The Term Structure of Sovereign CDS and the Cross-Section Exchange Rate Predictability

Giovanni Calice* Ming Zeng†

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Abstract

We provide novel evidence on exchange rate predictability by using the term premia of the sovereign credit default swap (CDS). Using a sample of 29 countries, we find that the sovereign CDS term premia significantly predict the exchange rate out-of-sample. On average, a steeper CDS spread curve for a country predicts its currency appreciation against the US dollar (USD). Empirically, while the sovereign CDS level mainly reflects global risk, the information in the term structure of the sovereign CDS spreads reveals country-specific risk. Notably, the predictive power of the term premia is robust after controlling for the sovereign CDS level and other conventional macroeconomic factors. Further analysis shows that the information in the sovereign CDS term structure is also helpful for forecasting other important financial markets such as the stock markets in different countries.

JEL Classification: F31, G12, G13

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*School of Business and Economics, Loughborough University, LE11 3TU, United Kingdom. Email: g.calice@lboro.ac.uk

†School of Economics, Singapore Management University. Email: ming.zeng.2013@smu.edu.sg

1 Introduction

Exchange rate predictability is among the most popular and important topics in macroeconomics and finance. Since the seminal study of Meese and Rogoff (1983) which emphasizes the inability of economic motivated variables for predicting the exchange rate, a large strand of the financial economics literature continues searching for powerful variables or alternative econometric methods for testing the significance of exchange rate predictability. Unfortunately, the performance of various macro variables is in fact unsatisfactory and this highlights the difficulty of identifying robust predictors for exchange rates.

In an effort to shed light on these and related issues, in this paper we argue that the link between the sovereign credit default swap (CDS) market and the foreign exchange market can help us identify useful predictors for exchange rates. The market for sovereign CDS has witnessed an extraordinary growth over the last decade. According to data from the Depository Trust & Clearing Corporation (DTCC), at the end of May 2010, the outstanding gross notional amount of the total sovereign CDS market reached \$ 2,2 trillion. Recent data from the DTCC suggests that the market for sovereign CDS remains still highly sizable. In fact, the gross notional amount of outstanding sovereign CDS contracts as of July 2017 is almost \$1.7 trillion. We believe, therefore, that it is of critical importance to better understand the relationship between the sovereign CDS market and the foreign exchange market.

The motivation for investigating cross-market predictability is straightforward. While traditional macro models treat exchange rate as the conversion between different currencies and hence build the predictors based on differentials in economic fundamentals (see a recent review by Rossi, 2013), we instead take an asset pricing perspective by viewing currencies as being no special compared to other financial assets such as stocks, bonds, or credit derivatives. If investors are consistently pricing assets across different markets, it is sensible that state variables from one asset market could predict another due to the share of risks across financial markets.[1]

We first establish the theoretical link between the sovereign CDS markets and the currency market through an illustrative model. The model helps shed light on how variables charac-

[1] It should be noted that the literature offers different explanations for cross-asset predictability. In fact, various studies argue that the gradual information diffusion in financial markets leads to cross-asset predictability, see e.g. Menzly and Ozbas (2010), and among others. Our macro-based explanation builds on the rational that risk across a variety of financial markets share common sources within the stochastic discount factor of investors (see a comprehensive discussion in Cochrane, 2011)

terizing sovereign CDS markets overlap with those for the currency market. Moreover, we go one step further by arguing that the information contained in the sovereign CDS level and its term structure has a considerably different nature.[2] Specifically, the information embodied in sovereign CDS levels relates predominantly to global shocks, while the sovereign CDS term premium reflects mostly country-specific shocks. As a result, those two distinctive sources of risk may affect the exchange rates in different manners.

We arrive at several novel and interesting findings. Consistent with our proposed theoretical predictions, we find that the factor structure of CDS levels is statistically and economically important (the first principal component (PC) accounts for around 60% of total variations), whereas the explanatory power of the first PC from the panel of CDS slopes is much weaker (around 35%).[3] Moreover, the factor structure is relatively stable over different economic regimes. While the financial crisis period experiences rising correlations, with the first PCs explaining around 67% and 45% of total variations of CDS levels and slopes respectively, this explanatory power drops substantially to 44% and 29% after 2013. Therefore, our empirical evidence (specifically, the low correlation among sovereign CDS term premia) enables us to identify the slope of the sovereign CDS as containing information on country-level specific shocks rather than on global systematic risk.

Next, we proceed to incorporate more variables, both global and local, to better understand the nature of CDS term premia from the panel regression analysis. It turns out that for a wide range of variables used in the literature, the local economic states show a large explanatory power for contemporaneous changes in the sovereign CDS term structure. For all three country-specific variables, i.e., the local stock market returns denominated in local currency, the percentage changes in the local foreign reserve holdings, and the currency returns, the regression coefficients are all significant at the 1% level. Simultaneously, among the three global variables used in Longstaff et al. (2011), only the coefficient for the US stock returns is significant. The results arguably highlight the local nature of the sovereign CDS slope.

Given the interesting information embedded in the sovereign CDS term structure, we evaluate its potential predictive power for exchange rates *out-of-sample*. We adopt the cross-sectional approach pioneered by Fama and French (1992), which has been highly influential also on the

[2]We use the words *term premium*, *slope*, and *term structure* interchangeably.

[3]We define the CDS level as the log of 5-year CDS spread, and the CDS slope as the difference between the log of the 10-year and the 1-year CDS spreads.

growing body of research on exchange rates (see e.g. Lustig et al., 2011; Sarno and Schmeling, 2014). Overall, we find that the currency portfolios with the highest CDS term premia earn on average an annualized 4.8% higher future returns compared with those with lowest CDS term premia. The results are significant at the 5% level, and are robust across different subsamples. The Fama-MacBeth regressions, which allow us to control for various risk factors in determining currency returns, provide a consistent message confirming the significant and positive relationship between the sovereign CDS slope and the cross-section of currency returns.

Since our analysis relies on the share of risk between sovereign CDS and exchange rates as the source of predictability, naturally we should examine whether such relation holds in other asset markets. More specifically, we study whether the sovereign CDS slope can predict local stock market returns denominated in local currency. In line with the results on forecasting exchange rates, we find that the sovereign CDS slope emerges as the most significant predictor after we control for well-known factors documented in the international stock return literature on predictability (see e.g. Ang and Bekaert, 2006; Rapach et al., 2013). Importantly, this additional evidence supports our intuition on the cross-asset predictability and the unique role played by the sovereign CDS term structure.

This paper contributes to various streams of the literature. First, it contributes to the long-standing debate on whether the exchange rate is predictable *out-of-sample*, by providing compelling evidence on the benefit of using the sovereign CDS term structure to forecast exchange rates at relatively higher frequency (monthly). This evidence is encouraging since as suggested by Rogoff and Stavrakeva (2008), the out-of-sample forecasting power at monthly horizons is far less successful compared with lower-frequency predictability. Moreover, while a majority of the studies within this literature adhere to time-series models to evaluate the predictive performance (see a recent review by Rossi, 2013), we instead rely on the cross-sectional approach that has a long tradition in examining stock expected returns since the seminal work of Fama and French (1992). The time-series framework is typically applicable for only one currency pair at a time, which leaves out the rich cross-section information among all other currencies. Furthermore, the forecasting model is typically assumed to be parametric and hence needs to be estimated first. Thus the unavoidable estimation errors would bias the out-of-sample predictive performance. Relative to this literature, our analysis is distinct in that to evaluate the out-of-sample predictability, we depart from such paradigm by using the methodology of portfolio sorting, which is nonparametric and therefore does not require any estimation. Concurrently, the conventional Fama-MacBeth regression provides additional evidence by being able to control for various characteristics. Both methods are important elements in this type of analysis that utilizes the full cross-section information.

Second, our paper adds to the growing body of literature on the sovereign CDS market. However, there are only a few studies that directly relate the sovereign CDS market to the FX market, which is the principal motivation for our study. One notable exception is the paper by Della Corte et al. (2016), that also examines the link between sovereign credit risk and currencies. However, our paper departs substantially from their work in two critical ways. First, whilst Della Corte et al. (2016) use the CDS level to forecast currency excess returns, we instead exploit the information in the whole term structure of sovereign CDS premia. The term structure of asset prices should deliver valuable and complementary information compared to the use of assets with single maturity.[4] Indeed, our results suggest that the predictive power of sovereign CDS term premia is robust even after controlling for the CDS level. On the other hand, in their framework, the channel through which the sovereign CDS level affects currency returns is through the exposure to global shocks. In contrast, our focus on the CDS slope builds on its signal regarding country-specific shocks, for which we provide the first extensive empirical evidence. Hence, we consider our paper as complementary to the work of Della Corte et al. (2016). Another subtle but important advantage of studying the CDS term premium is that the inherently strong factor structure of the CDS level and its high correlation with measures of global risk such as VIX (see e.g. Pan and Singleton (2008), Longstaff et al. (2011)) raise serious concerns on its appropriateness as an effective measure of country-level credit risk. In contrast, the weaker commonality across the CDS slope helps yield a more clean identification of country-specific credit risk and makes the results more interpretable.

Third, our paper is connected to the extant sizeable literature on currency risk premia. Important recent papers are Lustig et al. (2011), Menkhoff et al. (2012a), Sarno and Schmeling (2014), and Jurek (2014). This strand of research focuses on the cross-section currency trading strategies that could deliver satisfactory excess returns to investors. Among the most important and well-known strategies is the so-called carry trade strategy, which essentially takes long

[4] See the discussions on the bond market (Estrella and Hardouvelis, 1991), equity market (Van Binsbergen et al, 2017), the sovereign CDS market (Augustin, 2016), and a recent comprehensive review by Van Binsbergen and Koijen (2017).

positions on currencies with high interest differences and shorts those with low interest rate differences against the U.S. dollar. However, as effectively pointed out by Menkhoff et al. (2012b), and Jurek (2014), among others, the profitability of this strategy mainly stems from the risk-free part (interest rate differences) of the strategy. In contrast, we find that the sovereign CDS term premium predicts changes in the spot exchange rates, which reflects the essential fluctuations in asset prices. This is an important result since it ensures the sovereign CDS slope to be included into a small set of predictors for being able to forecast changes in the spot exchange rate.[5]

Last but not least, we extend the empirical investigations by Han et al. (2017) and Han and Zhou (2015) to the foreign exchange market. To the best of our knowledge, they are the only two studies that tie corporate CDS to firm-level stock returns and characteristics. Nonetheless, different from these papers, we examine the natural extension from the firm-level perspective to the country-level dimension. As argued in Cochrane (2005), there is in fact a direct analogy between stock and currency assets when mapping firms to countries. Overall, by showing a statistically and economically significant relation between the CDS term structure and asset returns at the country-level currency markets, we also provide complementary additional evidence consistent with their results.

The remainder of the paper is outlined as follows. In Section 2, we formulate a simple conceptual framework that guides our empirical analysis. Section 3 describes the data. Section 4 presents our main empirical findings regarding the local nature of the sovereign CDS term premia. Section 5 examines exchange rate predictability by using the sovereign CDS term premium. Section 6 extends our analysis to international stock returns predictability. Finally, Section 7 concludes.

2 Motivating Framework

In this section we develop an illustrative equilibrium model that motivates our empirical study of the sovereign CDS term premia and exchange rates. For country i, the consumption growth is assumed to follow:

$$\Delta c_{it+1} = \alpha_i x_t + \beta_i x_{it} + \sigma_i \epsilon^i_{t+1}. \tag{1}$$

[5]To the best of our knowledge, examples that lead to forecasting changes in the spot exchange rate with success include the momentum strategy by Menkhoff et al. (2012b) and the value strategy by Menkhoff et al. (2016).

Without loss of generality, we will consider the case when there are only two states, and the state vector is given by $X_t = (x_t, x_t^i)$. Innovations in x_t characterize the global shocks, and innovations in x_t^i represent the country-specific shocks to country i. We assume that global and country-specific shocks are independent with each other. Formally, their dynamics are given by:

$$x_{t+1} = \mu + \phi x_t + \sigma_x \eta_{t+1}, \tag{2}$$

$$x_{it+1} = \mu_i + \phi_i x_{it} + \sigma_{ix} \eta_{t+1}^i. \tag{3}$$

As for the equilibrium valuation of CDS spreads, we follow analogous derivations in Augustin (2016) and Augustin and Tédongap (2016). To ease notations, we will omit the country index for the subsequent part. Define the (conditional) survival probabilities $S_t = Prob(\tau > t | I_t)$ as

$$S_t = S_0 \prod_{j=1}^{t} (1 - h_j), \tag{4}$$

where the hazard rate $h_t = Prob(\tau = t | \tau \geq t, I_t)$ characterizes the probability of having a credit event for country i at a specific time t. Then a K-period CDS spread at time t is given by[6]

$$CDS_t(K) = \frac{(1-R)\sum_{j=1}^{KJ}[\Psi_{j,t}^* - \Psi_{j,t}]}{\sum_{k=1}^{K} \Psi_{kJ,t} + \sum_{j=1}^{KJ}(\frac{j}{J} - \left\lfloor \frac{j}{J} \right\rfloor)[\Psi_{j,t}^* - \Psi_{j,t}]}, \tag{5}$$

where J is the number of days within a period, R is the recovery rate once default occurs. $\Psi_{j,t}^* = E_t[M_{t,t+j}\frac{S_{t+j-1}}{S_t}]$ and $\Psi_{j,t} = E_t[M_{t,t+j}\frac{S_{t+j}}{S_t}]$ represent the present value of expected future default, where $M_{t,t+j}$ is the j-period stochastic discount factor at time t.

Within the model, $\Psi_{j,t}^*$ and $\Psi_{j,t}$ have the classical exponential affine forms:

$$\Psi_{j,t}^* = e^{A_j^* + B_j^{*T} X_t}, \tag{6}$$

$$\Psi_{j,t} = e^{A_j + B_j^T X_t}, \tag{7}$$

where the factor loadings A_j, B_j, A_j^*, B_j^* satisfy some iterations involving structural model parameters, as in canonical affine term structure models (see e.g. Duffie and Kan, 1996).

Now we consider the term premium of log CDS spreads with one-period and two-period maturity $CDS_t(2) - CDS_t(1)$. We define an auxiliary variable $z_{jt} = \Psi_{j,t}^* - \Psi_{j,t}$, which denotes

[6]See Proposition 3.1 in Augustin (2016).

the (discounted) changes in the expected default. Then, the log CDS term premium is given by

$$\log(CDS_t(2)) - \log(CDS_t(1)) = \log(\frac{\sum_{j=1}^{2J} z_{jt}}{\sum_{j=1}^{J} z_{jt}}) - \log(\frac{\Psi_{J,t} + \Psi_{2J,t} + \sum_{j=1}^{2J}(\frac{j}{J} - \left\lfloor \frac{j}{J} \right\rfloor) z_{jt}}{\Psi_{J,t} + \sum_{j=1}^{J}(\frac{j}{J} - \left\lfloor \frac{j}{J} \right\rfloor) z_{jt}}). \quad (8)$$

Taking the Taylor expansion on the right hand side yields

$$\log(CDS_t(2)) - \log(CDS_t(1)) \approx \log(\frac{\sum_{j=1}^{2J} z_{jt}}{\sum_{j=1}^{J} z_{jt}}) - \frac{\Psi_{2J,t} + \sum_{j=J+1}^{2J}(\frac{j}{J} - \left\lfloor \frac{j}{J} \right\rfloor) z_{jt}}{\Psi_{J,t} + \sum_{j=1}^{J}(\frac{j}{J} - \left\lfloor \frac{j}{J} \right\rfloor) z_{jt}}. \quad (9)$$

Typically, the hazard rate $h_{t+j} \approx 0$, then we have $z_{jt} \approx 0$. In this case,

$$\log(CDS_t(2)) - \log(CDS_t(1)) \approx -\frac{\Psi_{2J,t}}{\Psi_{J,t}} + residual_t. \quad (10)$$

From the exponential-affine form of $\Psi_{j,t}$, the CDS spread and the term premium can be further expressed as

$$\log(CDS_t(2)) - \log(CDS_t(1)) \approx (B_J^T - B_{2J}^T) X_t + residual_t. \quad (11)$$

An important takeaway from identify (11) is that the sovereign CDS term premium does not convey the information on all risk factors, especially for those that are similarly loaded by CDS contracts of different maturities. Hence, the information content is different from that of the sovereign CDS spread, which usually combines all kinds of risk factors (and predominantly the global risk). Indeed, as we will show in the next sections, the sovereign CDS slope is more informative empirically on country-specific risk compared to the CDS level. Note that equation (11) has a straightforward interpretation. Given the nature of global shocks, the CDS spreads at different maturities should have relatively homogeneous loadings. Therefore, the risk loadings cancel out with each other and this leads to the unique information regarding the country-specific risk from the CDS term premia.

For the equilibrium exchange rate in the model, in a standard manner similar to Backus et al. (2001), we can define the exchange rate between country i and k as

$$S_{t+1} = \frac{M_{t+1}^i}{M_{t+1}^k}. \quad (12)$$

To obtain sharper predictions, we assume that agents have Constant Relative Risk Aversion (CRRA) utility with risk aversion γ, then the currency log return is

$$\Delta s_{t+1} = \gamma(\Delta c_{i,t+1} - \Delta c_{k,t+1}) = \gamma((\alpha_i - \alpha_k)x_t + \beta_i x_{i,t} - \beta_k x_{k,t}) + \gamma(\sigma_i \epsilon_{t+1}^i - \sigma_k \epsilon_{t+1}^k). \quad (13)$$

Equation (13) essentially tells us that an interesting equilibrium relationship holds between the currency market and the sovereign CDS market. Indeed, we can see that there is a significant share of risk between these two markets, which reflects the consistent stochastic discount factor in pricing both assets. In fact, we can infer more information on such common risk by disentangling the two components of global and local or country-specific risks. As we noted above, the CDS level is substantially more affected by global shocks. Consequently, if we were to understand how those two markets are integrated, we should expect to find that an important share of risk is attributed to the systematic co-movements. This prediction is strongly supported by a recent paper by Della Corte et al. (2016), who document that global sovereign credit risk captures around 19% of fluctuations in the exchange rate, even after controlling for orthogonal changes in VIX, a well-known global risk measure.

However, our approach is novel and differs sharply from Della Corte et al. (2016) since they are agnostic about the usefulness of the CDS term premium in affecting exchange rates. It is important to note, as can be seen clearly from our model and specifically from identity (11), that if the CDS spreads of various maturities load similarly on common shocks but differently on country-specific shocks, then the CDS term premium will provide a clean measure of country-specific risk since the component of global risk vanishes. Consequently, this offers a tractable and useful framework to explore whether the CDS term premium affects the exchange rate. More importantly, we view this approach as providing a complementary yet independent understanding of the sources of risks in financial markets in addition to the standard analysis based on measures of CDS spreads.

3 Data

Our data covers both the sovereign CDS market and the currency market. We obtain the 1-, 5- and 10-year sovereign CDS spreads, and the mid-level spot exchange rates of 29 countries from

Datastream.[7] Due to the data availability of sovereign CDS spreads, we focus on the sample period from December 2007 to June 2017. Thus, our sample encompasses the global financial crisis, the Euro-zone debt crisis, as well as the recovery period, and hence allows us to implement the analysis under various economic regimes.

We use the log of the 5-year CDS spread as the measure of the CDS level. Our choice is motivated by two main reasons. The primary motive is that for numerous models on CDS and also for our illustrative model presented in Section 2, the central modeling quantity is the log credit spread (see e.g. Gordy and Willemann, 2012; Gordy and Szerszen, 2015). The second consideration is due to the statistical tests that we will carry out in the next sections. As suggested by Gilchrist and Zakrajšek (2012), using logs of credit spreads is necessary to control for heteroscedasticity given that the distribution of raw credit spreads is highly skewed.[8] Similarly for the term premium estimation, we use the difference between the log of 10-year spread and the log of 1-year spread. Augustin (2016) also considers maturities of 10 and 1 years. More importantly, we do not include the 5-year spread to avoid any mechanical relations and this facilitates the interpretation of the results from empirical tests in the subsequent sections.

We also include a battery of macroeconomic and financial variables in our analysis. Consistent with our previous discussion and in the spirit of Longstaff et al. (2011) and Augustin (2016), we consider both global and country-specific variables. Specifically, for the group of global variables, we use U.S. aggregate stock returns, long-term yields and the variance risk premium. For the local variables, we use the local stock market return denominated in the local currency, percentage changes in the dollar value of sovereign foreign currency holdings, and local currency returns. We employ primarily financial markets variables. Such choice is not only due to the data availability, but also because those variables are well known to be forward-looking and hence dissect important information on the macroeconomic state of each country.

Table 1 presents the summary statistics of CDS levels and CDS slopes for each country. We can clearly see that the CDS levels show significant heterogeneity across different countries, with the emerging economies on average exhibiting higher credit spreads. Yet the volatilities of CDS spreads are similar across the two group of countries. Note that for most of the sovereigns, the

[7]We include the following countries in our sample: Argentine, Australia, Brazil, Chile, China, Colombia, Croatia, Czech, Denmark, Hong Kong, Hungary, Iceland, Indonesia, Israel, Japan, Korea, Malaysia, Mexico, New Zealand, Norway, Peru, Philippines, Poland, Russia, South Africa, Sweden, Thailand, Turkey and U.K.

[8]Indeed, within our sample of 29 countries, the skewness of raw CDS spreads ranges from 0.5 to up to 3, while the kurtosis varies from 2 to 11.

CDS level displays positive skewness, partially due to the financial crisis period when the CDS spreads widened dramatically.

On the other hand, the summary statistics of the CDS term premium reveals a different picture. In fact, countries with low (high) CDS level on average exhibit a higher (lower) CDS slope. The steepness of the credit curve indicates the relative magnitude between the short-run and the long-run credit risk. As can be seen, the countries with low CDS level on average have lower short-run risk compared with their long-run default prospects.

4 Understanding Sovereign CDS Term Premia

Given the paucity of research on the sovereign CDS term premium, in this section we briefly outline the properties of the CDS term structure before exploring formal asset pricing implications. To the best of our knowledge, only a small empirical literature exists on the sovereign CDS term structure (see, e.g. Calice et al., 2015; Augustin, 2016). Nevertheless, none of these earlier studies explicitly relate the CDS term premia to both global and country-specific macro fundamentals, especially in the context of asset pricing.[9]

4.1 Principal Component Analysis

We first analyze the factor structure of the CDS level and slope, which is helpful for distinguishing their differential information content. Previous studies have found that the CDS levels share substantial factor structure, and those principal components are mostly correlated with U.S. or global shocks but less so with country-specific risk (see e.g. Longstaff et al., 2011). Nevertheless, there are only a few papers discussing the factor structure for the CDS slope. Hence we run the Principal Component Analysis (PCA) on the correlation matrices of both the changes in CDS levels and slopes.[10]

Table 2 displays the results. Overall, we find that the CDS levels share a common factor that explains around 60% of cross-sectional variations, with comparable magnitudes in previous papers. The factor structure is relatively stable over time, it becomes stronger during the subperiod containing the 2008 global financial crisis and the 2012 Euro-debt crisis, and weakens

[9]Han and Zhou (2015) implement the analysis for the term structure of corporate CDS spreads.

[10]Note that we rely on the correlation tables instead of raw data to avoid the problem of unbalanced panel data (see Longstaff et al., 2011, for a similar implementation).

(but still with 43% of explanatory power) afterwards. On the other hand, the factor structure for the CDS slope is substantially weaker, with the first principal components accounting for around 35% of cross-sectional variations.

One may wonder why the factor structure is so different given that both quantities reflect the prospect of sovereign credit risk. As discussed in Section 2, we propose a possible explanation based on the relative magnitude of global and local risk. Economically speaking, while the CDS level contains information on both components, the similar loadings of CDS spreads at different maturities on global shocks tend to neutralize the global component encapsulated in the CDS term premium. In other words, the imbalanced proportions of global shocks among CDS levels and slopes explain the different factor structure.

4.2 Local Credit Risk and the CDS Term Premium

To further test our main hypothesis, we study the relationship between a proxy for local credit risk and the CDS term premium. More specifically, we seek to obtain a measure for local credit risk by isolating the global components of sovereign CDS levels. We project the changes in CDS levels for country i on the first three principal components of the world panel of the changes in CDS levels.[11] We then take the residual as the local credit risk proxy. Since the first three PCs account for more than 70% of cross-country variations in CDS levels, we reasonably believe that the residual should contain quite a limited amount of information on global risk.

Regarding the local nature of the sovereign CDS term premium, we regress the local credit risk proxy obtained through the above steps on the CDS slope for each country

$$Local_{it} = \alpha_i + \beta_i \Delta Slope_{it} + \epsilon_{it}, \tag{14}$$

where the coefficient β_i characterizes how fluctuations in the sovereign CDS slope reflects the local risk exposure of the credit market for country i. The regression results are reported in Table 3.[12] To start with, for 4 out of 7 developed countries in Panel A of Table 3, the CDS term premia account for a significant portion of local credit risk. Notably, the explanatory power ranges from 7.3% to 27.6%. Intuitively, the recent sluggish global demand for crude oil and iron ore creates

[11] Instead of the first three factors, we also try the cross-sectional average of changes in CDS spreads or only the first PC. Overall, the results are quantitatively similar, or even stronger.

[12] Since the regression requires non-missing data for all countries, we have to start the sample after May 2010.

nontrivial local economic downside risk for countries such as Denmark, Norway, Australia and New Zealand. Such information is of course incorporated in the forward-looking sovereign credit market. By successfully isolating the global impact on the sovereign CDS spreads and filtering out the local risk component, we find that in line with our hypothesis, the CDS term premium is able to effectively capture the local prospect of economic risk.

We now turn our attention to Panel B in Table 3 for the group of developing countries. We can clearly observe that only two out of 22 countries yield insignificant results at the 5% level. In other words, domestic credit risk is of greater magnitude among emerging market economies. Importantly, the results can be similarly linked to local economic risk. For example, the bullish market for commodities, the political crisis in Brazil, the debt crisis in Iceland, and uncertainty surrounding the Euro-zone debt crisis, all amplify local economic risk of various countries. In all, our analysis shows that the sovereign CDS term premium can effectively capture those fluctuations.

4.3 CDS Term Premia and Macroeconomic States

Our analysis so far has focused on whether the CDS term premium contains valuable information on country-specific risk. A relevant yet different question that naturally arises is whether the CDS term premium is more significantly affected by country-specific risk variables rather than global shocks. In this subsection, we employ a basket of global and local variables popularly used in the literature to study their roles in determining the evolution of the time-varying sovereign CDS term premium.

As the choice of our variables, we follow closely Longstaff et al. (2011) by considering variables from financial markets, which are well-known to be forward-looking and dissecting rich information from macro fundamentals. We treat U.S. stock returns, changes in the U.S. variance risk premium and U.S. long-term bond yields as global states. In contrast, local stock returns (denominated in local currency), currency returns and percentages changes in the dollar value of sovereign foreign currency holdings characterize local states. We then run the following panel regression by projecting changes of the CDS slopes on the explanatory variables.

$$\Delta Slope_{i,t} = \alpha + \beta_1 Stock_{i,t} + \beta_2 \Delta Reserve_{i,t} + \beta_3 FXret_{i,t} + \beta_4 USstock_t + \beta_5 \Delta VRP_t + \beta_6 \Delta LTY_t + \epsilon_{i,t},$$

where the variables with subscript i denote those for country i, and the model is estimated via OLS method.

Table 4 presents the results. Notice that for this regression, we report the estimates following the commonly used procedure in Petersen (2009) by reporting standard errors clustering either by country (column (2)) or by time (column (3)). In line with Petersen (2009), it turns out that using different estimation methods for standard errors yields different results. Nevertheless, we find that the three local variables are all significant at the 1% level regardless of the specific method for computing standard errors. Changes in the CDS slopes on average show a positive contemporaneous relationship with domestic stock returns, currency appreciation, as well as with the growth in FX reserves. This evidence suggests that the positive innovations in the CDS slope are in general good news for a country. On the other hand, the US stock return is the only robust and significant predictor of the global states, yet with a lower t-statistic than that of local stock returns after clustering over time. Remarkably, our empirical evidence from the CDS slope significantly complements the analysis provided by Longstaff et al. (2011), who only find that CDS levels are better explained by global variables.

5 CDS slope and the Cross-Section of Currency Returns

In the previous sections, we have explored the important relation between the sovereign CDS slope and a set of country-specific variables. We now turn our attention to study the predictive content subsumed in the CDS term premium on currency returns. To evaluate the predictability of exchange rates, we depart from standard time-series models and employ instead the cross-sectional approach proposed by Lustig and Verdelhan (2007), in the exchange rate literature. Such methodology effectively utilizes the rich information contained in the cross-section of a large number of assets rather than the information on a single currency pair.

5.1 Portfolio Sorts

We study whether the information in the sovereign CDS term premia help predict the cross-section currency returns out-of-sample. At the end of each month, we sort currencies based on their sovereign CDS term premia. To this end, we follow Menkhoff et al. (2012b) by recording the changes in the spot exchange rate as well as the carry components realized in the following month.[13] We then form three portfolios by equally weighting all currencies within each portfolio, and rebalancing them monthly. Finally, we compute various statistics of the portfolios and take time-series average of those statistics under a different set of sub-samples.

Our results are given in Table 5. On average, we find that a higher CDS term premium significantly predicts subsequent higher currency returns (currency appreciation), with an average annualized return spread of 4.84%. This is consistent with the evidence presented in Table 3, where a higher CDS slope predicts stronger country-specific fundamentals. As we have discussed, the CDS slope reflects the relative movement between short-run and long-run credit risk. Higher term premium represents either reduced short-term risk or increased long-term risk. Within our sample, the former effect dominates and hence the innovations in the CDS slope represent good news and indicate subsequent currency appreciations. The pattern is robust and not related to the financial crisis. In fact, the predictive ability of the CDS term premium is even weaker and marginally significant during the sub-period from 2008 to 2012, while the return spreads between high and low portfolios become economically quite significant, with an annualized excess return of 7.33% after 2012. Interestingly, we also find that the interest rate differences and sovereign CDS levels exhibit a monotonically decreasing pattern from low to high portfolios. It is important to note that this is not inconsistent with the sort on the CDS slope. Extant studies suggest that currencies with high interest rate differences (e.g. Lustig et al. (2011)) or high CDS level (e.g. Della Corte et al. (2016)) are more risky. Consequently, it is reasonable that the countries with high CDS slope experience lower forward discounts or CDS levels.

In addition to the average results, we also study the time-series properties of long-short portfolio return spreads. Figure 1 plots the cumulative raw returns obtained from a zero-investment strategy of buying the portfolio with the highest sovereign CDS term premia and short the one with the lowest term premia. As is clear from the figure, the performance is conservative during the financial crisis period (yet still positive). In the aftermath of the 2008 financial turmoil, the returns of long-short portfolio quickly bounce back. Also, in line with our previous sub-sample results, the predictive ability of the sovereign CDS slope is higher during the second half of the sample, especially over the last three years.

[13] As documented in Jurek (2014), the carry component is essentially the risk-free part, while the changes in the spot rate reflects the actual fluctuations of asset prices.

5.2 Fama-MacBeth Regression

Although portfolio sorting is a powerful methodology for detecting nonlinear predictive relations between CDS term premia and currency expected returns, is however unable to control for additional risk factors that may matter for the cross-section of stock returns. In particular, we aim to control for the effects from the CDS level, given its close relation with the slope. As the number of currencies is limited, it is infeasible to follow the convention of running a double sorting exercise to isolate the effect from the CDS level. We therefore rely on Fama-MacBeth regressions by controlling for country-specific CDS levels, as well as other risk factors.

We report the regression results in Table 6. Several important results emerge from the analysis. First, we find that the CDS slope significantly and positively predicts future currency returns, similar to the implications from the results of portfolio sorting. Second and more interestingly, even after adding the CDS level, the significance of the CDS slope is almost unchanged. The coefficient for the CDS slope only drops by a small proportion and still remains highly significant. Third, perhaps surprisingly, we find that the CDS level is not a significant predictor for currency returns within our sample, after controlling for the information in the term premium.

We then continue to add other risk factors. Column (3) reports the results when including also the local stock return. Intuitively, if investors are consistently pricing risk, the local stock returns contain information on the local risk appetite, which may be relevant for the currency fluctuations. However, we find that it is a insignificant predictor, while the predictive power of the sovereign CDS slope becomes more significant. As another experiment, we include the growth in the country-specific foreign reserves. Higher FX reserves indicate better country fundamentals and should typically lead to currency appreciations. We find results that match this prediction from the Fama-MacBeth regression, though with insignificant estimates from Column (4).

Last, we put together all the variables into a single regression. This “kitchen-sink” exercise provides a powerful and comprehensive test on the predictive power of the sovereign CDS slope. The results are shown in Column (5). As we can clearly observe, the predictability of the sovereign CDS slope is only reduced marginally. Furthermore, the predictive power of the growth of FX reserves increases substantially, at a 10% statistical significance.

6 Additional Results and Robustness Checks

6.1 Does the CDS Slope Predict the Stock Market?

Our analysis up to this point has explored the nature of the sovereign CDS term premium and its relation with currency returns. An important, complementary question is whether the information content of the sovereign CDS slope can be helpful for predicting other asset markets beyond the FX market.

To give an answer to this question, we follow Hjalmarsson (2010) by pooling data from all countries within the panel regression framework, instead of the country-by-country predictive regressions methodology of e.g. Rapach et al. (2013). More specifically, we run the following panel regression

$$\begin{aligned} r_{i,t+1} =& \alpha + \beta_1 Slope_{i,t} + \beta_2 Level_{i,t} + \beta_3 FXret_{i,t} + \beta_4 \Delta Reserve_{i,t} + \beta_5 USstock_t + \\ & \beta_6 VRP_t + \beta_7 LTY_t + \epsilon_{i,t+1}, \end{aligned}$$

where we select the controlled variables described in the previous sections. In particular, a large body of the literature has restricted attention to global state variables as among the most popular predictors of stock markets variables.[14] It is therefore an essential further step to control for these variables to capture the effect attributable to the sovereign CDS term premium.

The regression results are provided in Table 7, where in addition to the OLS parameter estimates, we also report the OLS standard errors, the standard errors clustered over country or time in parentheses. Our empirical evidence shows that an higher sovereign CDS term premium is indicative of lower future stock returns (and hence the expected returns). As noted in previous sections, positive innovations in the sovereign CDS term premium indicate normally good news to a particular country. In other words, an intuitive economic interpretation for the sign of the regression coefficient is that a higher slope will predict lower risk premia and hence expected returns.

In addition to the slope, perhaps surprisingly, we also find that the local currency returns are significant predictors for the stock market under various clustering methods. To the best of

[14]Rapach et al. (2013) identify significant predictive ability of U.S. aggregate stock returns on international stock markets. Bollerslev et al. (2009) show both theoretically and empirically that the variance risk premium is an important predictor for stock returns. Ang and Bekaert (2006) discuss the usefulness of long-term yield in the context of international return forecasting.

our knowledge, the strong predictive power has not been documented by the extant literature.[15] In fact, the sign is consistent with the typical conclusion from the cross-section of international stock returns, where on average the appreciation of local currency coincides with higher local stock returns (see e.g. Dumas and Solnik (1995)).

Turning our discussion on the global variables, when the standard errors are not clustered by time, they all show significant predictive power. However, when we control for the time effect, only the long-term yield remains significant. It is well understood that within our sample (especially the post-crisis period), the coordination of monetary policy becomes stronger internationally (Taylor (2013)). Since the worldwide policy rates exhibit strong co-movements, and a strand of the literature on monetary policy and stock prices (see e.g. Bernanke and Kuttner (2005)) suggests that a tightening in monetary policy typically coincides with rising long-term yields and negatively forecast subsequent stock returns, it is not surprising that the U.S. long-term yields shows such strong predictability for worldwide stock market returns.

6.2 Alternative controls in Fama-MacBeth Regression

The Fama-MacBeth regressions produce an important result on the cross-sectional predictability of exchange rates. As a robustness check, we evaluate the predictive power of sovereign CDS term premia by controlling for some closely related variables of global risk. First, we consider the global FX volatility betas. Menkhoff et al. (2012a) show that the volatility exposure is crucial for understanding the cross-section of currency excess returns. Since a sovereign credit event is typically associated with exchange rate turmoil, the influence of FX volatility could be quite relevant for understanding the predictive power of CDS term premia on the path of exchange rates. As an alternative control for the risk from the CDS level, we follow Della Corte et al. (2016) by considering the country i's exposure to global sovereign credit risk (average of the CDS level), instead of using the country i's raw CDS level. Introducing those measures for the exposure to global risk into the Fama-MacBeth regression help us better understand the local nature of sovereign CDS term premia.

[15]Research exploring the links between the stock market and the FX market is scarce. Earlier studies includes Dumas and Solnik (1995), Jorion (1991), and a recent contribution by Atanasov and Nitschka (2015). However, most of these studies focus on cross-sectional predictability, while our characterization provides evidence on the time-series dimension.

To measure the global FX volatility and CDS exposure, we estimate the following regression

$$r_{it} = \alpha_i + \beta_i \Delta X_t + \epsilon_{it}, \tag{15}$$

where X_t represents month-t global FX volatility or CDS level, [16] r_{it} is the currency i's return at month t. At the end of each month, the regression is estimated via weighted least square (WLS) by using all available historical data. Then we estimate the Fama-MacBeth cross-sectional regression by using the estimated betas. We report the results in Table 8.

Our evidence is strongly supportive of the notion that the sovereign CDS term premia positively forecast currency returns out-of-sample, regardless on how one controls for the global risk exposures. The Newey-West t-statistics remain significant at 1% level for all the specifications considered. Interestingly, we can clearly see from column (4) that all the three regressors show significant predictive power for the exchange rate. Consistent with the main results in Table 6, the global CDS betas, which serve as another proxy for the exposure to global credit risk, negatively forecast currency returns. The strong predictive power further supports the argument that the sovereign CDS term premium encapsulates effectively the share of local variation of sovereign credit risk.

7 Conclusion

In this paper we bridge a significant gap in the rapidly expanding literature on sovereign CDS by empirically examining the nature of the sovereign CDS term structure and its relation with the foreign exchange market. Specifically, we first build a novel theoretical framework and then provide ample empirical evidence that the CDS term premium contains important information regarding country-specific risk. We advocate therefore the use of the sovereign CDS term premium for exploring important features of asset markets dynamics and in particular on exchange rate predictability.

Using the sovereign CDS term structure, we establish a number of new results regarding the nature of sovereign credit risk and movements in exchange rates. First of all, we show that the CDS term premium helps predict the exchange rate out-of-sample, suggesting that it is not

[16] We take the cross-sectional average as global FX volatility (Menkhoff et al. (2012a)) or CDS level (Della Corte et al. (2016)).

only a meaningful tool specific to credit market research, but can be also highly informative on commonalities across different financial markets. Our findings on the cross-asset predictability point towards a more complex pricing dynamic interaction (kernels) of investors between sovereign CDS and currency markets. Consistent with this rational, we also document a significantly strong predictability for international stock market returns. Additionally, our findings in support of the predictive ability of the CDS term premium are fairly robust even after taking into account other conventional characteristics.

All in all, from a policy perspective, the evidence uncovered in this paper highlights the benefits of exploiting the information role of the sovereign CDS market to construct powerful (and high-frequency) forecasting measures of exchange rates, which is challenging yet extremely important for policy makers.

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Table 1: Summary Statistics for CDS level and term premium

Country	*CDS Level*					*CDS Slope*				
	Mean	Stdev	Skewness	Kurtosis	AR(1)	Mean	Stdev	Skewness	Kurtosis	AR(1)
Panel A. Developed countries										
Australia	3.79	0.42	0.53	3.20	0.92	1.72	0.79	-0.44	1.85	0.91
Japan	3.55	0.53	-0.22	2.13	0.93	1.77	0.61	-0.22	2.19	0.83
Denmark	3.26	0.76	0.85	2.45	0.96	1.72	0.73	-0.41	2.07	0.88
Norway	2.96	0.36	0.87	3.18	0.92	1.77	0.64	-0.54	2.13	0.91
Sweden	3.05	0.73	0.62	2.37	0.95	1.76	0.71	-0.68	2.42	0.85
New Zealand	3.79	0.43	0.10	2.16	0.96	1.86	0.67	-0.62	2.23	0.90
U.K.	3.67	0.57	0.08	2.12	0.95	1.78	0.81	-0.29	1.88	0.90
Panel B. Developing countries										
Argentine	7.13	0.76	-0.11	1.67	0.93	0.05	0.84	0.32	2.10	0.95
Brazil	5.17	0.41	0.70	2.45	0.91	1.15	0.36	-0.08	2.32	0.84
Czech	4.16	0.50	0.70	2.79	0.92	1.36	0.62	-0.18	2.04	0.93
Russia	5.31	0.45	1.02	4.00	0.90	0.96	0.64	0.09	2.92	0.90
Hong Kong	3.95	0.29	0.95	3.51	0.85	1.41	0.49	0.38	2.67	0.87
Hungary	5.34	0.56	-0.15	2.20	0.96	1.01	0.66	0.07	2.07	0.94
Thailand	4.76	0.32	0.38	4.00	0.86	1.36	0.61	0.12	2.13	0.91
Malaysia	4.74	0.33	0.75	3.11	0.87	1.45	0.60	-0.33	1.84	0.90
China	4.51	0.32	0.21	4.34	0.80	1.47	0.58	-0.07	1.85	0.91
Indonesia	5.25	0.39	1.89	6.79	0.91	1.39	0.57	-0.76	2.91	0.90
Philippines	4.93	0.42	0.99	3.57	0.94	1.50	0.63	-0.90	2.93	0.91
South Africa	5.19	0.31	0.89	3.88	0.88	1.17	0.47	-0.16	2.88	0.84
Chile	4.48	0.32	1.31	4.74	0.81	1.24	0.37	-0.08	2.78	0.72
Colombia	5.00	0.36	0.81	3.72	0.90	1.17	0.40	-0.08	2.70	0.87
Croatia	5.55	0.38	-0.95	4.71	0.89	0.84	0.54	0.55	3.27	0.95
Iceland	5.37	0.65	0.71	2.84	0.98	0.83	0.87	-0.27	1.47	0.99
Korea	4.45	0.52	1.08	3.99	0.93	1.26	0.71	-0.19	1.65	0.95
Peru	4.90	0.32	1.48	5.70	0.86	1.20	0.42	0.17	2.87	0.89
Poland	4.57	0.51	0.51	2.33	0.92	1.33	0.61	0.03	2.60	0.89
Turkey	5.31	0.29	0.44	3.68	0.90	1.03	0.42	-0.34	3.93	0.85
Israel	4.65	0.35	0.39	2.20	0.90	1.35	0.65	0.15	2.09	0.94
Mexico	4.87	0.35	1.08	4.85	0.88	1.23	0.45	-0.50	2.58	0.92

Notes: We include the term structure data of sovereign CDS of 29 countries. The CDS level is defined as the log of 5-year CDS spread, and the CDS slope is the log of 10-year spread minus the log of 1-year spread. Data sample is from December 2007 to June 2017.

Table 2: Principal Component Analysis on changes in CDS Level and Slope

	PC	CDS Level	CDS Slope
Panel A. Full sample			
	1	60.02	35.73
	2	7.89	7.96
	3	5.53	7.77
Panel B. Dec 2007 to Dec 2012			
	1	66.68	44.95
	2	6.82	9.56
	3	5.32	6.17
Panel C. Jan 2013 to Jun 2017			
	1	43.58	28.81
	2	10.42	11.05
	3	5.90	7.99

Notes: We include the term structure data of sovereign CDS of 29 countries. The CDS level is defined as the log of 5-year CDS spread, and the CDS slope is the log of 10-year spread minus the log of 1-year spread. The numbers reported are in percentages. Data sample is from December 2007 to June 2017.

Table 3: Country-specific credit risk and CDS term premium

Country	β	t-stat	$R^2(\%)$
Panel A. Developed countries			
Australia	-0.11	-8.56	26.90
Japan	-0.05	-0.77	1.58
Denmark	-0.07	-2.54	7.31
Norway	-0.09	-3.78	9.95
Sweden	0.05	1.48	3.33
New Zealand	-0.16	-3.56	27.55
U.K.	-0.07	-1.48	3.94
Panel B. Developing countries			
Argentine	-0.01	-0.58	0.81
Brazil	-0.18	-4.70	20.60
Czech	-0.09	-2.34	9.67
Russia	-0.16	-2.77	19.62
Hong Kong	-0.08	-1.91	8.21
Hungary	-0.21	-6.88	29.08
Thailand	-0.07	-2.27	7.72
Malaysia	-0.07	-2.60	9.44
China	-0.08	-2.53	14.07
Indonesia	-0.11	-4.33	17.18
Philippines	-0.05	-2.26	7.58
South Africa	-0.13	-8.44	35.81
Chile	-0.11	-2.92	13.29
Colombia	-0.12	-2.36	15.73
Croatia	-0.20	-3.62	18.31
Iceland	-0.17	-4.68	17.44
Korea	-0.08	-2.37	10.57
Peru	-0.10	-2.17	6.94
Poland	-0.11	-6.10	28.33
Turkey	-0.16	-4.38	22.49
Israel	-0.19	-3.71	32.87
Mexico	-0.14	-2.50	13.39

Notes: Country-specific risk is the residual obtained by projecting each country's CDS level on the first three principal components of global CDS levels. t-statistics are the Newey-West statistics with 12 lags. Data sample is from May 2010 to June 2017 due to missing observations for some countries at the beginning of the original sample.

Table 4: Determinants of Changes in sovereign CDS term premia

Variables	(1)	(2)	(3)
$Stock_{i,t}$	0.55	0.55	0.55
	(6.37)	(5.29)	(5.15)
$\Delta Reserve_{i,t}$	0.42	0.42	0.42
	(2.85)	(2.94)	(2.97)
$FXret_{i,t}$	1.18	1.18	1.18
	(7.63)	(5.45)	(4.94)
$USstock_t$	1.13	1.13	1.13
	(8.56)	(9.93)	(4.46)
ΔVRP_t	2.69	2.69	2.69
	(2.47)	(2.11)	(1.18)
ΔLTY_t	-1.26	-1.26	-1.26
	(0.71)	(0.80)	(0.31)

Notes: CDS slope is defined as log 10-year spread minus log 1-year spread, CDS level is defined as the log of 5-year sovereign CDS spreads. Local stock return is denominated in the local currency. Local reserve represents the percentage changes in the dollar value of sovereign foreign currency holdings. Column (1) reports the results with no clustering, (2) and (3) are results with clustering over country and time. t-statistics are reported in parentheses. Data is from December 2008 to June 2017.

Table 5: Currency portfolios sorted by sovereign CDS term premium

	1	2	3	Diff
Panel A. Full sample				
Returns	-7.20	-2.52	-2.31	4.84
	(-2.11)	(-0.91)	(-1.00)	(2.53)
Interest rate differences	63.4	26.1	15.1	
CDS level	5.38	4.68	4.10	
Panel B. Dec 2007 to Dec 2012				
Returns	-3.44	-0.58	-0.59	2.85
	(-0.80)	(-0.14)	(-0.16)	(1.66)
Interest rate differences	48.7	27.6	20.9	
CDS level	5.35	4.80	4.45	
Panel C. Jan 2013 to Jun 2017				
Returns	-11.64	-4.71	-4.31	7.33
	(-2.44)	(-1.48)	(-1.73)	(2.25)
Interest rate differences	79.9	24.5	8.65	
CDS level	5.40	4.55	3.71	

Notes: CDS level is defined as the 5-year sovereign CDS spreads, while CDS slope is defined as log 10-year spread minus log 1-year spread. At the end of each month, we assign each currency into three portfolios. The breakpoints are separated by 30th and 60th quantiles of cross-sectional CDS slopes. We report Newey-West t-statistics in the parenthesis. We include 29 countries with data from December 2007 to June 2017.

Table 6: Fama-MacBeth regression

Variables	(1)	(2)	(3)	(4)	(5)
Slope	0.49	0.44	0.42	0.42	0.43
	(3.47)	(2.93)	(3.53)	(3.22)	(2.82)
Level		-0.09			-0.08
		(1.19)			(0.84)
Local stock return			-0.29		0.11
			(0.26)		(0.09)
Local reserve				1.88	2.50
				(1.20)	(1.99)

Notes: CDS slope is defined as log 10-year spread minus log 1-year spread, CDS level is defined as the log of 5-year sovereign CDS spreads. Local stock return is denominated in the local currency. Local reserve represents the percentage changes in the dollar value of sovereign foreign currency holdings. The Newey-west t-statistics adjusted for 12 lags are reported in the parentheses. All coefficients are in percentages. Data sample is from December 2008 to June 2017.

Table 7: Forecasting local stock returns

Variables	(1)	(2)	(3)
$Slope_{i,t}$	-0.013	-0.013	-0.013
	(4.83)	(4.98)	(3.36)
$Level_{i,t}$	-0.001	-0.001	-0.001
	(0.66)	(0.62)	(0.69)
$FXret_{i,t}$	0.595	0.595	0.595
	(16.18)	(7.56)	(9.49)
$\Delta Reserve_{i,t}$	0.015	0.015	0.015
	(0.43)	(0.32)	(0.36)
$USstock_t$	0.137	0.137	0.137
	(4.83)	(4.80)	(1.66)
VRP_t	1.860	1.860	1.860
	(3.81)	(4.03)	(1.29)
LTY_t	-1.055	-1.055	-1.055
	(6.22)	(6.25)	(2.59)

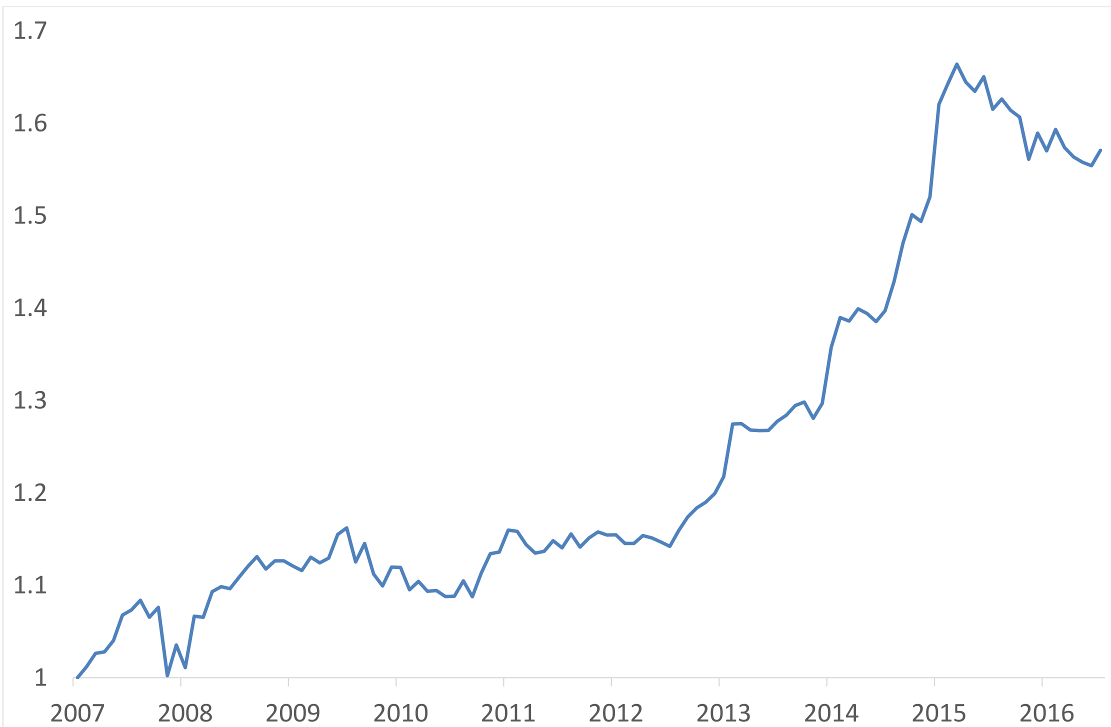
Notes: CDS slope is defined as log 10-year spread minus log 1-year spread, CDS level is defined as the log of 5-year sovereign CDS spreads. Local stock return is denominated in the local currency. Local reserve represents the percentage changes in the dollar value of sovereign foreign currency holdings. Column (1) reports the results with no clustering, (2) and (3) are results with clustering over country and time. t-statistics are reported in parentheses. Data sample is from December 2008 to June 2017.

Table 8: Fama-MacBeth Regression with Additional Controls

Variables	(1)	(2)	(3)	(4)
Slope	0.49	0.39	0.43	0.44
	(3.47)	(3.16)	(3.18)	(2.96)
Global Volatility Betas		0.01		0.05
		(0.63)		(3.02)
Global CDS Betas			-0.25	-4.33
			(-0.18)	(-1.92)

Notes: The CDS slope is defined as log 10-year spread minus log 1-year spread, the global volatility (CDS) betas are obtained by regressing currency returns on innovations in global volatility (CDS level). The Newey-west t-statistics adjusted for 12 lags are reported in the parentheses. All coefficients are in percentages. Data sample is from December 2008 to June 2017.

Figure 1: Cumulative raw returns of High-minus-Low Portfolio



Notes: The time-series plot of return spreads between currencies with high and low sovereign CDS slope portfolios.