Sovereign Tail Risk*

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Abstract

We provide a new measure of sovereign country risk exposure to global sovereign tail risk (SCRE) based on information incorporated in 5-year sovereign CDS spreads. Our panel regressions with quarterly data from 53 countries show that macro risks have strong explanatory power for SCRE. After controlling for liquidity conditions and financial market variables, SCRE increases for countries with higher interest rates, public debt, public deficit, credit-to-GDP, lower economic growth and looser monetary policy. We show that our risk exposure variable reacts significantly more than mean (median) CDS spreads to macro-financial risks. Our results therefore imply that good fundamentals protect countries against sovereign risk especially in times of global distress.

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1 Introduction

In times of global financial turmoil some countries appear more vulnerable than others. Indeed, while investors seem to be reluctant to invest in some countries, they can be eager to invest their savings in assets of other countries yielding almost zero interest rates. Understanding along what dimensions these countries are discriminated is thus of outmost important for both the monetary and fiscal authorities, as well as the private sector and institutional financial investors. In this context, this paper tries to answer a very specific question: What macro-financial fundamentals make investors distrust some countries in times of global sovereign debt crises?

The paper's first contribution is to derive a new measure of country-sovereign debt exposure to global-sovereign debt distress. This measure is obtained as the average of the country's 5-year sovereign debt credit default swap (CDS) spread associated with the *worst* realizations of global sovereign risk during each quarter at alternative significance levels. Global sovereign risk is in turn computed as the implied time-varying GDP-weighted average of 53 countries sovereign CDSs. In this way we are able to distinctly capture the elasticity of country risk to global tail risk. A key contribution of the paper is to explain what macro-financial factors make such exposure more severe in a panel data setting.

Our results show that strong macro fundamentals decisively insulate countries from global sovereign risk. We find that countries with lower GDP growth, higher inflation rate and higher interest rates are significant more exposed to global risk. In contrast, sound monetary and fiscal policies are both key in reducing exposure: A higher fiscal space - lower debt/deficit to GDP ratios - prevents exposure against global sovereign risk. In turn, we find that variables associated with financial instability, such as a lax monetary policy and a higher credit-to-GDP ratio, are forward-looking predictors of higher sovereign exposure. We show that these results are independent of the significance level of the global tail risk (1, 5 or 10%).

Recent literature also uses CDS spreads as a measure of sovereign credit risk.[1] In their regressions, Longstaff, Pan, Pedersen, and Singleton (2011) emphasize the key role of international factors in credit risk differentials. While we also control for global factors, we find that local macro-financial variables are important in explaining these differentials. The focus of our study is also quite different. First, we identify the exposure of particular countries to global sovereign *tail* risk. In a second step, we identify what macro-financial factors directly influence such exposure. This novel focus on explaining the factors behind global-to-local interdependence differentiates our approach from that of Aizenman, Hutchison, and Jinjarak (2013). Indeed, we show that while sound fundamentals and good monetary/fiscal policies are generally priced in sovereign CDS markets, they provide a specially useful buffer in times of global distress. Other relevant differences with respect to this study is that we work with a higher frequency (quarterly) dataset and control for a much larger set of variables. In particular, we include crucial financial stability variables in our study, which turn out to be key forward-looking indicators of sovereign tail risk. Our results are robust to the inclusion of expectations of future macro variables, alternative debt thresholds, global and local liquidity and financial market variables, interaction effects and other considerations.

The present paper is also related to the vast literature on financial contagion. Some works, such as Ang and Longstaff (2011) and Broto and Perez-Quirós (2013), estimate the exposure of US states and European Monetary Union countries to the systemic component of sovereign credit risk. Our results implicitly support some of their findings, as

[1]Earlier work focused instead on sovereign yield spreads across countries. Some examples are Edwards (1984), Edwards (1986), Berg and Sachs (1988), Duffie and Singleton (2003).

they also find that some countries suffer more than others in times of global turbulence. Our methodologies and analysis are however largely different on many dimensions. The most important difference across studies is that they do not explain tail-risk exposure in terms of specific macro-financial fundamentals, as we do.

Another strand of the contagion literature focuses on correlations across alternative financial markets, distinguishing between quiet and turbulent times (see King and Wadhwani (1990), Longin and Solnik (2001) and Caporin, Pelizzon, Ravazzolo, and Rigobon (2013), among others). In contrast to these studies, we extract exposure measures based on the CDS performance associated with global tail risk. In this way, we explicitly account for the impact of global distress on the home market and, at a later stage, relate exposure to macro fundamentals. Bae, Karolyi, and Stulz (2003) develop the co-excedence measure, which captures coincidences in tail stock returns across markets. Based on this measure, they run multinomial logits of actual coincidences on regional volatilities, interest rates and exchange rates. While the spirit of our exercise is similar to theirs, there are some important differences in terms of markets (stocks v/s sovereign debt), sample (pre-2000 v/s post-2000) and econometric framework, among others. Our two metrics of exposure are also quite different, since they count coincidences in two-sided tail returns while we capture CDS sovereign debt market spreads associated with global left tail risk. Finally, our set of exposure macro-financial drivers is substantially larger and allows for dynamic effects, giving rise to richer policy implications.

Our results resonate well with the flight-to-quality international finance literature. Theoretical and empirical work has provided a good characterization of flight-to-quality events in the wake of financial crisis episodes (see Calvo (2005), Caballero and Krishnamurthy (2008), Krishnamurthy (2010) and Baele, Bekaert, Inghelbrecht, and Wei (2013), among others). The focus of our study is however to explain why some countries end up being more exposed than others. While our results are associated with the years around the recent 2008 financial crisis, this key event provides a very relevant episode to study the macro-financial drivers of capital flows. Finally, our methodology to identify sovereign country exposure to global sovereign turmoil is also reminiscent of the recent financial systemic risk literature (see, for instance, Acharya, Pedersen, Philippon, and Richardson (2011)). In these works, banks' exposure to systemic risk is explained in terms of balance sheet determinants. In our work, country exposure to global sovereign risk is related to its macro-financial policies and fundamentals.

The paper proceeds as follows. In Section 2, we develop a measure of global sovereign debt distress and the associated exposure by country. Section 3 discusses our data selection and sources and derives our econometric setting in order to identify the country exposure to global sovereign risk. Section 4 shows the empirical results, performs a battery of robustness exercises and derives policy implications. Section 5 derives policy implications and concludes.

2 A Measure of Exposure to Global Sovereign Debt Distress

This section proceeds in two parts. The first one develops a measure of global-sovereign risk while the second one derives a metric capturing the exposure of country-sovereign risk to global financial risk. We now explain in detail how we construct these two measures.

2.1 A Global Sovereign Debt Risk Measure

Sovereign risk is normally associated with country risk. However, sovereign risk is often correlated across countries and it is thus natural to introduce a measure of global sovereign risk in order to account for this global phenomenon. This is what we do in this subsection.

In this paper we measure country sovereign risk with the price of the CDS spread of 5-year sovereign debt. These contracts, which are highly liquid, pay back the full sovereign investment in case of default. When the credit risk of the underlying asset increases, CDS premiums tend to increase, thus hindering supply and demand in actual sovereign debt markets. CDS pricing also feeds into rating models and thus into both the issuance cost of sovereign debt and the willingness of market participants to hold sovereign paper (see Fitch (2007)).

Another popular way to measure sovereign risk is to use the long-term interest rate itself. Indeed, most of the early literature on sovereign credit spreads, dating back to the 80s, uses bond rates as the variables object of analysis. Nevertheless, as Ang and Longstaff (2011) explain, CDSs have the advantage of isolating additional factors from credit risk, such as interest rate movements and the supply of bonds. While liquidity scarcity can affect CDS spreads prices much like actual interest rates, we show below how to control for liquidity in order to account for the effects of macro-financial risk factors on CDSs.

This paper proposes the following real GDP-weighted measure of global sovereign risk:

$$GR_t = \left(\sum_{j=1}^{n} GDP_{j,t} \right)^{-1} \sum_{j=1}^{n} GDP_{j,t} \times CDS_{j,t}. \tag{1}$$

We thus give a greater weight in our global sovereign risk measure to more economically important countries. The idea is that larger countries create more global interdependences and therefore have a higher potential to distress more countries. We work with a sample of n=53 countries, covering all continents. Table 1 shows all the countries in our sample. We work with daily CDS data, while the GDP weights are updated on a quarterly basis.

Figure 1 plots our measure of time-varying global sovereign risk. Our measure exhibits two clear and distinct peaks: The beginning of 2009, coinciding with the aftermath of the sub-prime financial crisis in the US, and the end of 2011, coinciding with some of the worst moments of the European sovereign debt crisis. The graph shows that global risk was quite low until the summer of 2007, but it then started to increase. Between the second half of 2009 and the beginning of 2011 it was relatively constant but hovered at clearly higher levels than previously to the crisis. The top panel of Figure 2 shows the analog of Figure 1 but constructing a global measure of equally weighted CDSs across countries. The dynamics are very similar to those of Figure 1, with a correlation above 93%. The lower panel of Figure 2 graphs the equally-weighted implied cross-sectional volatility. It shows that the dispersion of risk across countries follows a very similar pattern than the global risk measure -with a 0.98 correlation-, although dispersion becomes considerably larger when the European sovereign debt crisis broke.

As a comparison, we construct measures of continent sovereign risk, weighting countries by its relative size in the continent GDP. Table 2 shows the correlation matrix of continent sovereign risk and shows high correlations across continents. In particular, Asia sovereign risk is very highly correlated with Africa, North America, South America and Oceania, with values around 90% and higher. Europe is most highly correlated with North America, but at a lower value of 76%, while its correlation with South America is the lowest between any two continents: 31%.

Figure 3 shows the GDP-weighted sovereign risk measures across continents. Much like the correlation matrix, it reveals that sovereign risk across continents is very positively correlated. South America exhibits the highest levels of sovereign risk around the time of the subprime crisis in 2008 and 2009, whereas Europe is more risky at the end of 2011. The implications of this figure are thus especially interesting since the subprime crisis was not originated in Soth America, but in the US. As a result, the exposure variable should be closely watched and studied and this is what we do in this paper.

Within Europe, we also differentiate between euro and non-euro countries in Figure 4. During the initial periods of the financial crisis, the non-euro area experienced higher sovereign risk. However, from the beginning of 2010 onwards, the euro adopters exhibited higher sovereign risk. Thus, there is clearly a structural break in European CDS markets, since at this time the market started to price in risk in the euro area heavily. In the next section we show how countries from around the world are exposed to global sovereign risk.

2.2 A Measure of Exposure to Global Sovereign Risk

The goal of this paper is to identify the macroeconomic and financial factors which expose countries to global sovereign risk. As a result, we need a measure of country exposure to global sovereign risk. To do so, we perform as follows. We first identify the higher realizations of our global sovereign risk measure each quarter (at the 10, 5 or 1% level).[2] Then we select the associated observations of country j sovereign risk for each of these dates. We thus identify the following set of exposure observations:

[2] We define the significance level from the right tail of the distribution. Thus, the exposure at the 10/5/1% level is associated with the 90/95/99% percentiles of the global sovereign distribution, respectively.

$$SCR_{j,t,\alpha} = \{CDS_{j,t,\alpha} \quad | \quad GR_{\forall i \neq j,t,\alpha} \leq GR_{\forall i \neq j,t}\} \quad \alpha = 10, 5, 1\%. \tag{2}$$

This set of realizations therefore reflects the elasticity of country j to global tail risk. With quarterly data, this set includes six, three and one observation(s) at the 10, 5 and 1% significance levels, respectively. Notice that in order to avoid the mechanical effect of one country's risk on itself, we exclude that country from the computation of the global risk measure. Finally, by averaging these observations of country sovereign risk over the quarter, we have a measure of exposure to global risk:

$$SCRE_{j,t,\alpha} = K^{-1} \sum_{m=1}^{K} SCR_{m,j,t,\alpha}. \tag{3}$$

Thus $SCRE_{j,t,\alpha}$ (Sovereign Country Risk Exposure) measures the average quarterly realizations of the country sovereign CDS when global risk is at a specified risk level α. It therefore constitutes a measure of exposure to global tail risk.

As an illustration, Figure 5 plots the dynamics of the $SCRE$ index at the 1% level (alternative significance levels yield the same qualitative results) in 8 countries of our sample coming from the 6 different continents. The implied dynamics reveal several interesting facts. First, there is wide divergence in $SCRE$ across countries. Second, the fourth quarter of 2008 is the period where these countries were most exposed to global risk, coinciding with the aftermath of the Lehman Brothers collapse. Third, both Asian and South American countries were most affected by this event, followed by African countries. Fourth, France, a key European country was the least affected by the 2008 crisis but ended up being the third most exposed to global risk by the end of the sample, coinciding with the European sovereign debt crisis.

Figure 6 plots the exposure variables by continents at the 1% level. This figure confirms previous findings, with South America (especially), Asia and Africa most exposed to the 2008 crisis, while Europe becoming more and more exposed as the European sovereign debt crisis kicked in. Table 3 shows the correlations across these continent-exposure variables. The highest correlations are among Europe, North America, Asia and Oceania, whereas the lowest involve Africa and South America.

3 Data and Econometric Approach

Our dataset spans the period from the first quarter of 2006 to the last quarter of 2011. The goal of our study is to find the predictors of the $SCRE$ (sovereign exposure) variable. If the behavior of a given macro variable significantly contributes to this exposure, then the government should come up with policies aimed at improving its dynamics. Conversely, if specific policies prevent this exposure then policy makers should definitely promote them. As a result, important policy implications can potentially be drawn from the subsequent findings.

Our dataset includes data from countries of all continents. Data were downloaded from Datastream. In our paper we focus on the explanatory power of macro-financial factors on the exposure of countries to global sovereign risk. Thus, we match CDS data with macro-financial data for all countries. We ended up with data for 53 countries with a relatively large sample (beginning of 2006 to end of 2011). As mentioned above, Table 1 shows our list of countries. In some countries, CDS markets did not exist during our data-span; in these instances, we drop those observations from the regression analysis. Results are unaffected if zero values are set instead.

In terms of macro variables, we control for output growth and the inflation rate. In principle, we would expect that countries with higher growth rates would have lower exposure to global risk, given their ability to generate income and therefore tax revenues. In contrast, higher inflation rates can signal less productivity and can have the opposite effects. We also include the sovereign 3-month interest rate as an indicator of the short-term government borrowing price and the difference between the Taylor-implied interest rate and the 3-month rate. This latter variable captures how loose/strict monetary policy is or has been in the past. As emphasized by the literature, countries with loose monetary policy can also experience over-lending and bubbles (Maddaloni and Peydró (2011)). The credit-to-GDP variable is also included in the benchmark specification as a measure of financial stability. In terms of fiscal variables, we use both stock and flow variables: The debt-to-GDP and fiscal deficit-to-GDP ratios, respectively. We also include the external debt to GDP ratio, the trade (exports plus imports) to GDP ratio and the US TED spread -difference between the 3-month unsecured inter-bank interest rate and the 3-month Treasury bill rate-, as a proxy of liquidity conditions in global markets. Finally, we also perform robustness exercises with consensus forecasts of fiscal deficits, inflation and GDP, with financial variables (corporate yield spreads, term premium, equity premium and the VIX volatility index), and with alternative debt threshold levels and Eurozone interactions, as we show below.

Table 4 shows the table with unconditional correlations among the benchmark variables. The table first shows that the correlation among the exposure variables at the different significance level is really high, above 99%. This correlation lowers to 80% with respect to the mean/median CDS. GDP growth is negatively correlated with the exposure variables, while inflation is clearly positively correlated. Higher interest rates imply more exposure to the global debt crisis, while a looser monetary policy hardly displays any correlation. Higher government debt-to-GDP and deficit-to-GDP ratios imply more global exposure. Thus, in agreement with macroeconomic intuition, investors perceive countries with a higher fiscal burden as more risky. More open economies (with a higher exports plus imports over GDP ratio) are unconditionally less exposed to the global sovereign debt crisis. While a higher TED spread (lower liquidity) implies more exposure, the opposite is the case for the credit-to-GDP ratio. Finally note that while the correlations between exposure variables and macro variables are similar to those between mean/median CDSs and macro variables, the values are usually higher for the exposure variables. Additionally, the correlation with fiscal deficit is significant for exposure but not for mean/median CDSs.

The goal of the present paper is to explain the country exposure to global tail sovereign risk in terms of macro-financial fundamentals. In order to uncover potentially significant relations and derive the associated policy implications, we work in the following panel data setting with country fixed effects:

$$SCRE_{j,t}(\alpha) = \gamma_j(\alpha) + \beta'(\alpha) Z_{j,t} + \epsilon_{j,t}, \tag{4}$$

where $\gamma_j(\alpha)$ is a country specific fixed effect for a given significance level α, controlling for unobserved heterogeneous country effects. $Z_{j,t}$ is the set of macro variables for country j, which act as predictors of exposure to financial risk, and $\epsilon_{j,t}$ is a random term with mean zero. In order to gauge the robustness of our results, we work with three different significance levels for the exposure variable ($SCRE_{i,t}(\alpha)$): $\alpha = 10\%$, 5% and 1%. In the next section we report the results, a series of robustness exercises and the associated policy implications.

4 Results

We organize our results section as follows. First, we show the benchmark results with our fixed effects panel regressions for the different significance levels in our exposure variable and the CDS mean/median spreads. In this way, we try to uncover differences in terms of pricing: Do markets price CDS values, exposure or both? Second, we refine our results based on alternative debt-to-GDP thresholds and Euro-area dummies. Third, we perform a set of robustness analysis to determine whether our results continue to hold under different assumptions in our sample. In particular, we control for expectations of macro variables, the micro-structure of the CDS market (observed v/s derived prices), the inclusion of financial variables, and the exclusion of specific countries which may bias our results.

4.1 Baseline Results

The first three columns of Table 5 show the parameter estimates of our panel regressions for our exposure variable and for three different significance levels (10, 5 and 1% in columns (1), (2) and (3), respectively). We use robust double-cluster (country and quarter) standard errors. Results are similar across significance levels, with similar goodness of fit. We find the following statistically significant effects: countries with lower GDP growth, higher interest rates and a higher debt-to-GDP ratio are significantly more exposed to global sovereign risk. These results overall highlight the importance of high productivity as well as sound fiscal policy and capture the main message of the paper: Good macro policies act as insulators of global sovereign debt stress.

The last two columns ((4) and (5), respectively) of Table 5 show the results with the mean and median of the CDS values over the quarter as left-hand side variables, respectively. While results are similar to those of the exposure variables in terms of coefficient signs, two key differences emerge. First, the size of the exposure regression coefficients is substantially higher (sometimes beyond 100%) than in mean/median CDS regressions. Thus, the macro prices of risk are much higher in turbulent than normal times. Second, the fit of the model is significantly better in the exposure regressions, as the R^2 drop to 45% in the mean/median CDS regressions from 50%. Thus, macro risks are statistically more important in explaining sovereign risk in times of distress.

The literature on sovereign credit pricing has emphasized the importance of liquidity in driving both cross-country and time series variations. Indeed some papers highlight flight-to-liquidity patterns in sovereign debt markets (Beber, Brandt, and Kavajecz (2009)). Notice however that our analysis substantially differs from these studies, as we try to explain exposure to global sovereign turmoil. In Table 5 -and subsequent tables- we control for the US TED spread (the difference between the 3-month interbank rate and the 3-month Treasury Bill rate), as a proxy of the ease of credit in a key financial market reflecting global liquidity conditions.[3] Results indeed show liquidity scarcity drives higher CDS values, especially in times of global distress.

4.2 Predicting Sovereign Risk at Alternative Forecast Horizons

In our baseline regressions we have regressed our sovereign risk variables on contemporaneous macro-financial variables. But, how do current variables predict future sovereign risk variables? This is an important question with potentially key policy implications because if this is the case, policy makers would have time to prevent forthcoming problems of exposure in sovereign debt markets.

[3]The TED spread has also been used by Aizenman, Hutchison, and Jinjarak (2013) as a proxy for liquidity in global markets.

Figure 7 first assesses the predictive power of forecasting regressions compared with contemporaneous regressions comparing the implied R^2s. The figure shows that the predictive power decreases monotonically with the forecasting horizon but is still present at several forecast horizons. Interestingly, the R^2's of the sovereign tail risk regressions at the 1% significance level is the highest across forecast horizons. Sovereign tail regressions at the 1% level always contain higher predictive content than regressions with mean (median) CDSs. The difference between exposure and mean (median) R^2s is higher for contemporaneous regressions and becomes lower as the forecasting horizon lengthens. Thus, while regressions with mean/median CDSs display similar predictive power across forecast horizons, this is not the case for sovereign tail regressions, where this predictive power clearly becomes lower as a function of the forecast horizon. This implies that investors closely watch macroeconomic fundamental, policies and outlooks in distress scenarios.

Figures 8 through 10 show the t-statistics associated with the coefficients across predictive regressions and forecast horizons. In this way, we can understand where the predictive power is coming from and when it is increasing or decreasing. It is almost always the case that the these regressors exhibit more predictive power in the tail-regressions. It is usually the case that as the forecast horizon lengthens, the coefficients lose statistical significance. The TED liquidity spread (Figure 8) exhibits highest statistical significance and has predictive content in all regressions for all forecast horizons. In the case of GDP growth and interest rates (Figure 8), the predictive power exists up to the three-quarter horizon, while for the debt-to-GDP ratio (Figure 9), it is up to one-quarter in the tail regressions. For inflation (Figure 8), there is only statistical significance at the 10% level for contemporaneous tail regressions. Interestingly, higher external debt and lower trade (both as a ratio over GDP) imply higher exposure one year later.

An interesting case in terms of horizon-predictability is that of the financial stability variables: the monetary policy stance variable (Taylor implied minus actual interest rate) and the credit-to-GDP ratio (Figure 10). When the coefficient on the first variable is positive, it means that monetary policy is too loose under the Taylor standard. Excessively low interest rates can give rise to excessive lending. Additionally, less monetary space is left for subsequent interest rate decreases (?). In turn, a higher credit-to-GDP ratio can bring about overlending and a subsequent financial crunch. Interestingly, Figure 10 exhibits a hump-shape for both variables. While they do not have contemporaneously significant predictive power, they are forward looking indicators of sovereign stress, especially with three-quarters forward. As a result, too loose a monetary policy stance can yield a higher risk exposure several quarters ahead. Monetary policy implications are straightforward: First, adjust the interest rate following inflation and output targets. Second, prevent credit bubbles.

4.3 Debt Threshold Levels

One of the most important variables discussed in policy and academic circles is the level of debt over GDP and its relation with the capacity to grow. Indeed, Reinhart and Rogoff (2010) ignited an important debate by pointing at a 90% debt over GDP threshold level -via descriptive analysis- over which GDP growth levels resent. However, in a recent paper, Herndon, Ash, and Pollin (2013) have challenged their results. Our analysis already showed significant predictive power of debt-to-GDP on exposure. We can further shed some additional light on the issue but from a completely different perspective. We can check whether exposure of countries to global sovereign risk is affected by alternative debt-to-GDP thresholds. We first run regressions with the 90% debt-to-GDP level as a dummy.

Table 6 shows these results for the alternative exposure confidence levels and the mean (median) CDS spreads. The best fit is obtained for the 1% confidence level exposure regressions. The sensitivity of CDSs to debt-to-GDP is clearly higher for high debt-to-GDP countries, especially in sovereign-tail regressions. Across the board, remaining results are similar to the benchmark case. Thus, exposure of countries with higher levels of government debt are more sensitive to debt dynamics.

We further investigate the debt non-linearities and endogenously estimate the threshold themselves. We consider the possibility that the effect of debt changes in country exposure may non-linearly depend on the level of debt over GDP. Thresholds have been estimated endogenously from data, as in the threshold models literature, among others, by Tong (1983), Tong (1990), Chan (1993), Hansen (1999), Hansen (2000) and Caner and Hansen (2004). The two thresholds can be inferred similarly using sequential estimation as in the change-point literature; see Hansen (1999) for details. Our experiment shows that the best fitting model includes two thresholds, which are 51.32 and 117.15%. The results in Table 7 first show that the model fit is better under this non-linear effect of debt on exposure with an increase in R^2s ranging at about 3 percentage points with respect to the benchmark case.[4] Importantly, the marginal contribution of debt-to-GDP to country sovereign exposure is highest for the highest level of debt-to-GDP.

We further examined the importance of thresholds and interact them with the Eurozone dummy in order to assess the contribution of the Eurozone sovereign debt crisis in our setting. While we do not report these results, these interactions improved the empirical model fit. Essentially, debt-to-GDP remains economically significant across debt levels and Eurozone/non-Eurozone countries. Interestingly, the effect of debt on exposure

[4]In Table 7, low debt-GDP is associated with countries with less than 51.32% Debt-to-GDP, int debt-GDP is for countries between 51.32 and 117.15% Debt-to-GDP, while high debt-GDP is for countries above 117.15% Debt-to-GDP.

is highest for Eurozone countries with high and intermediate debt levels. However, in countries with a low level of debt, the marginal effect of debt on exposure is higher for non-Eurozone countries.

4.4 Robustness Exercises

Forward-looking variables are important for investors, as they can signal the capacity to repay by countries and thus can be priced in CDS markets. In short, while some countries may have good/poor current fundamentals, prospects could worsen/improve their outlook. To control for this dimension, we include consensus expectations of GDP growth and inflation in our regressions, as shown in Table 8. Interestingly, GDP growth expectations matter beyond growth itself and have a substantially higher impact on pricing than growth. In turn, higher inflation expectations also increase significantly the mean (median) CDS spreads.[5]

During our sample period, some countries have been key originators of global risk. In particular, starting in 2010, the peripheral countries (Portugal, Italy, Ireland, Greece, Spain) were instrumental to increase European and global risk. We carefully designed our methodology in the construction of the global measure to exclude mechanical effects from local to global credit risk. Nevertheless, it could be argued that the home country influences our global measure indirectly, through contagion to other countries. To control for this potential effect and as a robustness analysis, we drop these countries from our estimation, but not from the computation of the global sovereign risk measure.

Table 9 excludes the five peripheral countries in the regression analysis. Three main findings are worth highlighting. First, dropping these countries result in a clear improve-

[5]We also ran regressions with expectations of fiscal deficits, but they were never significant nor changed the above results.

ment in the fit of the model, with much higher R^2s, sometimes increasing to 60%. This is probably due to the fact that we removed some of the countries with higher exposure and thus more difficult to fit (see also Aizenman, Hutchison, and Jinjarak (2013)). Second, it is still the case that our exposure regressions imply a substantially better fit than regressions with CDS values. Third, most of the previous results still hold under these specifications, with one exception: Interestingly, when dropping all peripherals, fiscal deficit significantly increases exposure to global tail risk.

In our last reported robustness exercise, we control for the US financial variables included in Longstaff, Pan, Pedersen, and Singleton (2011), such as the corporate yield spread (BBB minus AAA bond rates), the term premium on government bonds (with the Cochrane and Piazzesi (2005) measure) and the equity premium (changes in the price-earnings ratio for the S&P 500). We also control for market volatility using the average of the VIX index over the month. We measured very high correlations between the TED spread and three of these variables: the corporate yield spread, the term premium, and the VIX index (ranging from 56 to 72%). In these instances, we control for the orthogonal component of these variables with respect to the TED spread in order to separate liquidity from the information in these variables. Table 10 shows the results of this exercise. All the previous results in the paper are preserved when controlling for all these variables. Out of these four variables, only the VIX market volatility significantly influences CDS spreads.

We performed several other robustness exercises. We experimented with meaningful interactions among right-hand-side variables, such as deficit and debt over GDP ratios. Having shown the importance of global liquidity, we introduced local inter-bank liquidity spreads instead. We also worked with accumulated deviations of interest rates over Taylor-implied rates. We also controlled for the CDS market micro-structure, distinguishing between observed CDS spreads -at least with three different quotes from at least two members of the consortium-, and derived ones -not fulfilling this requirement- (see Mayordomo, Rodríguez, and na (2012) for a discussion on the topic). Alternatively, we included dummy variables for countries with floating exchange rates or, alternatively, for countries belonging to the European Union, instead of the Eurozone (only euro-adopters). We also employed the net exports ratio over GDP instead of the sum of exports and imports over GDP ratio. In all these instances, the model fit and results were similar and therefore we do not report these results, which are available upon request from the authors.

5 Conclusions, Policy Implications

In this paper we have focused on exposure of countries to global sovereign distress. In short, we wanted to explore one particular direction of international financial interdependence: from global to country risk in sovereign debt CDS markets. CDS prices reflect solvency risk, which are in turn related to country level macro-financial variables. Our battery of regressions shows that good macro fundamentals are indeed key to understand why some countries are more affected by global risk than others. Thus, having good fundamentals is just not something good in itself but happens to be key in order to insulate countries from global turbulence episodes.

Our careful, if straightforward, analysis identified exposure to global sovereign risk. We first constructed a measure of global sovereign risk and then selected the country-sovereign risk observations associated with global distress over each quarter. We also removed the effect of a given country on global sovereign risk in order to avoid mechanical transmission from country sovereign risk. To control for additional sovereign risk interdependences, we further refined our analysis along some dimensions: Exploring non-linearities based on debt-to-GDP levels and countries belonging to the Eurozone, adding forward-looking variables and key financial market variables, removing key countries triggering sovereign crisis in our sample and our model provided a better fit. Across exercises, these regressions basically reinforced the baseline results.

In times of distress money flees problematic countries. This is the main tenet of the "flight to quality" literature (see Calvo (2005)), a point which our paper confirms from a new perspective: Sovereign exposure to global tail risk in CDS markets. While we did not quantify the implied borrowing costs under global tail risk, our results clearly show that poor fundamentals exacerbate credit risk making sovereign debt more expensive to insure.

These results have important policy implications at both the country and the multinational level. At the country level, fiscal, monetary and regulatory authorities should focus on good fundamentals not only to improve the current economic environment, but because these act as an insurance against global turmoil in sovereign debt markets. On the cross-sectoral dimension, given the interplay of risks across the sovereign, banking, and corporate sectors typically revealed in times of stress,[6] easing sovereign risk can also reduce the risk of spillovers to the financial sector and to the broader economy. On the time dimension, our results suggest that building economic buffers matter most in times of global distress. This points at the benefits of a framework for countercyclical macroeconomic policy which takes into account the global business cycle.

Our work also has implications for the work of international financial institutions (IFIs), aimed at preventing global financial crises. IFIs provide strong support for policies

[6] See Gray, Gross, Paredes, and Sydow (2013) for an integrated macroeconomic systemic risk framework that draws on the advantages of forward-looking contingent claims analysis (CCA) risk indicators for the banking systems in each country, forward-looking CCA risk indicators for sovereigns, and a GVAR model to combine the banking, the sovereign, and the macro sphere for 15 European countries and the United States.

aiming at enhancing macro-financial stability. Our results provide support to the early warning exercise conducted by the IMF to strengthen surveillance of cross-sectoral and cross-border spillovers of economic, financial, and fiscal risks. As macro fundamentals grow more stable across countries, the probability of facing crisis-prone scenarios clearly diminishes.

An alternative interesting route of analysis would be to study the contribution of particular countries to the global sovereign crisis.[7] It may be that a country has been especially exposed to the crisis even if it has not contributed to the crisis at all. While disentangling exposure and contribution in sovereign debt markets remains a challenge from both conceptual and technical viewpoints, it definitely deserves further research.

[7] Our exposure approach can be seen as complementary to the contribution approach, also present in the systemic risk literature, and developed in Adrian and Brunnermeier (2011) and López-Espinosa, Moreno, Rubia, and Valderrama (2012).

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Table 1: **List of countries in the sample**

Africa	Asia	America	Europe	Oceania
Egypt	China	Argentina	Austria	Australia
Morocco	Hong-Kong	Brazil	Belgium	New Zealand
South Africa	Indonesia	Canada	Croatia	
	Israel	Chile	Czech Republic	
	Japan	Mexico	Denmark	
	Malaysia	Colombia	Estonia	
	Pakistan	United States	Finland	
	Philippines	Venezuela	France	
	South Korea	Perú	Germany	
	Saudi Arabia		Greece	
	Thailand		Hungary	
	Turkey		Iceland	
			Ireland	
			Italy	
			Lithuania	
			Netherlands	
			Norway	
			Poland	
			Portugal	
			Romania	
			Russia	
			Slovakia	
			Slovenia	
			Spain	
			Sweden	
			Switzerland	
			United Kingdom	

Table 2: **Panel of CDS Correlations Across Continents**

	Europe	N. America	S. America	Africa	Asia	Oceania
Europe	1					
N. America	0.76	1				
S. America	0.31	0.67	1			
Africa	0.58	0.83	0.91	1		
Asia	0.64	0.88	0.90	0.97	1	
Oceania	0.70	0.90	0.78	0.87	0.91	1

This table shows the correlation of the GDP-weighted daily CDS values across continents.

Table 3: **Panel of Exposure Correlations Across Continents**

	Europe	N. America	S. America	Africa	Asia	Oceania
Europe	1					
N. America	0.98	1				
S. America	0.78	0.76	1			
Africa	0.56	0.51	0.73	1		
Asia	0.95	0.92	0.78	0.75	1	
Oceania	0.97	0.95	0.66	0.53	0.95	1

This table shows the correlation of the measures of exposure to sovereign debt risk ($SCRE$) across continents at the 1% significance level.

Table 4: **Panel of Correlations of Variables: All Countries**

	SCRE 1%	SCRE 5%	SCRE 10%	CDS-MEAN	CDS-MEDIAN
SCRE 1%	1				
SCRE 5%	0.99***	1			
SCRE 10%	0.99***	0.99***	1		
CDS-MEAN	0.80***	0.80***	0.80***	1	
CDS-MEDIAN	0.79***	0.78***	0.79***	0.99***	1
growth	-0.14***	-0.14***	-0.14***	-0.17***	-0.16***
inflation	0.44***	0.43***	0.43***	0.32***	0.32***
int-rate	0.38***	0.37***	0.37***	0.24***	0.24***
MP stance	0.01	0.01	0.01	-0.01	-0.01
debt-GDP	0.12***	0.13***	0.13***	0.08***	0.08***
def-GDP	0.17***	0.16***	0.17***	0.03	0.03
extdebt-GDP	-0.02	-0.01	-0.01	0.02	0.02
trade-GDP	-0.13***	-0.13***	-0.13***	-0.09***	-0.09***
TED	0.13***	0.12***	0.12***	0.10***	0.11***
Credit-GDP	-0.20***	-0.19***	-0.19***	-0.10***	-0.11***

This table shows the correlation of our set of quarterly variables (from 2006:1Q to 2011:4Q) for our panel of 53 countries. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level.

Table 5: **Benchmark Parameter Estimates**

	(1)	(2)	(3)	(4)	(5)
growth	-25.95***	-27.25***	-26.55***	-18.23***	-17.52***
inflation	20.79	20.94	21.07	12.67	11.93
int-rate	52.79**	54.74***	53.02***	33.49**	32.05**
MP stance	12.88	13.96	13.22	4.71	4.48
debt-GDP	19.32**	19.96**	19.52**	13.76*	13.06**
def-GDP	-3.34	-3.41	-2.89	-0.65	-0.01
extdebt-GDP	-1.00	-1.05	-1.01	-0.73	-0.66
trade-GDP	-1.72	- 1.78	-1.81	-0.63	-0.63
TED	65.14***	68.67***	72.82***	52.86***	57.70***
Credit-GDP	2.35	2.43	2.35	1.43	1.39
N	1178	1178	1178	1178	1178
R^2	0.50	0.50	0.51	0.45	0.45

This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects for our panel of 53 countries (see Table 1). Results in columns (1), (2) and (3) are those associated with exposure at the 10, 5 and 1% confidence level, respectively. (4) and (5) are results with the mean and median of the CDS values. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and quarter) standard errors are employed.

Table 6: **Parameter Estimates: Threshold on 90% of Debt-To-GDP**

	(1)	(2)	(3)	(4)	(5)
growth	-26.43***	-27.74***	-27.05***	-17.90***	-17.21***
inflation	19.85	19.97	20.09	11.23	10.58
int-rate	52.21***	54.14***	52.41***	31.94**	30.51**
MP stance	12.18	13.24	12.49	4.07	3.85
low debt-GDP	16.33*	16.90*	16.43**	12.38*	11.64*
high debt-GDP	19.16**	19.80**	19.36**	14.20*	13.47**
def-GDP	-3.26	-3.33	-2.81	-1.45	-0.77
extdebt-GDP	-1.03	-1.08	-1.04	-0.67	-0.60
trade-GDP	-1.62	-1.68	-1.71	-1.05	-1.02
TED	64.07***	67.56***	71.70***	58.79***	59.48***
Credit-GDP	2.30**	3.09**	3.02**	2.18*	2.11*
N	1178	1178	1178	1178	1178
R^2	0.50	0.50	0.52	0.46	0.46

This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects. The debt/GDP threshold applied is 90%. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and quarter) standard errors are employed.

Table 7: **Parameter Estimates: Endogenous Thresholds**

	(1)	(2)	(3)	(4)	(5)
growth	-23.85***	-25.08***	-24.41***	-16.84***	-16.16***
inflation	20.52*	20.65*	20.83*	12.39	11.78
int-rate	55.66***	57.72***	55.88***	35.77**	34.10**
MP stance	13.12	14.20	13.46	5.07	4.84
low debt-GDP	21.76***	22.45***	22.09***	15.18**	14.69***
int debt-GDP	17.19***	17.75***	17.43***	11.90**	11.40**
high debt-GDP	22.12***	22.87***	22.35***	16.23***	15.43***
def-GDP	-1.82	-1.84	-1.38	0.71	1.27
extdebt-GDP	-1.20	-1.26	-1.20	-0.93	-0.84
trade-GDP	-0.91	-0.95	-1.01	0.06	0.03
TED	66.71***	70.26***	74.47***	58.91***	59.89***
Credit-GDP	3.22**	3.33**	3.23**	2.21**	2.13**
N	1178	1178	1178	1178	1178
R^2	0.53	0.53	0.55	0.48	0.48

This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects for our panel of countries and considering the endogenous two debt-to-GDP threshold levels (51.32 and 117.15%). Results in columns (1), (2) and (3) are those associated with exposure at the 10, 5 and 1% confidence level, respectively. (4) and (5) are results with the mean and median of the CDS values. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and quarter) standard errors are employed.

Table 8: **Parameter Estimates: Benchmark plus Expectations**

	(1)	(2)	(3)	(4)	(5)
growth	-19.56**	-20.95**	-20.24**	-8.72*	-7.99
inflation	15.43	15.57	21.73*	3.58	2.99
int-rate	56.21***	58.66***	56.57***	31.36*	29.78*
MP stance	9.39	10.77	9.92	-2.45	-2.68
debt-GDP	18.99**	19.69**	19.23**	13.49*	12.72*
def-GDP	-4.70	-4.77	-4.29	-3.32	-2.63
extdebt-GDP	-1.78	-1.83	-1.73	-1.40	-1.29
trade-GDP	-1.00	-1.07	-1.10	-0.00	-0.01
TED	47.30***	50.87***	55.22***	35.92***	39.48***
Credit-GDP	4.89	4.94	4.69	4.22	4.14
E(growth)	-30.10*	-30.96*	-31.34*	-35.92**	-35.68**
E(Inflation)	11.42	10.55	12.04	27.58*	27.68*
N	1134	1134	1134	1134	1134
R^2	0.50	0.50	0.52	0.47	0.47

This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects for our panel of 53 countries (see Table 1). This table adds expectations of growth and inflation as explanatory variables. Results in columns (1), (2) and (3) are those associated with exposure at the 10, 5 and 1% confidence level, respectively. (4) and (5) are results with the mean and median of the CDS values. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and quarter) standard errors are employed.

Table 9: **Parameter Estimates: Without Peripherals**

	(1)	(2)	(3)	(4)	(5)
growth	-25.05***	-26.34***	-25.63***	-16.08***	-15.35***
inflation	17.94	17.92	18.06	9.76	9.13
int-rate	37.65***	39.03***	38.09**	20.37*	19.89*
MP stance	13.85	15.03	13.90	5.69	5.08
debt-GDP	5.58**	5.79**	5.93**	4.08**	4.09**
def-GDP	4.93**	5.13**	5.35**	5.36**	5.72**
extdebt-GDP	-0.10	-0.11	-0.10	0.22	0.26
trade-GDP	-0.43	-0.46	-0.50	-0.40	-0.40
TED	63.88***	67.85***	73.31***	57.15***	58.44***
Credit-GDP	0.09	0.10	0.13	0.58	0.67
N	1058	1058	1058	1058	1058
R^2	0.60	0.60	0.60	0.55	0.54

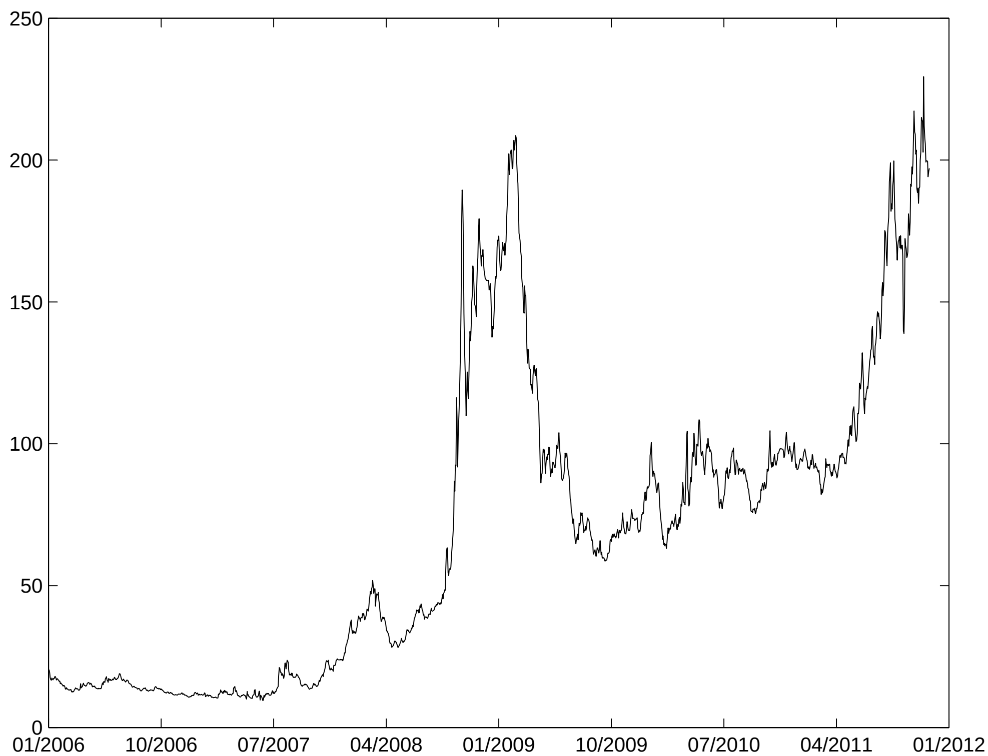
This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects for our panel of 53 countries (see Table 1). Results in columns (1), (2) and (3) are those associated with exposure at the 10, 5 and 1% confidence level, respectively. (4) and (5) are results with the mean and median of the CDS values. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and quarter) standard errors are employed.

Table 10: **Parameter Estimates: Controlling for Financial Variables**

	(1)	(2)	(3)	(4)	(5)
growth	-17.88**	-19.11**	-18.23**	-9.61*	-8.76
inflation	17.56	17.70	17.62	8.08	7.23
int-rate	59.73***	61.73***	60.16***	39.04***	37.81***
MP stance	12.65	13.63	12.90	4.52	4.27
debt-GDP	15.66**	16.21**	15.84**	11.26*	10.58*
def-GDP	-5.04	-5.13	-4.66	-3.35	-2.73
extdebt-GDP	-0.81	-0.85	-0.81	-0.48	-0.41
trade-GDP	-1.54	-1.62	-1.66	-1.10	-1.08
Credit-GDP	1.17	1.23	1.17	0.75	0.69
TED	44.15***	47.17***	51.53***	42.42***	43.07***
EP	-1.75	-1.75	-1.84	-1.28	-1.27
TP	10.18	16.02	9.56	4.65	1.82
CS	0.23	-0.04	-0.80	-3.47	-3.39
VIX	11.40***	11.52***	11.55***	10.80***	10.92***
N	1231	1231	1231	1231	1231
R^2	0.52	0.51	0.53	0.48	0.48

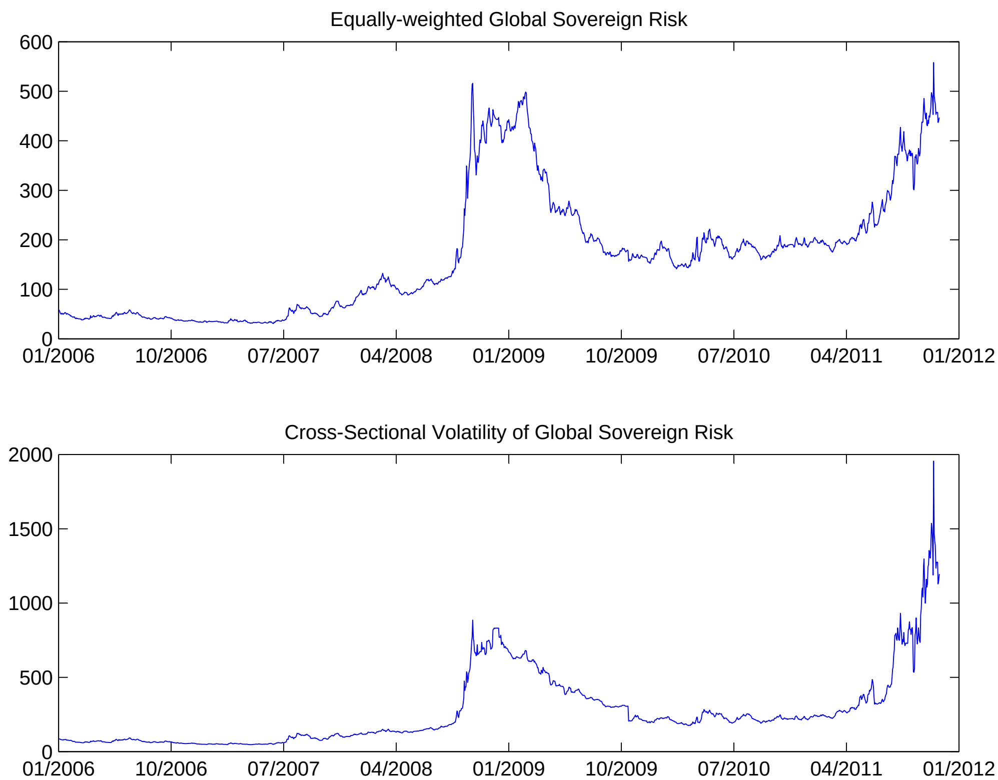
This table shows the estimates of our econometric model (see equation (4) in the text) with quarterly data (from 2006:1Q to 2011:4Q) and country-fixed effects for our panel of 53 countries (see Table 1) controlling for global liquidity (US TED spread), the equity premium (EP), the term premium (TP), the corporate yield spread: BBB minus AAA (CS) and the VIX volatility index. The TP, VIX and CS are the orthogonal components with respect to the TED spread. Results in columns (1), (2) and (3) are those associated with exposure at the 10, 5 and 1% confidence level, respectively. (4) and (5) are results with the mean and median of the CDS values. Three, two and one star(s) imply statistical significance at the 1, 5 and 10% confidence level. Robust double-cluster (country and date) standard errors are employed.

Figure 1: **GDP-Weighted Global Sovereign Risk**



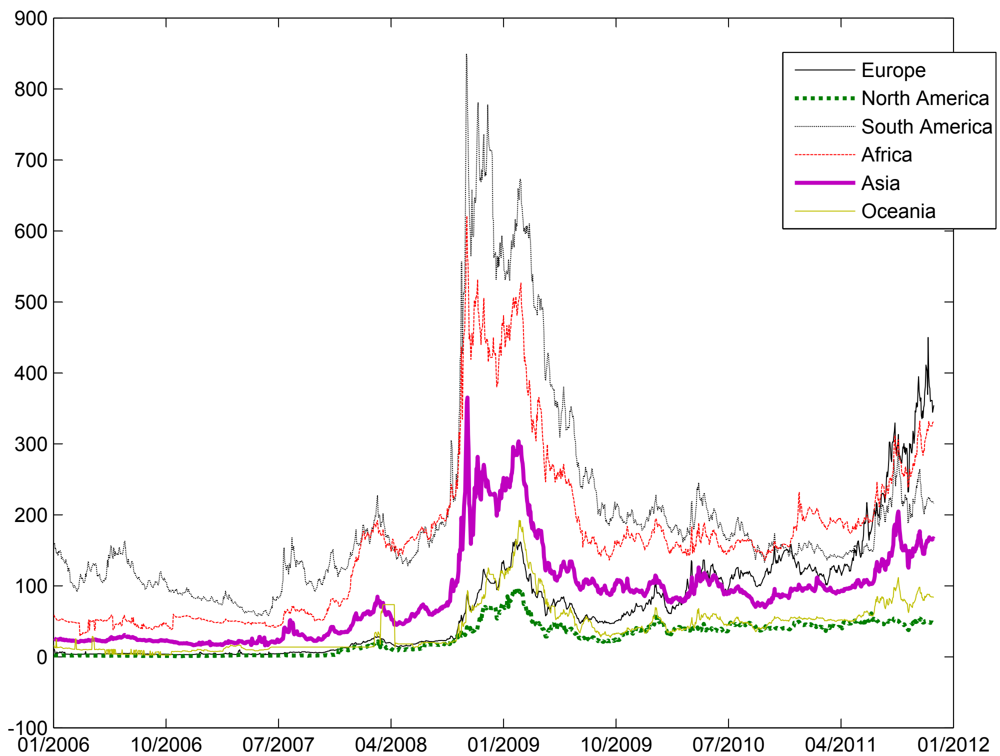
Note: This graph plots the daily series of the GDP-weighted global sovereign risk for our panel of 53 countries since 2006 to 2011.

Figure 2: **Equally-Weighted Global Sovereign Risk**



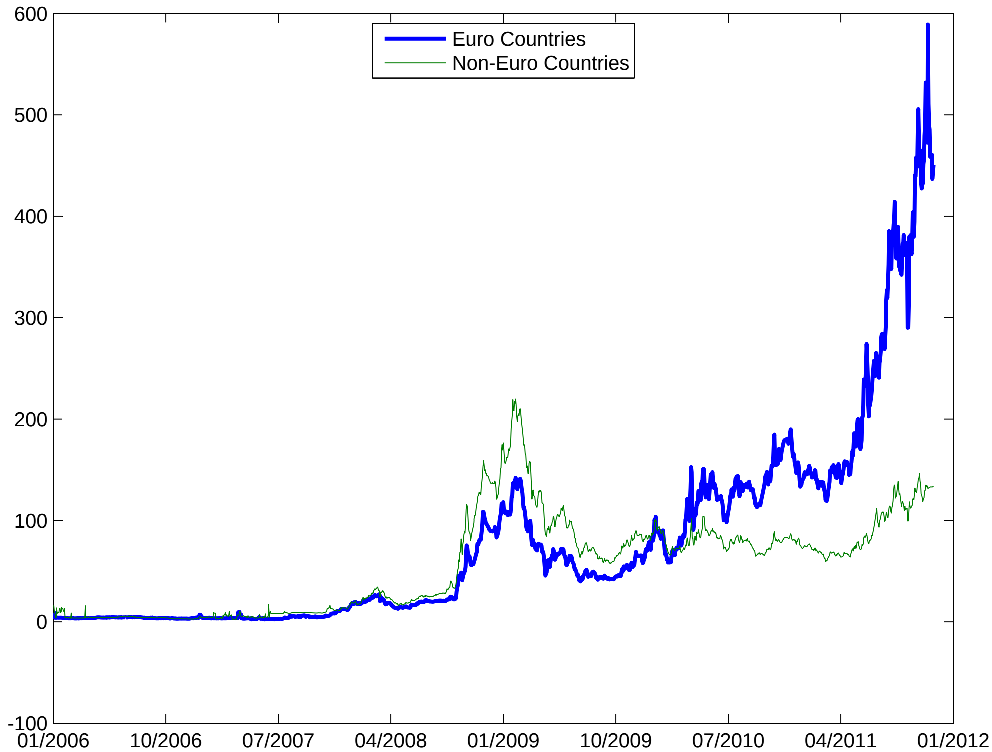
Note: The top panel plots the daily series of the equally-weighted global sovereign risk for our panel of 53 countries since 2006 to 2011, whereas the bottom panel plots the associated series of historical cross-sectional volatility.

Figure 3: **GDP-Weighted Sovereign Risk Across Continents**



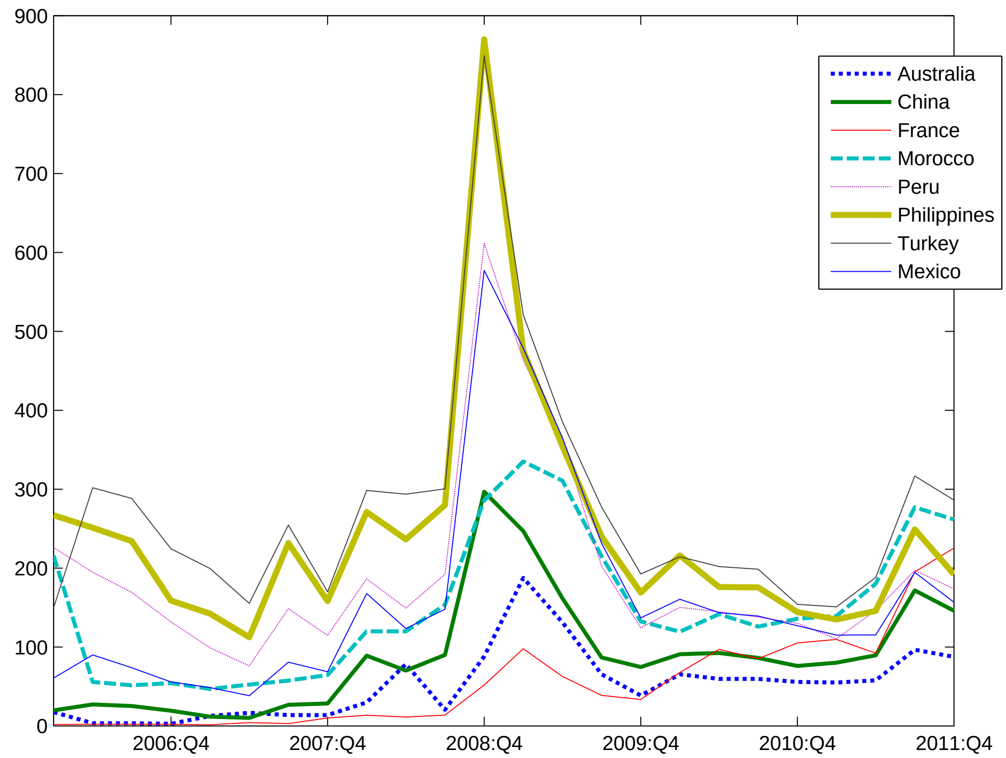
Note: This figure plots the daily series of the GDP-weighted continent sovereign risk since 2006 to 2011.

Figure 4: **GDP-Weighted Sovereign Risk Europe: Euro v/s Non-Euro Countries**



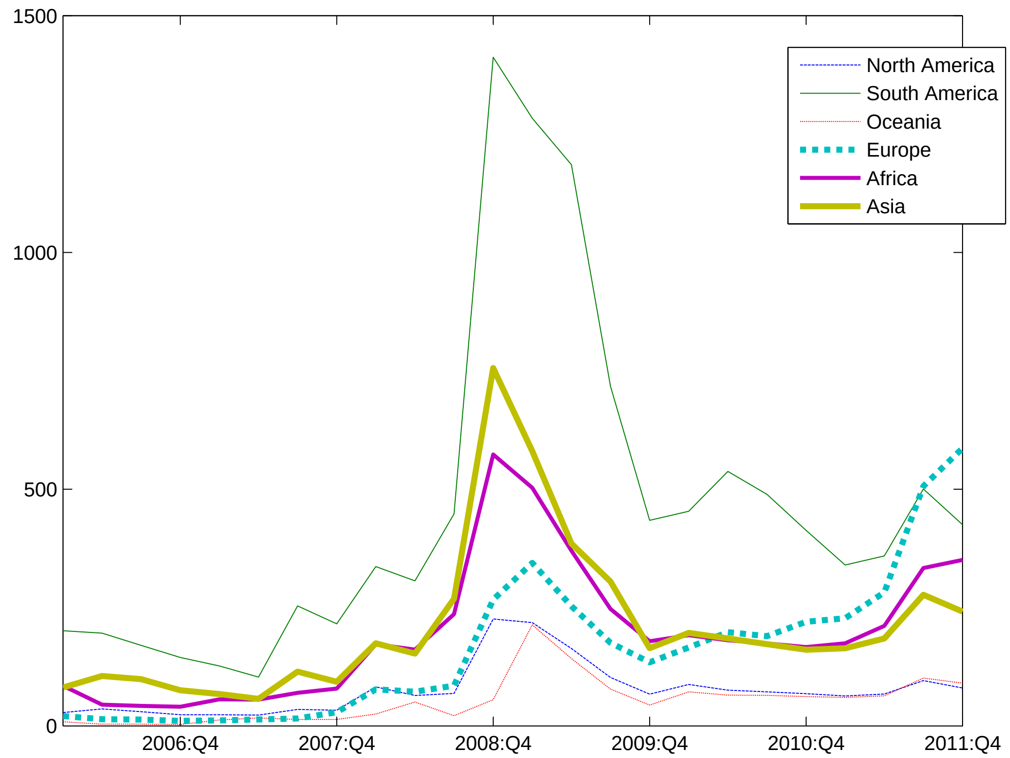
Note: This figure plots the daily series of the GDP-weighted sovereign risk for the euro and non-euro countries of the European continent since 2006 to 2011.

Figure 5: **Exposure to Global Sovereign Risk: Some Countries**



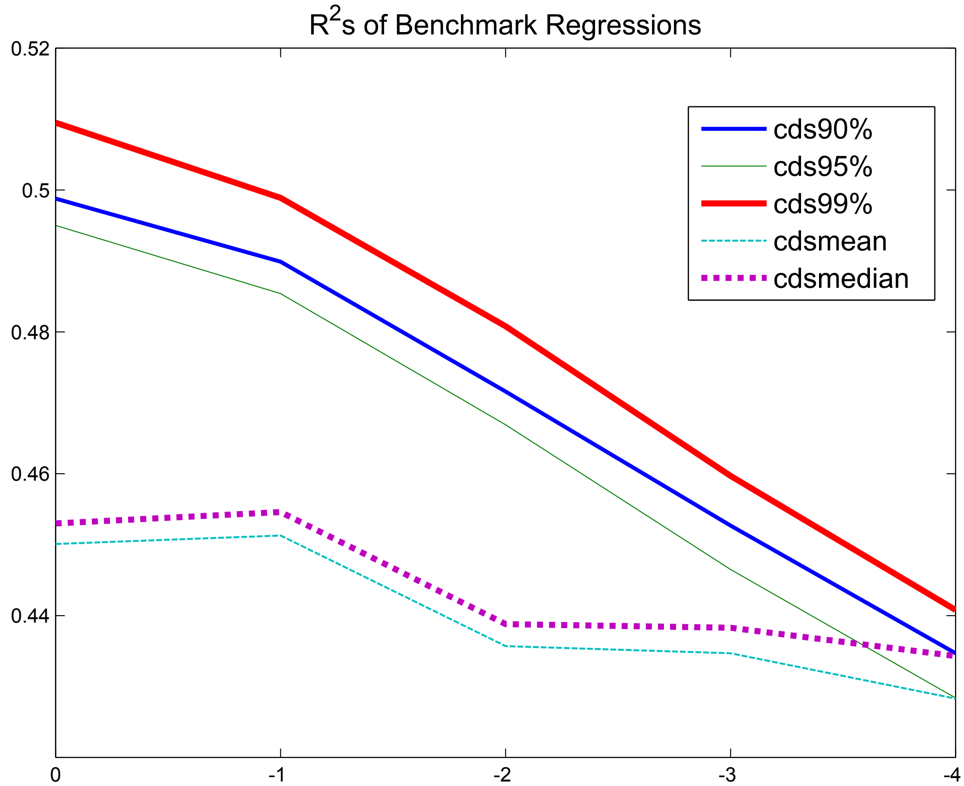
Note: This figure shows the time series of our measure for exposure to global sovereign risk (SCRE) for some countries of the six continents at the 1% significant level.

Figure 6: **Exposure to Global Sovereign Risk by Continents**



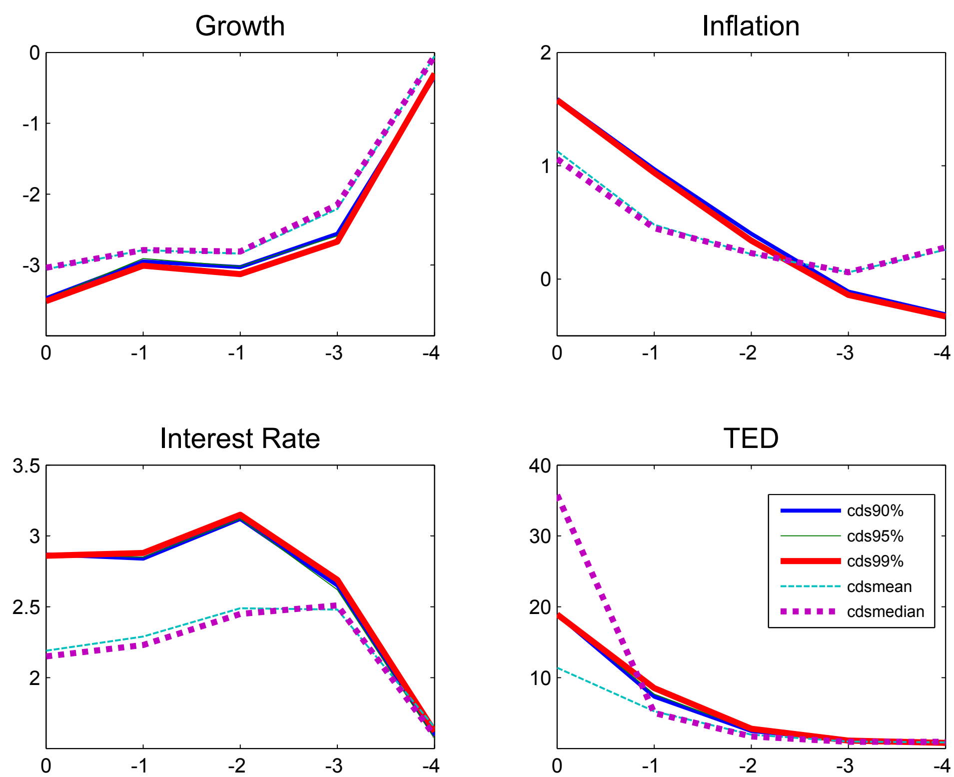
Note: This figure shows the averages of our measure for exposure to global sovereign risk (SCRE) across six continents at the 1% significant level.

Figure 7: **Regressions' Predictive Power and Forecast Horizons**



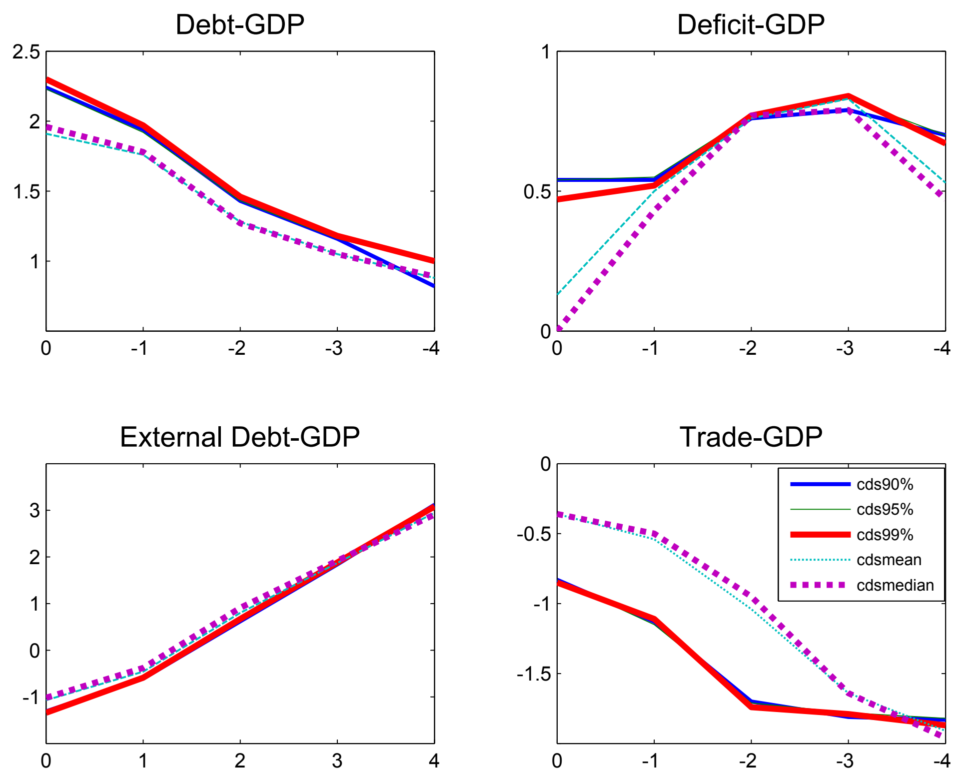
Note: This figure plots the R^2's associated with the three sovereign tail regressions and the CDS mean/median regressions as a function of the forecast horizon in the regressors (0 is contemporaneous regressors, while -k $\quad (k = 1, \ldots, 4)$ are lags in quarters).

Figure 8: **T-Statistics**



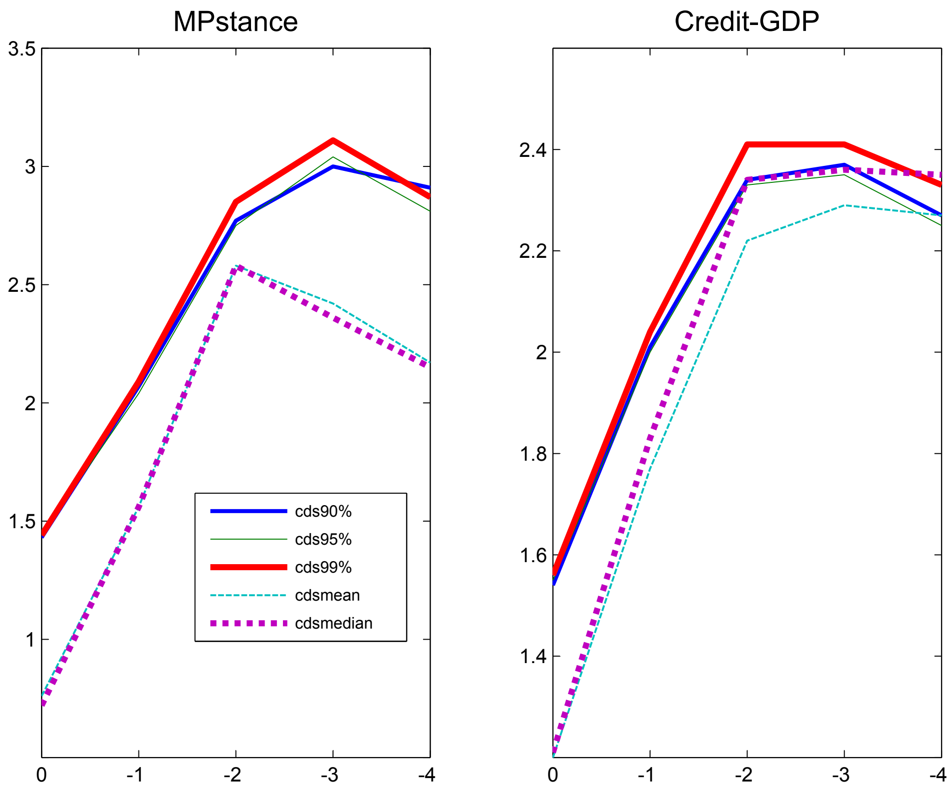
Note: This figure plots the t-statistics associated with the coefficients of the three sovereign tail regressions and the CDS mean/median regressions as a function of the forecast horizon in the regressors (0 is contemporaneous regressors, while -k $(k = 1, \ldots, 4)$ are lags in quarters.

Figure 9: **T-Statistics**



Note: This figure plots the t-statistics associated with the coefficients of the three sovereign tail regressions and the CDS mean/median regressions as a function of the forecast horizon in the regressors (0 is contemporaneous regressors, while -k $\quad (k = 1, \ldots, 4)$ are lags in quarters.

Figure 10: **T-Statistics**



Note: This figure plots the t-statistics associated with the coefficients of the three sovereign tail regressions and the CDS mean/median regressions as a function of the forecast horizon in the regressors (0 is contemporaneous regressors, while -k $(k = 1, \ldots, 4)$ are lags in quarters.