrees to pass on the position to C, then B (the step-out party) assigns the trade to C (the step-in party). Counterparty A needs to be informed and consent to the novation. A new trade relationship exists between A and C, but the gross and net notional amounts of CDS outstanding remain unchanged.

Participants in the CDS market may also unwind their contracts in the TIW by entering into a contract *termination*, which is often called a *cancellation*, C. This could potentially be done through *portfolio compression*, which is the process by which two counterparties maintain the same risk profile, but reduce the number of contracts and gross notional amounts of CDS outstanding held by participants. Dongyoup (2012) and Duffie et al. (2011) provide examples of portfolio compression, which we also depict in Panels E.1 and E.2 of Table A-1. In this example, counterparty A bought \$5 million from counterparty C and

[2]This statement assumes absence of counterparty risk.

[3]It goes without saying that there would be an impact on individual counterparty net notional amounts outstanding.

sold \$10 million to counterparty B. In addition, B bought \$10 million from A and sold \$10 million to C. Finally, C bought \$10 million from B and sold \$5 million to A. The total gross and net notional amounts of CDS outstanding reported by DTCC would be \$25 million and \$5 million, respectively (Panel E.1). If the regulators call for a trade compression to engage in credit risk mitigation, then the trade compression process would, for example, reduce the gross notional amount of CDS outstanding from \$25 million to \$5 million, while the net notional amount of CDS outstanding would remain unchanged, as is illustrated in Panel E.2. This would effectively happen by terminating the two trades B has with A and C, while replacing the trades between A and C with a new transaction that preserves the previous risk profile between these two counterparties.

Gross and net notional amounts of CDS outstanding can also be affected through termination or expiration at maturity. Thus, *matured contracts*, M, arise when contracts have reached their scheduled termination date. A similar effect on gross and net notional amounts of CDS outstanding arises through *exits*, E, which arise when bilateral counterparties mutually agree to remove contracts from the TIW. We illustrate this in Panel F of Table A-1. Consider the example in Panel B, in which A has bought (sold to) \$20 million from B (C), B has sold \$20 million to C, and C has bought \$20 million from A, resulting in a total gross (net) notional amounts of CDS outstanding of \$40 (\$20) million. Suppose that the \$20 million C bought from A were purchased in three separate transactions on 5 year CDS contracts: \$10 million were bought at $t-5$, \$5 million were bought at $t-2$, and another \$5 million were bought at $t-1$. In this case, even though there is no contemporaneous transaction at time t, the gross notional amount outstanding shrinks to \$30 million, while the net notional amount outstanding remains flat at \$20 million. The illustration of a trade exit would be identical. Finally, gross notional amounts of CDS outstanding may also be altered by *backloads*, B, which refers to previously registered and non-electronically confirmed trades that the TIW registers at a date later than the contract signing date. Thus, to summarize, gross notional amounts of CDS outstanding are increasing in new transactions (T) and backloads, and decreasing in matured contracts, compressions and exits. The net notional amount of CDS outstanding may be increasing or decreasing in new transactions, increasing in backloads and decreasing in matured contracts and compressions. Novations should, in principle, have no effect on the aggregate gross and net notional amounts of CDS outstanding. We characterize this law of motion for CDS quantities, in terms of the change in the gross notional amount of CDS outstanding, as follows:

$$G_{t+1} = G_t + T_{t+1} - M_{t+1} - C_{t+1} - E_{t+1} + \sum_{j=1}^{J} B_{t-j}, \tag{A-2}$$

where the new transactions, T, are contemporaneous trades that effectively transfer risks between counterparties.[4] DTCC also refers to *market risk transfer activity*, a quantity that we will subsequently refer to as *volume*, V. Volume relates to all activities that result in risk transfer between two counterparties and, therefore, changes the composition of risk across counterparties, but not necessarily in the aggregate. As such, it includes new trades, terminations, and assignments, but excludes portfolio compressions and matured transactions.[5]

A-II. CDS Trading Terminology

A-II.A. Gross Notional Amounts of CDS Outstanding

According to the Derivatives Consulting Group Glossary, *Gross* refers to “A derivative or asset position expressed without netting bought and sold trades,” and *Notional Amount* refers to “The amount of principal underlying the derivative contract, to which interest rates are applied in order to calculate periodic payment obligations.”[6] In other words, for CDSs, notional amount refers to the par amount of credit protection bought or sold, equivalent to debt or bond amounts, and is used to derive the premium payment calculations for each payment period and the recovery amounts in the event of a default. The Depository Trust & Clearing Corporation’s (“DTCC”) Trade Information Warehouse (“Warehouse”) reports aggregate gross notional amounts outstanding on a weekly basis. According to their definition, “*Gross Notional Values are the sum of CDS contracts bought (or equivalently sold) for all Warehouse contracts* in aggregate, by sector or for single reference entities displayed. Aggregate gross notional value and contract data provided are calculated on a per-trade basis. For example, a transaction of \$10 million notional between buyer and seller of protection is reported as one contract and \$10 million gross notional, as opposed to two contracts worth \$20 million. According to ISDA interpretations, “notional amount most certainly overstates the level of new activity because it represents a cumulative total of past transactions, many of which were used by dealers to make their daily adjustments to their risk positions.”[7] In addition, ISDA states that “given the increasing awareness that notional amount outstanding is not a useful measure of risk, there are efforts to provide more meaningful data.” Also, the Bank for

[4] To be precise, total reductions in the gross notional amount of CDS outstanding are also affected by *post-trade event* (PTE) in-flight, referring to transactions that become uncertain (but were certain in the previous week) after a PTE, like an assignment or a novation. Similarly, total increases in gross notional amounts of CDS outstanding are affected by PTE completed, i.e., uncertain transactions that become certain after a PTE. Thus, PTE completed (PTE in-flight) needs to be added to (subtracted from) equation (1) to completely reconcile DTCC’s summary statistics. We abstract here from these components for simplicity.

[5] A slightly different definition of volume is used by the clearing platforms of the Chicago Mercantile Exchange (CME) and the New York Stock Exchange (NYSE) for OTC derivatives. These institutions define volume as the sum of the notional amounts for trades where both the buyer and seller agree to clearing the transaction.

[6] http://www.isda.org/c_and_a/oper_commit-dcg-glossary.html#g

[7] http://www.isdacdsmarketplace.com/market_statistics/understanding_notional_amount

International Settlements ("BIS") reports that "[gross notional] amounts are generally not those truly at risk."[8]

Note that gross notional amount outstanding should not be confused with *gross (positive and negative) market values*, which are reported by the BIS. According to the BIS, "*gross market values are defined as the sums of the absolute values of all open contracts with either positive or negative replacement values evaluated at market prices prevailing on the reporting date*." Thus, the gross positive market value of a dealer's outstanding contracts is the sum of the replacement values of all contracts that are in a current gain position to the reporter at current market prices (and therefore, if they were settled immediately, would represent claims on counterparties). The gross negative market value is the sum of the values of all contracts that have a negative value on the reporting date (i.e., those that are in a current loss position and therefore, if they were settled immediately, would represent liabilities of the dealer to its counterparties). The term "gross" indicates that contracts with positive and negative replacement values with the same counterparty are not netted.

Finally, the BIS also reports statistics on *gross credit exposures and liabilities*. According to the BIS, "*gross credit exposure represents the gross value of contracts that have a positive market value after taking account of legally enforceable bilateral netting agreements*." Similarly, liabilities arising from OTC derivatives contracts represent the gross value of contracts that have a negative market value taking account of legally enforceable bilateral netting agreements.

A-II.B. Net Notional Amounts of CDS outstanding

One section of the 2002 ISDA Master Agreement allows counterparties to proceed to the netting of payments. Payment netting takes place during the normal business of a solvent firm, and involves combining offsetting cash flow obligations between two parties on a given day in a given currency into a single net payable or receivable.[9] Another form of netting guided buy Section 6 of the Master Agreement is close-out netting, which applies to transactions between a defaulting firm and a non-defaulting firm. Close-out netting refers to a process involving termination of obligations under a contract with a defaulting party and subsequent combining of positive and negative replacement values into a single net payable or receivable. Hence, the DTCC reports, in addition to gross notional amounts of CDS outstanding, net notional amounts of CDS outstanding. Following their definition, "*net notional values with respect to any single reference entity is the sum of the net protection bought by net buyers (or equivalently net protection sold by net sellers)*. The aggregate net notional data provided is calculated based on counterparty family. A counterparty family will typically include all of the accounts of a particular asset manager

[8] http://www.bis.org/publ/otc_hy1111.pdf
[9] http://www.isda.org/researchnotes/pdf/Netting-ISDAResearchNotes-1-2010.pdf

or corporate affiliates rolled up to the holding company level. Aggregate net notional data reported is the sum of net protection bought (or equivalently sold) across all counterparty families.[10] Given that net notional positions generally represent the maximum possible net funds transfers between net sellers of protection and net buyers of protection that could be required upon the occurrence of a credit event relating to particular reference entities (actual net funds transfers are dependent on the recovery rate for the underlying bonds or other debt instruments), net notional is often considered to be an economically more meaningful measure (Oehmke and Zawadowski, 2017).

A-II.C. Novation/Assignment

If a counterparty would like to reduce its credit exposure towards an individual reference entity, she would usually enter a new trade by doing the same trade in the opposite direction, thereby offsetting its exposure. In contrast to exchange traded derivatives, for which the sale of the contract would effectively erase the deal from the trading book, in the presence of OTC derivative transactions, both deals stay "alive" until expiration of the contracts. Although this would reduce the *net* credit exposure, it doesn't reduce counterparty risk. There is however a procedure, which allows to completely eliminate transactions from the trading book. Such a procedure is called *Novation* or, equivalently, *Assignment*. Following the Derivatives Consulting Group Gloassary, an Assignement or Novation refers to "*the process by which one counterparty (transferor) agrees to transfer to a third party (transferee) its obligations under an existing transaction they have with another counterparty (remaining party)*." Thus, the transferee is *stepping in*, and the transferor is *stepping out*. It refers to the process by which one of the original parties exits a transaction, and instead of terminating, a third party steps in upon identical terms and assumes the rights and obligations of the party that is stepping out.

Contractually, the *2004 ISDA Novation Definitions* are intended to facilitate the documentation of the novation of transactions under the ISDA Master Agreement and the *2005 ISDA Novation Protocol* provides an outline of the duties of each of the parties to a novation when completing a novation pursuant to the terms of the 2005 ISDA Novation Protocol. The *August 2010 Additional Provisions for Consent to, and Confirmation of, Transfer by Novation of OTC Derivative Transactions* were prepared to facilitate the launch of the Consent (i.e., Confirmation project) for Credit Derivatives Transactions. They are designed for incorporation into the documentation governing use of a Novation Consent Platform to set out the legal effect of a novation consent request processed through that platform. It is intended to apply to users of the relevant platform via the users' agreement to be governed by the platform's rules, and to ensure that consistent legal provisions apply to novation consent requests processed through different platforms.[11]

[10] http://www.dtcc.com/downloads/products/derivserv/tiw_data_explanation.pdf

[11] See also http://www.isda.org/isdanovationprotII/isdanovationprotII.html,

DTCC states that *since an assignment transaction is the transfer of a pre-existing Warehouse position to another party, it does not affect Gross Notional Value or Contract totals*. For the purpose of aggregated *net* notional amounts, the fact that certain trades may be novated has no effect either. This would be different, however, if the purpose was to study the net exposure of individual counterparties at the micro level. Note that there may also be *partial* assignments/novations.

A-II.D. Cancellations/Terminations and Compressions

Terminations or cancellation of trades refers to the unwinding of certain contracts in the TIW. This may reduce both the gross and net notional amounts of CDS outstanding, but more likely the gross amount. The practice of termination has become more common since the call by regulators for increased credit risk mitigation. As a consequence, the industry engages in *trade compression* cycles on a periodic basis for single name reference entities and indices. *The objective of a trade compression is to maintain the same risk profile but reduce the number of contracts and Gross Notional value held by participants*. Compression cycles involve both Full Terminations and New Trades. According to ISDA explanations, "Portfolio compression reduces the overall notional size and number of outstanding contracts in credit derivative portfolios. Importantly, it does so without changing the overall risk profiles of these portfolios. This is achieved by terminating existing trades on single name reference entities and on indices and replacing them with a smaller number of new trades, but with substantially smaller notionals that carry the same risk profile and cash flows as the initial portfolio."[12] Trade compression has the effect of reducing gross (and sometimes net) notional amounts of CDS outstanding.

A-II.E. Matured Transactions, Backloads, and Exits

Another mechanism, by which gross and net notional amounts of CDS outstanding (in DTCC), as well as open interest (CME and NYSE) may be influenced is *matured transactions*, which occurs when contracts have reached the end of the contract (referred to as the scheduled Termination Date). A small source of error for weekly data are *backloads* and *exits*. Backloads refer to the fact that the Warehouse allows participants to register contracts previously executed and confirmed non-electronically. These transactions impact both gross notional value and contract totals, but are not indicative of new trade activity. Exits, in contrast, represent contracts that have been removed from the Warehouse bilaterally by participants. Exits are most commonly processed at the conclusion of a single name credit event, succession event, or upon other activity typically confirmed outside the Warehouse (e.g. bankruptcy close-out procedures).

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and http://www.isda.org/isdanovationprotII/novprotII_opin.html for an opinion by Allen & Overy under New York law and English law regarding the enforceability of the ISDA Novation Protocol II.

[12] http://www.isdacdsmarketplace.com/market_statistics/portfolio_compression

A-II.F. Volume and Open Interest

The CME and NYSE (through Intercontinental Exchange (NYSE: ICE)) provide clearing platforms for OTC credit derivatives.[13] They report on their websites information about *open interest* and daily *volume*. In a footnote, they define "*open interest as the sum of the net notional outstanding per contract*." This should thus be in line with the definitions of net notional amounts outstanding reported bt DTCC. Moreover, "*Volume is defined as the sum of the notional for trades where both the buyer and seller agree to clearing the transaction*." The values are said to be one sided and volume is calculated daily. Open interest may therefore be affected by trade compressions, but not by novations. Volume should not be affected at all.

A-III. Commonality in Quantities and Commonality in Returns by Asset Class

In Figure 1.a, we illustrate the relation between commonality in quantities and commonality in returns for different asset classes. For each asset class, commonality is measured as the fraction of common variation explained by the first principal component of returns (x-axis), or the first principal component of changes in quantities (y-axis). As quantities, we use net notional amounts outstanding (sovereign CDS, U.S. corporate CDS), open interest (FX futures, E.U. bond futures, U.S. equity options), and volume (FX spot, E.U. bond futures, country ETFs, U.S. stocks). Below, we explicitly describe the sources and composition of the alternative asset classes in our analysis. We summarize this information in Table A-6.

U.S. Corporate Futures: We employ a sample of 264 U.S. corporate CDS reference entities from October 2008 to November 2014. The net notional amounts of CDS outstanding are from DTCC, CDS spreads are from Markit. The sample covers the period from October 2008 to November 2014, and has a weekly frequency. We measure changes in quantities as changes in net notional amounts outstanding, and returns as percentage changes in CDS spreads. The data frequency is weekly.

FX Spot: The information is based on the data used in Gargano et al. (2018), and we thank Steven J. Riddiough for providing us with this information. Commonality in quantities (returns) is measured as the common variation explained by the first principal component among the the trading volumes (spot exchange rates) of 16 currencies against the U.S dollar from October 2008 to November 2014. The data frequency is weekly. The data is from Quandl.

FX Futures: We use a sample of 7 FX futures contract from October 2008 to July 2015. Prices are from Datastream, open interest is from the CFTC Commitments of Traders (COT). We measure changes

[13] See http://www.cmegroup.com/trading/cds/index.html and https://www.theice.com/homepage.jhtml

in quantities as changes in open interest, and returns as percentage changes in futures prices. The data frequency is weekly.

E.U. Bond Futures: We employ a sample of 3 futures contracts on the long-term bonds of European sovereign issuers (Germany, Italy, and France) from April 2012 to December 2017. The data are from the Eurex Exchange. We measure changes in quantities as (i) changes in the number of traded contracts; (ii) changes in open interest; (iii) the level of open interest. We measure returns as percentage changes in futures transaction prices. The data frequency is weekly. The first principal component among changes in quantities is similar for all three quantity measures.

Country ETFs: We use 30 country Exchange Traded Funds (ETFs) from November 2010 to December 2016. Country ETFs are contracts whose value depends on the prices of stocks representing a country's stock market. Prices and quantities are form CRSP. We measure changes in quantities as changes in trading volume, and returns as percentage changes in prices. The data frequency is weekly, based on an aggregation of daily prices.

U.S. Stocks: We use 500 randomly selected U.S. stocks from October 2008 to December 2016. The data are from CRSP. We measure changes in quantities as changes in trading volume, and returns as percentage changes in prices. The data frequency is weekly, based on an aggregation of daily prices. We repeat the analysis for a subset of 60 randomly selected stocks to illustrate that the fraction of variation explain by the first principal component does not depend on the sample selection.

U.S. Options: We use option price and quantity information for 500 randomly selected options (same 500 randomly selected stocks and options) from October 2008 to April 2016. Prices and quantities are from OptionMetrics. We only use at-the-money options. We measure changes in quantities as changes in open interest, and returns as percentage changes in option prices. The data frequency is weekly.

Fig. A-1. DTCC Sovereign Coverage Ratio. In this figure, we plot the fraction of the aggregate single name sovereign CDS net notional amounts outstanding accounted for by the sovereign reference entities listed among the 1,000 most heavily traded reference entities in the DTCC Trade Information Warehouse over the time period November 2008 to September 2015. The observation frequency is weekly. The dashed line (*Sovereign Countries*) only includes the net notional amounts of CDS outstanding of sovereign countries. The solid line (*All Sovereigns*) includes the net notional amounts of CDS outstanding of sovereign states and state bodies, in addition to those of sovereign countries. Source: DTCC.

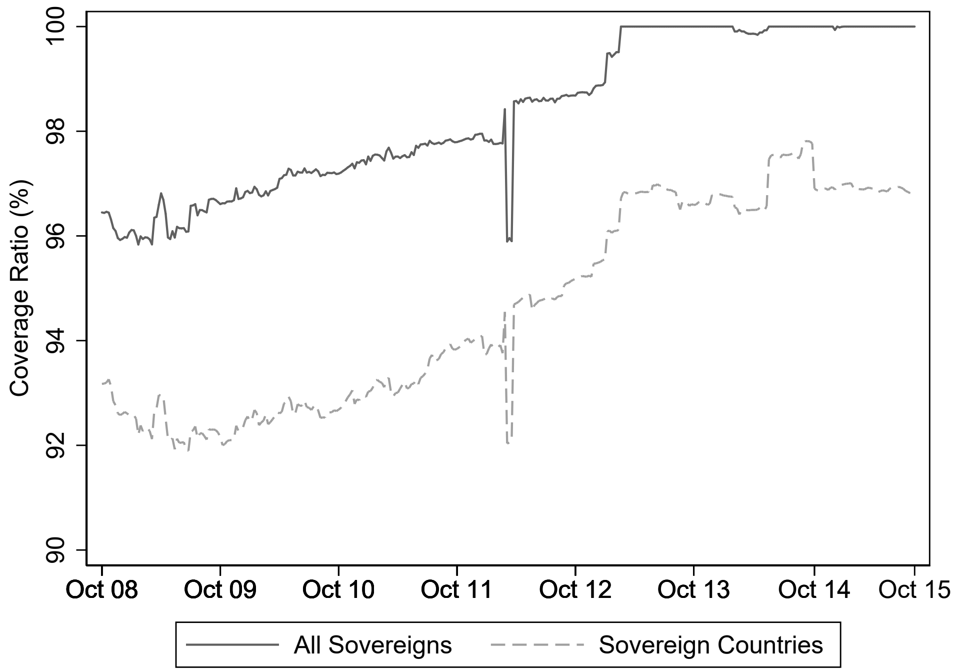

Table A-1

Descriptive Examples of CDS Trading Components. This table provides examples of how trading in credit default swaps generates gross and net notional amounts of CDS outstanding (Panels A, B, and C), and how these quantities are affected by novations (Panels D.1 and D.2), portfolio compressions (Panels E.1 and E.2), as well as by matured contracts and exits (Panel F). In each panel, we indicate the number of counterparties, *CP*, labeled A, B, and C. In the last row of each panel, we report the quantities as registered in the Depository Trust and Clearing Corproation (DTCC) data repository. Source: Authors' illustration.

A: Gross and Net Notional, 2 CP, no Netting

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	20	0	-	0	0	20	0	0
Counterparty B	0	-	0	-20	-	0	0	-20	-20
Counterparty C	0	0	-	0	0	-	0	0	0
DTCC DATA							20		20

B: Gross and Net Notional, 3 CP, Netting

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	20	0	-	0	-20	20	-20	0
Counterparty B	0	-	0	-20	-	0	0	-20	-20
Counterparty C	20	0	-	0	0	-	20	0	20
DTCC DATA							40		20

C: Gross and Net Notional, 3 CP, Netting

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	20	0	-	0	-20	20	-20	0
Counterparty B	0	-	20	-20	-	0	20	-20	0
Counterparty C	20	0	-	0	-20	-	20	-20	0
DTCC DATA							60		0

D.1: Novation, 3 CP

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	20	0	-	0	0	20	0	20
Counterparty B	0	-	0	-20	-	0	0	-20	-20
Counterparty C	0	0	-	0	0	-	0	0	0
DTCC DATA							20		20

D.2: Novation, 3 CP

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	20	0	-	0	0	20	0	20
Counterparty B	0	-	0	0	-	0	0	0	0
Counterparty C	0	0	-	-20	0	-	0	-20	-20
DTCC DATA							20		20

E.1: Portfolio compression, 3 CP

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	0	5	-	-10	0	5	-10	-5
Counterparty B	10	-	0	0	-	-10	10	-10	0
Counterparty C	0	10	-	-5	0	-	10	-5	5
DTCC DATA							25		5

E.2: Portfolio compression, 3 CP

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	0	0	-	0	-5	0	-5	-5
Counterparty B	0	-	0	0	-	0	0	0	0
Counterparty C	5	0	-	0	0	-	5	0	5
DTCC DATA							5		5

F: Gross and Net Notional, 3 CP, Matured Contracts and existing positions

	Bought from			Sold CDS to			Total gross		Net position
	A	B	C	A	B	C	bought	sold	
Counterparty A	-	0	0	-	0	0	20	-10	10
Counterparty B	0	-	0	0	-	0	0	-20	-20
Counterparty C	0	0	-	0	0	-	10	0	10
DTCC DATA							40(t-1)$\mapsto$30		20(t-1)$\mapsto$20

Table A-2

Data Appendix. In this table, we report the definitions and data sources of the main variables used in the analysis. The sources are the Depository Trust and Clearing Corporation (DTCC), Markit CDS (Markit), Thomson Reuters Datastream (Datastream), the Bank for International Settlements (BIS), the International Monetary Fund International Financial Statistics (IMF), the World Bank, and Bloomberg.

Variable	Label	Source	Definition
Net Notional Amounts of CDS outstanding	NN	DTCC	Aggregate net notional amount of CDS outstanding, defined as the sum of the net protection bought by net buyers (or equivalently net protection sold by net sellers), expressed in USD millions equivalents using the prevailing foreign exchange rates.
Gross Notional Amounts of CDS outstanding	GN	DTCC	Aggregate gross notional amount of CDS outstanding, defined as the sum of CDS contracts bought (or equivalently sold), expressed in USD millions equivalents using the prevailing foreign exchange rates.
Total Debt	TD	BIS	Total general government debt in USD billions.
International Debt	ID	BIS	Total international general government debt in USD billions. International debt comprises debt securities issued in a market other than the local market of the country where the borrower resides. This captures debt conventionally known as euro-bonds and foreign currency denominated bonds.
Domestic Debt	DD	BIS	Total domestic general government debt in USD billions. Domestic debt comprises debt securities issued in the local market of the country where the borrower resides, regardless of the currency in which the security is denominated.
Gross Domestic Product	GDP	IMF	Gross domestic product (current prices) in USD billions.
Foreign Exchange Reserves	FX Reserves	IMF	Total foreign exchange reserves in USD billions.
Credit Default Swap Spread	CDS Spread	Markit	Five-year senior unsecured sovereign CDS spread with full restructuring credit event clause, expressed in percent, i.e., 100 basis points.
Credit Default Swap Spread Volatility	σ^2_{CDS}	Markit	Variance of weekly percentage changes in a country's CDS spread.
Credit Default Swap Liquidity	CDS Liquidity	Markit	CDS liquidity/depth, defined as the number of dealer quotes used in the computation of the 5-year mid-market CDS spread.
Idiosyncratic stock market return	$\text{Equity}^{\perp}$	Thomson Reuters Datastream	OLS residuals from the regression of local benchmark equity index returns of country i on the MSCI World return index, expressed in percentages.
Equity Volatility	σ^2_{MKT}	Thomson Reuters Datastream	Variance of weekly percentage changes in a country's stock market index.
Foreign exchange rate return	FX	Thomson Reuters Datastream	Log percentage changes in the exchange rate vis-‐vis the USD, expressed in percentages.
Foreign exchange rate volatility	σ^2_{FX}	Thomson Reuters Datastream	Squared percentage changes in the exchange rate vis-‐vis the USD, expressed in percentages.
Inflation	Inflation	World Bank	Inflation is the change in GDP deflator
Stock Market Capitalization	Market Capitalization	World Bank	*Market Capitalization* is the total size of the country's stock market, measured in USD trillions
Debt Issuance	Issued ($bill)	Bloomberg	Sovereign debt issuance (issuance date, # of bonds, or issuance amount). All amounts are converted into USD using the prevailing foreign exchange rate.

Table A-3

Descriptive Statistics by Country. In this table, we report summary statistics on CDS net and gross notional amounts outstanding for the 60 sovereign reference entities (*Country*) that rank among the 1,000 most heavily traded contracts in the DTCC TIW, and which are grouped into 5 ISDA Determination Committee regions (*DC Region*), with EMEA standing for Europe, the Middle East and Africa. We report the average (*Avg*) and standard deviation (*STD*) for the gross (*Gross Notional*) and net (*Net Notional*) notional amount (in USD billions) on CDS contracts outstanding in USD equivalents (using the prevailing foreign exchange rates). We report the average domestic (*DD*) and international (*ID*) general government debt (in USD billions), the average ratio of net notional to aggregate debt outstanding, and the average ratio of aggregate debt outstanding to GDP. The sample period extends from the fourth quarter of 2008 to the second quarter of 2015. We report the number of quarterly observations in the column titled "N". CDS positions data are obtained from DTCC, GDP and debt data are obtained from the IMF and Bank for International Settlements respectively.. Emerging market countries are marked with a star*.

Country	**DC Region**	**N**	**Gross Notional**		**Net Notional**		**ID**	**DD**	**NN/Debt**	**Debt/GDP**
			Avg	STD	Avg	STD	Avg	Avg	Avg	Avg
AbuDhabi*	EMEA	23	7.55	2.70	1.08	0.28	4	0	26%	3%
Argentina*	Americas	24	42.09	12.63	1.69	0.56	45	54	2%	19%
Australia	Australia/NZ	24	21.99	11.98	3.30	1.64	10	449	1%	33%
Austria	EMEA	26	48.42	11.24	5.62	1.70	108	155	2%	63%
Belgium	EMEA	26	45.87	16.92	4.60	1.32	36	418	1%	89%
Brazil*	Americas	26	145.71	18.69	15.06	2.89	54	1,242	1%	58%
Bulgaria*	EMEA	26	16.05	3.61	0.84	0.36	2	0	47%	4%
Chile*	Americas	26	5.70	2.08	0.72	0.27	4	24	3%	11%
China*	Asia X-Jp.	26	54.75	22.52	7.23	3.96	9	1,167	1%	15%
Colombia*	Americas	26	28.07	3.17	1.96	0.32	20	79	2%	30%
Croatia*	EMEA	26	9.52	2.99	0.67	0.15	8	14	3%	37%
Cyprus*	EMEA	12	1.88	0.15	0.25	0.05	4	7	2%	45%
Czech Rep.*	EMEA	26	10.85	2.64	0.79	0.25	13	57	1%	33%
Denmark	EMEA	26	15.00	4.93	2.15	0.46	18	129	1%	45%
Dubai*	EMEA	26	6.93	2.00	0.57	0.12	4	0	17%	2%
Egypt*	EMEA	21	3.54	0.89	0.49	0.26	5	0	12%	2%
Estonia*	EMEA	26	2.64	0.65	0.33	0.15	0	0	138%	1%
Finland	EMEA	26	14.99	4.74	2.10	0.35	16	89	2%	40%
France	EMEA	26	109.82	50.40	13.71	5.59	12	1,965	1%	72%
Germany	EMEA	26	102.65	36.14	14.08	3.24	114	1,905	1%	56%
Greece	EMEA	17	55.69	29.54	5.31	2.80	81	239	2%	107%
Hungary*	EMEA	13	55.30	11.27	3.61	0.56	24	54	5%	58%
Iceland	EMEA	26	6.43	1.79	0.69	0.21	3	6	9%	65%
Indonesia*	Asia X-Jp.	26	35.28	4.15	2.82	0.75	26	95	2%	15%
Ireland	EMEA	26	39.67	9.26	3.35	1.40	20	105	3%	54%
Israel	EMEA	26	10.33	2.97	1.23	0.48	12	122	1%	52%

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Table A-3 – *Continued from previous page*

Country	DC Region	N	Gross Notional		Net Notional		ID	DD	NN/Debt	Debt/GDP
			Avg	STD	Avg	STD	Avg	Avg	Avg	Avg
Italy	EMEA	26	308.76	83.37	21.34	2.69	133	2,033	1%	101%
Japan	Japan	26	52.43	25.88	7.23	3.10	3	9,481	0%	181%
Kazakhstan*	EMEA	26	16.80	5.95	0.84	0.31	0	0	14%	0%
Korea*	Asia X-Japan	26	65.95	11.52	5.34	1.47	7	379	1%	32%
Latvia*	EMEA	26	8.56	1.20	0.58	0.16	3	2	16%	16%
Lebanon*	EMEA	22	2.01	0.13	0.53	0.09	28	34	1%	142%
Lithuania*	EMEA	26	5.99	1.18	0.56	0.17	10	0	6%	24%
Malaysia*	Asia Ex-Jp.	26	17.78	1.81	1.40	0.34	4	125	1%	45%
Mexico*	Americas	26	106.49	15.04	8.31	2.12	48	299	2%	30%
Netherlands	EMEA	26	23.87	9.01	2.91	0.48	24	396	1%	49%
New Zealand	Australia/NZ	22	3.19	0.64	0.53	0.04	1	49	1%	29%
Norway	EMEA	26	7.41	2.67	0.86	0.23	0	91	1%	19%
Panama*	Americas	26	6.61	0.95	0.58	0.13	9	0	6%	28%
Peru*	Americas	26	20.99	3.93	1.71	0.25	13	11	8%	14%
Philippines*	Asia Ex-Jp.	26	49.51	14.25	2.42	0.34	27	70	3%	42%
Poland	EMEA	26	32.24	8.84	1.68	0.52	60	163	1%	44%
Portugal	EMEA	26	62.84	13.07	5.21	2.13	38	131	3%	73%
Qatar*	EMEA	26	7.73	2.05	0.82	0.35	14	0	6%	8%
Romania*	EMEA	26	15.17	2.80	1.06	0.21	10	0	18%	5%
Russia*	EMEA	26	110.74	13.10	5.48	1.63	35	90	5%	7%
Saud.Arabia*	EMEA	17	2.64	0.35	0.44	0.05	0	27	2%	4%
Slovakia*	EMEA	26	10.00	1.80	0.82	0.17	12	26	2%	40%
Slovenia*	EMEA	25	6.04	2.10	0.70	0.17	6	16	3%	46%
Sth.Africa*	EMEA	26	44.65	7.43	2.95	1.05	11	118	2%	35%
Spain	EMEA	26	147.47	45.55	12.71	3.27	71	823	2%	63%
Sweden	EMEA	26	18.24	5.03	2.34	0.75	42	119	2%	31%
Switzerland	EMEA	6	1.41	0.04	0.51	0.01	0	111	0%	16%
Thailand*	Asia X-Jp.	26	15.00	3.56	0.99	0.20	0	90	1%	26%
Turkey*	EMEA	26	141.22	13.96	6.76	1.39	50	203	3%	34%
Ukraine*	EMEA	26	35.26	11.74	1.13	0.61	13	0	13%	9%
U.S.	Americas	26	18.72	7.07	3.24	1.12	4	12,766	0%	80%
U.K.	EMEA	26	53.07	18.09	7.63	3.29	16	1,902	0%	73%
Venezuela*	Americas	26	46.50	7.55	1.90	0.27	32	0	6%	13%
Vietnam*	Asia X-Jp.	26	7.33	1.75	0.58	0.13	2	0	25%	2%

Table A-4

Descriptive Statistics by Country. In this table, we report summary statistics (at the quarterly frequency) of the explanatory variables used for the explanation of net notional amounts of CDS outstanding of the 60 sovereign reference entities (*Country*) that rank among the 1,000 most heavily traded contracts in the DTCC Trade Information Warehouse, and which are grouped into 5 ISDA Determination Committee regions (*DC Region*). We report the average quarterly GDP (*GDP*), the foreign currency reserves of the country (*Reserves*), both measured in USD billions. We also report the average CDS Spread in % (*CDS Spread*), the variance of weekly percentage changes in the CDS Spread (σ^2_{CDS}), CDS liquidity defined as the number of dealer quotes used in the computation of the 5-year mid-market CDS spread (*CDS Liquidity*), the country's stock market capitalization in USD trillions (*Market Cap*), the variance of weekly percentage changes in the country's stock market index (σ^2_{MKT}), the average quarterly inflation (*Inflation*), the variance of changes in the foreign exchange rate against USD (σ^2_{FX}), and the average foreign long-term credit rating as reported by Fitch Ratings (*Rating*). All countries are ranked in alphabetical order. The countries are grouped into five regions: Americas, Asia ex-Japan, Australia and New Zealand, Europe/Middle East and Africa (EMEA) and Japan. Emerging market countries are marked with a star*. The sample period is Q4 2008 through Q2 2015. Source: BIS, Markit, Datastream, FitchRatings, World Bank.

Country	GDP	Reserves	CDS Spread	σ^2_{CDS}	CDS Liquidity	Market Cap	σ^2_{MKT}	Inflation	σ^2_{FX}	Rating
AbuDhabi*	176	25	0.93	0.21	5.38	0.14	0.05	3.18	0.00	AA
Argentina*	522	41	16.91	0.98	6.95	0.05	0.21	18.43	0.01	CC
Australia	1,385	44	0.50	0.45	6.07	1.32	0.04	2.46	0.03	AAA
Austria	415	11	0.81	0.58	7.15	0.11	0.15	1.66	0.02	AAA
Belgium	509	17	1.10	0.53	6.69	0.30	0.08	1.49	0.02	AA
Brazil*	2,238	316	1.63	0.43	8.87	1.15	0.11	7.73	0.04	BBB
Bulgaria*	53	17	2.40	0.37	6.88	0.01	0.03	2.47	0.02	BBB-
Chile*	238	35	0.98	0.39	7.07	0.27	0.09	3.87	0.03	A+
China*	7,776	3,121	0.97	0.47	8.38	4.18	0.05	3.58	0.00	A+
Colombia*	328	34	1.50	0.43	8.76	0.19	0.07	3.61	0.02	BBB-
Croatia*	59	15	3.19	0.33	6.38	0.02	0.46	1.46	0.02	BBB-
Cyprus*	24	0	8.20	0.28	4.85	0.00	0.04	-0.36	0.01	B
CzechRep*	210	44	0.95	0.36	5.03	0.04	0.09	1.08	0.03	A+
Denmark	330	78	0.53	0.43	6.10	0.15	0.09	1.65	0.02	AAA
Dubai*	172	23	3.58	0.25	5.20	0.14	0.17	2.33	0.00	AA
Egypt*	256	18	4.25	0.17	6.23	0.06	0.12	12.09	0.00	B+
Estonia*	23	1	1.51	0.20	4.87		0.08	2.85	0.02	A
Finland	262	8	0.37	0.42	6.16	0.18	0.10	2.04	0.02	AAA
France	2,756	49	0.81	0.52	6.67	1.92	0.10	0.83	0.02	AAA
Germany	3,618	62	0.43	0.54	6.07	1.50	0.10	1.46	0.02	AAA
Greece*	292	1	17.87	1.09	5.87	0.07	0.24	0.98	0.02	BB
Hungary*	135	45	3.42	0.47	8.69	0.03	0.17	2.97	0.07	BBB
Iceland	15	5	3.37	0.11	4.57		0.10	4.59	0.04	BBB-
Indonesia*	817	91	2.20	0.44	7.31	0.35	0.08	7.90	0.01	BB+

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Table A-4 – *Continued from previous page*

Country	GDP	Reserves	CDS Spread	σ^2_{CDS}	CDS Liquidity	Market Cap	σ^2_{MKT}	Inflation	σ^2_{FX}	Rating
Ireland	233	2	3.04	0.58	7.36	0.11	0.11	-0.56	0.02	A
Israel	258	72	1.33	0.20	6.09	0.19	0.08	2.36	0.01	A
Italy	2,158	48	2.14	0.66	7.55	0.55	0.15	1.27	0.02	A
Japan	5,260	1,148	0.71	0.47	7.44	3.82	0.09	-0.75	0.02	AA-
Kazakhstan*	182	23	2.71	0.38	6.60	0.03	0.20	10.80	0.02	BBB
Korea*	1,193	303	1.19	0.48	8.13	1.07	0.06	1.84	0.03	A+
Latvia*	29	6	3.10	0.21	6.19		0.06	0.76	0.02	BBB
Lebanon*	44	35	3.79	0.06	3.81	0.01	0.01	2.75	0.00	B
Lithuania*	43	7	2.49	0.21	5.76		0.06	1.90	0.02	BBB+
Malaysia*	281	117	1.14	0.48	7.01	0.41	0.02	2.07	0.01	A-
Mexico*	1,143	141	1.41	0.45	8.27	0.45	0.07	3.89	0.02	BBB
Netherlands	855	19	0.54	0.49	5.79	0.67	0.10	0.90	0.02	AAA
NewZealand	172	18	0.57	0.31	6.07	0.05	0.01	2.29	0.03	AA
Norway	472	55	0.23	0.40	4.78	0.24	0.10	2.66	0.03	AAA
Panama*	34	3	1.43	0.37	8.06	0.01	0.03	3.31	0.00	BBB-
Peru*	172	50	1.48	0.41	8.44	0.08	0.11	3.17	0.00	BBB
Philippines*	234	60	1.61	0.35	7.09	0.18	0.07	3.23	0.01	BB+
Poland*	502	91	1.41	0.41	6.94	0.17	0.06	2.17	0.04	A-
Portugal	233	3	4.22	0.79	7.75	0.07	0.09	0.76	0.02	BBB+
Qatar*	165	28	1.06	0.24	5.27	0.16	0.11	2.65	0.00	AA
Romania*	182	42	2.90	0.33	6.53	0.01	0.13	4.59	0.03	BBB-
Russia*	1,741	437	2.49	0.59	8.40	0.73	0.24	9.00	0.04	BBB
Saud.Arabia*	721	642	0.83	0.13	4.41	0.42	0.04	4.02	0.00	AA-
Slovakia*	94	2	1.13	0.35	5.78	0.00	0.06	0.52	0.02	A+
Slovenia*	49	1	1.91	0.41	5.31	0.01	0.05	0.90	0.02	A
SthAfrica*	362	41	1.90	0.42	9.03	0.86	0.07	6.40	0.04	BBB+
Spain	1,432	28	2.16	0.59	6.82	1.10	0.13	0.19	0.02	A+
Sweden	527	48	0.40	0.46	5.76	0.29	0.08	1.45	0.03	AAA
Switzerland	687	483	0.38	0.12	3.15	1.48	0.03	-0.17	0.01	AAA
Thailand*	342	155	1.31	0.42	8.12	0.31	0.07	2.21	0.00	BBB
Turkey*	755	89	2.15	0.37	8.48	0.24	0.13	7.03	0.03	BB+
Ukraine*	150	25	13.52	0.64	5.72	0.03	0.25	12.00	0.13	B-
U.S.	15,917	122	0.37	0.44	3.71	19.42	0.06	1.48	0.00	AAA
U.K.	2,614	77	0.58	0.40	6.04	1.87	0.07	2.13	0.02	AAA
Venezuela*	253	12	13.94	0.51	7.90	0.00	0.15	26.48	0.17	B
Vietnam*	144	22	2.89	0.22	5.94	0.03	0.11	10.33	0.00	B+

Table A-5

Debt Issuance Statistics by Country. In this table, we report country summary statistics of the sovereign debt issuances for the 57 countries that issued debt between November 7, 2008 and June 26, 2015. The data source is Bloomberg. For each country, we report the number of bond issuances (*# Issues*), the fraction of issued bonds that can trigger a credit event (*CDS Bonds %*), the average bond maturity (*Avg. Maturity*), the minimum issuance size in USD billions (*Min. Size ($bill.)*), the average issuance size in USD billions (*Avg. Size ($bill.)*), the maximum issuance size in USD billions (*Max. Size ($bill.)*), the total issuance size in USD billions (*Total Issuance ($bill.)*), and the fraction of total debt issuance that is accounted for by CDS bonds. All debt amounts are converted to USD using the prevailing weekly exchange rate. All countries are ranked in alphabetical order.

Country	# Issues	CDS Bonds (%)	Avg. Maturity	Min.Size ($bill.)	Avg.Size ($bill.)	Max.Size ($bill.)	Total Issuance ($bill.)	% Intl.
Argentina	14	50	10.2	0.5	2.1	4.5	30	54
Australia	26	100	11.1	2.7	11.8	23.1	307	100
Austria	19	100	12.1	0.5	7.7	14.7	146	100
Belgium	32	100	10.2	0.7	9.8	27.6	313	100
Brazil	57	9	8.3	1.8	26.4	99.1	1,505	1
Bulgaria	27	41	7.6	0.1	0.4	2.0	11	74
Chile	18	39	13.4	0.3	1.0	1.5	17	42
China	44	0	7.9	8.3	11.9	18.3	525	0
Colombia	24	33	11.3	0.5	3.4	10.4	81	19
Croatia	17	77	8.5	0.7	1.3	1.8	22	85
Cyprus	10	100	6.1	0.1	0.5	1.5	5	100
Czech Rep.	31	19	7.4	0.3	1.9	5.1	60	17
Denmark	22	100	6.7	0.4	6.4	20.8	141	100
Dubai	7	100	11.3	0.5	3.3	10.0	23	100
Egypt	84	6	5.0	0.3	1.2	3.0	101	7
Finland	35	100	7.6	0.3	3.4	9.0	118	100
France	45	100	9.8	3.3	30.0	58.0	1,350	100
Germany	72	100	6.7	4.0	21.8	33.0	1,571	100
Greece	68	100	10.6	0.3	3.3	15.0	227	100
Hungary	31	42	7.7	0.1	1.8	4.0	57	35
Iceland	19	21	8.8	0.1	0.6	1.7	11	32
Indonesia	40	50	14.7	0.7	2.7	11.5	108	30
Ireland	24	100	20.0	0.4	6.4	17.6	152	100
Israel	32	19	10.3	0.4	3.2	5.2	101	9
Italy	95	100	7.1	2.5	20.4	35.5	1,941	100
Japan	388	100	12.8	4.6	28.9	106.6	11,205	100
Kazakhstan	47	4	12.9	0.1	0.4	1.5	16	15
Korea	47	4	8.0	1.5	9.9	19.6	465	1
Latvia	16	88	6.1	0.1	0.4	1.4	7	97

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Table A-5 – *Continued from previous page*

Country	# Issues	% Bonds (%)	Avg. Maturity	Min.Size ($bill.)	Avg.Size ($bill.)	Max.Size ($bill.)	Total Issuance ($bill.)	% Intl.
Lebanon	277	7	4.2	0.0	0.3	1.8	71	26
Lithuania	37	92	6.4	0.1	0.4	2.0	15	97
Malaysia	78	0	9.0	0.3	2.2	5.0	172	0
Mexico	50	40	17.2	0.9	4.1	15.9	204	22
Netherlands	24	100	8.9	3.3	17.4	22.9	418	100
New Zealand	7	100	13.0	1.6	5.1	8.9	36	100
Norway	4	100	10.5	2.8	7.4	10.9	30	100
Panama	12	8	11.1	0.1	0.7	1.5	9	6
Peru	15	13	8.6	0.2	0.9	2.5	14	25
Philippines	56	23	12.4	0.2	1.4	6.0	81	22
Poland	58	48	7.0	0.6	4.6	11.1	266	18
Portugal	15	100	8.9	0.3	5.8	15.6	87	100
Qatar	34	24	6.6	0.3	1.5	9.1	51	30
Romania	39	46	6.4	0.6	1.7	2.7	68	42
Russia	44	9	7.9	1.3	3.8	9.2	166	7
Slovakia	29	100	9.3	0.2	1.8	4.2	52	100
Slovenia	17	100	8.5	1.0	1.8	2.5	30	100
Sth. Africa	21	33	20.6	0.7	4.1	11.0	85	12
Spain	51	100	7.7	2.0	18.1	33.0	921	100
Sweden	47	100	5.6	0.4	3.0	17.6	139	100
Switzerland	2	100	20.5	0.9	1.8	2.7	4	100
Thailand	30	0	14.0	0.6	3.3	10.2	99	0
Turkey	84	21	7.7	1.0	4.4	9.5	371	10
Ukraine	198	11	6.3	0.1	0.3	3.0	57	31
U.S.	392	100	6.8	14.7	36.6	74.2	14,343	100
U.K.	237	100	15.4	2.5	9.9	53.9	2,335	100
Venezuela	67	9	8.0	0.3	1.3	4.2	85	18
Vietnam	111	2	4.3	0.1	0.3	1.0	31	7

Table A-6

Description of Data Employed in Figure 1. In this table, we summarize the data sources, frequencies, and sample periods used in the computation of Figure 1. In the column titled N, we indicate the number of series for the analysis of a particular asset class. For each asset class, we report the fraction of common variation explained by the first principal component of returns (*Return PCA*), the fraction of common variation explained by the first principal component of quantities (*Quantity PCA*), and the ratio of the two (*Ratio*). We also indicate the nature of the quantity variable: changes in open interest ΔOI, changes in net notional amounts outstanding ΔNN, levels of trading volume $Volume$ ($Quantity\ Variable$).

Asset Class	N	Quantity Variable	Return PCA	Quantity PCA	Ratio	Period	Frequency	Source
Sovereign CDS	60	ΔNN	53%	6%	8.8	10/2008–07/2015	Weekly	DTCC, Markit
U.S. Corporate CDS	264	ΔNN	44%	16%	2.8	10/2008–11/2014	Weekly	DTCC, Markit
FX Spot	16	Volume	66%	51%	1.3	10/2011–12/2016	Daily	Datastream, CLS(Quandl)
FX Futures	7	ΔOI	54%	56%	1.0	10/2008–07/2015	Weekly	Datastream, CFTC COT
E.U. Bond Futures	3	Volume	64%	73%	0.9	04/2012–12/2017	Weekly	Eurex
E.U. Bond Futures	3	OI	64%	88%	0.7	04/2012–12/2017	Weekly	Eurex
E.U. Bond Futures	3	ΔOI	64%	95%	0.7	04/2012–12/2017	Weekly	Eurex
Country ETFs	30	Volume	63%	29%	2.2	11/2010–12/2016	Weekly	CRSP
U.S. Stocks	60	Volume	30%	15%	2.0	10/2008–12/2016	Weekly	CRSP
U.S. Stocks	500	Volume	30%	17%	1.8	10/2008–12/2016	Weekly	CRSP
U.S. Options	60	ΔOI	20%	36%	0.6	10/2008–04/2016	Weekly	OptionMetrics
U.S. Options	500	ΔOI	19%	37%	0.5	10/2008–04/2016	Weekly	OptionMetrics