# A Ratings Based Approach to Measuring Sovereign Risk

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## Abstract

We propose a new approach to measuring sovereign default risk. We use sovereign credit ratings and historical default rates provided by credit rating agencies to construct a measure of ratings implied expected loss. We compare our measure of expected loss from sovereign defaults with stand-alone credit ratings and also examine its relationship with credit default swap spreads. We show that our measure is more informative for measuring sovereign risk. We re-examine the fundamental determinants of sovereign risk and find further evidence to support the debt intolerance and original sin explanations for country risk. This study contributes an improved understanding of the value of sovereign credit rating teams in assessing the long-term country risks accompanying emerging market investments.

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## 1. Introduction

How should one measure sovereign risk? In recent years, policy makers and emerging market observers have witnessed a dramatic and steady narrowing of spreads in emerging debt markets. The natural question this poses is whether emerging markets are becoming less risky? Unfortunately, the literature on sovereign spreads has not provided us with the tools to answer this question. In principle, these spreads reflect both sovereign risk and risk premia, and the answer to the question would involve distinguishing between the two concepts. Much of the recent literature has confused these concepts, implicitly assuming that such spreads measure just risk. This misconception in the sovereign debt literature clearly needs to be addressed.

The presumption that spreads measure just risk and not risk premia seems common among recent papers that propose structural models to measure sovereign risk. Gapen *et al* (2005) and Oshiro and Saruwatari (2005), for example, apply the standard Merton model for corporate credit risk by inventing country proxies for balance-sheet leverage and option volatility. Hence, they judge their approach to be a good one because they find their risk indicators to be highly correlated with market spreads. Diaz Weigel and Gemmill (2006) fit a structural model with a Kalman filter to par Brady bond prices to derive a "distance-to-default" measure of sovereign risk. They then

express surprise that country-specific variables account for only 8% of the explained variance of the distance-to-default measure. In both cases, the notion that spreads might contain significant risk premia that are driven by investors' risk aversion is not seriously entertained. Yet the importance of risk premia has been documented by Baek *et al* (2005), who find that their index of risk appetite has a relatively large impact on Brady bond spreads.

In this paper, we propose a measure of sovereign risk that allows us to decompose sovereign spreads into a risk component and a risk premium component. In particular, we exploit information in credit ratings and historical default experiences to estimate expected losses on sovereign debt as our measure of sovereign risk. To a large extent, this proposed measure is a return to more traditional measures of sovereign risk. Eichengreen *et al* (2003), Borio and Packer (2004) and Kim and Wu (2006), for example, use linearly transformed sovereign credit ratings as their measure of sovereign risk. One of our key contributions is to transform the ordinal scale of ratings into a cardinal scale of expected losses. Since this cardinal scale can be expressed in the same units as sovereign spreads, we can directly determine what part of the spread is accounted for by expected loss separately from risk premia. Hence, we present a useful sovereign risk measure that is applicable for a much wider set of emerging markets.

Our proposed measure of sovereign risk also reconciles the traditional literature on country risk with the more recent one based on structural models. The country risk literature has focused largely on certain country-specific fundamentals as explanatory variables in reduced-form equations. Recently, this literature has tended to identify these fundamentals from one of three basic perspectives: debt

intolerance, original sin and currency mismatches. By contrast, the literature on structural models has borrowed from the corporate credit risk literature to introduce notions of asset volatility and default thresholds. This literature is still incomplete and can benefit enormously from the insights of the traditional country risk literature. As Duffie, Pedersen and Singleton (2003, p.122) highlight, “Structural models, which directly capture the default incentives and solvency of the issuer, can be problematic when empirically modeling sovereign debt.” Our measure of country risk provides a common standard for testing both traditional and structural models. Indeed even with the far more developed structural models of corporate credit risk, Leland (2004) argues that expected losses based on ratings remain the standard that the models need to achieve, and here default probabilities predicted by the models still severely underestimate the actual default rates reflected in agency ratings data.

In applying our measure of sovereign risk in this paper, we limit ourselves to assessing the three perspectives of country risk. In advocating the perspective of debt intolerance, Reinhart *et al* (2003) emphasise the importance of a country’s past debt repayment and macroeconomic performance. They find that for emerging markets with a poor history of performance the thresholds for sustaining debt are quite low, roughly 10-15% of GNP. Eichengreen *et al* (2003) define original sin as the inability of a country to borrow in its own currency and argue that it is the critical determinant of country risk. Goldstein and Turner (2004) maintain that currency-mismatch makes those countries whose net worth is more sensitive to currency depreciation more vulnerable in a crisis and thus carry more country risk. Borio and Packer (2004) examine all three perspectives and find varying support for each.

Our study differs from the existing sovereign risk literature in three main aspects. First, we extend the traditional use of an ordinal ratings scale into a mapping of both sovereign and corporate ratings information from Moody's and Standard and Poors (S&P) into a rating implied expected loss measure based on actual sovereign default experiences. Second, contrary to extant studies which attribute the entirety of emerging market spreads to either sovereign risk or the country risk premium, we show how sovereign risk itself is only a small component of spreads, hence leaving a much larger sovereign risk premium as compensation for perceived sovereign risk. Using this conceptual framework we are able to differentiate between the various explanations of country risk by determining expected loss within a fixed effect panel regression that incorporates information in both the cross-sectional and time-series dimensions. We find support for the debt intolerance and original sin hypotheses for country risk. Third, we relate our ratings-based expected loss measure to sovereign credit default swap (CDS) spreads instead of conventional emerging market index and Brady bond yields. Credit derivatives are a rapidly growing part of the sovereign debt market and they are much more liquid than the cash market. They are also freed of tax and other regulatory effects.

The remainder of this paper is structured as follows: Section 2 explains the concept of ratings-implied expected losses as a measure of sovereign risk and Section 3 discusses the data used. Section 4 discusses our empirical findings on sovereign default risk, its determinants and its relationship with sovereign CDS spreads. Finally, Section 5 summarises our conclusions and suggests further work to be done in this research area.

## 2. Measuring sovereign risk as expected loss from sovereign default

Credit ratings are commonly used as a general categorical indicator of country risk and are thus useful for financial decision-making in the face of uncertainty. Ratings are a forward looking measure of the perceived ability and willingness of debt issuers to service their financial obligation. Altman and Rijken (2004) suggest that rating agencies tend to focus on a long-term horizon (in using a "through-the-cycle" rating methodology) and thus aim to respond only to the perceived permanent component of credit-quality changes. As such, many studies readily employ sovereign credit ratings provided by rating agencies or even the published country rating indices (compiled by *Institutional Investor, Euromoney* or *Economist Intelligence Unit*) to capture country-specific fundamentals and/or relative levels of country risk. In the country risk literature, *Institutional Investor* country ratings are featured in several studies as a measure of country risk (see *inter alia* Baek *et al* (2005), Reinhart *et al* (2003) and Ul-Haque *et al* (1996)).

In this cross-country study we rely on information contained in sovereign ratings provided by credit rating agencies. This is because sovereign ratings are superior to *Institutional Investor* ratings for the following reasons[1]: (a) rating agencies explain their criteria and rating methodologies while respondents to the *Institutional Investor* survey do not; (b) rating agencies regularly review their ratings performance against actual default experience whilst the *Institutional Investor* survey was only conducted once a year prior to 2004 and twice a year since; and (c) responses to the *Institutional Investor* survey are

[1] See Borio and Packer (2004) for a more detailed discussion.

anonymous while rating agencies stake their business on the accuracy of their ratings. In addition, Micu, Remolona and Wooldridge (2006) demonstrate that corporate credit default swap spreads react to announcements by credit rating agencies, showing investors regard such announcements to be informative - something that has not been shown for *Institutional Investor* ratings. In a similar spirit, Gande and Parsely (2005) find using S&P sovereign credit ratings and sovereign credit spreads that a ratings change also has spillover effects into other countries.

Following Borio and Packer (2004) and Sy (2002), we use long-term foreign currency ratings information from *both* Moody's and S&P, rather than from just one or the other.[2] Micu, Remolona and Wooldridge (2006) also find that two ratings are better than one: credit spreads react to a rating change by one agency even when it is preceded by a similar rating change by another agency. Moreover, it is fairly common at any given time for rating agencies not to agree, resulting in split ratings. In these situations, Cantor, Packer and Cole (1997) find that bond spreads tend to be priced at the average of the ratings. Our focus on long-term foreign currency sovereign debt isolates sovereign default risk from confounding factors like inflation, foreign exchange and liquidity risks that are inherently linked to local currency denominated debt.

Using information from Moodys and S&P, we compute our measure of sovereign risk in a form that that can be directly compared to a

[2] In their analysis of original sin, Eichengreen *et al* (2003) rely on a single rating. We do not take into account of other credit rating agencies, including Fitch Ratings because their coverage is less comprehensive and hence, their historical default rates are less reliable.

sovereign spread, which itself is a forward-looking measure expressed as an annual yield differential. To do this, we introduce the idea of a *ratings-implied expected loss* (RIEL) measure, which maps sovereign ratings onto annualised expected losses from sovereign default. To construct RIEL, we start with country default probabilities based on historical default experiences. Both Moody's and S&P publish average cumulative default rates by rating for various investment horizons and they do so separately for corporate debt and sovereign debt. We focus on 5-year cumulative default rates for country $i$ ($PD_i$) and annualize them into $\delta_i$ by assuming a constant default intensity during the 5-year horizon.[3]

$$1-PD_i = Ae^{-5\times\delta_i}$$

$$\Rightarrow \delta_i = -\frac{\ln(1-PD_i)}{5} \qquad (1)$$

Hence, we have a forward measure of default probability at the one-year horizon implied by ratings ($\delta_i$), and this itself can be taken to be a measure of sovereign risk (akin to structural based studies). However, we take a further step and scale default probabilities by the loss given default (LGD).[4] This gives us a measure of expected loss from default ($EL$) as implied by credit ratings from each ratings agency. We arithmetically average the expected losses implied by Moody's and S&P and call this the RSW (Remolona, Scatigna and Wu)-RIEL measure. RIEL for period $t$ is then measured as the derived annualized expected loss from default - that is, the default probability

[3] See the discussion of default intensity in Duffie and Singleton (2003), pp 59-63.

[4] We use an estimate of loss given default for sovereign issuers based on their historical average recovery rates. Sturzenegger and Zettelmeyer (2005) and Moody's (2006) provide estimates of recovery rates given default but these recovery rates vary widely from one default to another and the methods for estimating them also differ.

for each credit rating multiplied by loss given default based on average recovery rates (RR). We compute the RIEL for each month based on the country's credit ratings at the end of that month. In a scaled form, equation (1) can be represented as shown in equation (2).

$$RIEL_{i,t} = -\frac{\ln(1-EL_{i,t})}{5}$$

$$= -\frac{\ln(1-PD_{i,t} \times (\overline{LGD}))}{5}$$

$$= -\frac{\ln(1-PD_{i,t} \times (1-\overline{RR}))}{5} \qquad (2)$$

One problem with using just the historical default experience of sovereign bond issuers is the small number of actual defaults, particularly for higher rated sovereigns. For example, while Moody's rates over 100 sovereigns, only 11 have defaulted since 1983 and none rated single-A nor higher has defaulted. It is a natural question then whether market participants would rely on such a limited sample to form their expectations of loss from sovereign default - would they not also look at the historical default experience of corporate bond issuers within the country? As Duffie, Pedersen and Singleton (2003) point out, contrary to a corporate default, a sovereign default is largely a political decision, albeit influenced by macroeconomic factors. Rather than defaulting outright, a sovereign issuer usually pursues a restructuring or renegotiation of its debt. In doing so, sovereigns effectively trade off the cost of making debt repayments against the costs of reputation effects, asset seizure, increased regulatory monitoring, reduced access to external finance and international trade disruptions. However, rating agencies appear to take all these factors into account and attempt to rate sovereigns and

corporates in a consistent manner, so that a given rating represents the same assessment of risk regardless of the nature of the issuer.[5]

Hence, to guard against small sample bias, we calculate RIEL in two ways: using the sovereign default experience and using the corporate default experience. The data on corporate defaults have the advantage that they are available for each rating notch, while the data on sovereign defaults are available only by letter grade. In each case, we use the average of default rates from Moody's and S&P. For the recovery rate, we apply the average for the 11 sovereign defaults since 1983 based on the 30-day post default price of the debt. This average recovery rate is 55%, implying a loss given default of 45%. This is consistent with the estimated investor losses from sovereign debt restructurings in Sturzenegger and Zettlemeyer (2005).

## 3. Data used

Our sample comprises 27 small and/or emerging countries from around the world. There are 10 Latin American, 7 European, 6 Asian and 4 Middle Eastern and African (MEA) countries. Our sample period is from January 2002 to June 2006 for which sovereign CDS market data are available for all sample countries.

We rely on sovereign foreign currency credit ratings history for each country and five-year issuer-weighted cumulative average default rates by ratings for sovereign and corporate issuers from *Moody's*

[5] Moody's is supposed to assign a rating based on an assessment of *expected loss* while Standard and Poor's does so on an assessment of *default probability*. This does not make a difference to our analysis since we apply the same recovery rate to the implied default probability for the ratings of either agency.

*Investor Services* and *Standard and Poors* (S&P). Furthermore, we also use historical country credit ratings published by *Institutional Investor* from March 2002-2005.

In addition, we use 5 year sovereign credit default swap (CDS) spreads sourced from the comprehensive *Markit* database. This database contains monthly quotes on CDS market spreads for 70 developed and emerging market sovereign obligors worldwide. As the sovereign CDS market enables the exchange of sovereign risk between participating financial institutions, *Markit* compiles quotes from a large sample of financial institutions and aggregates them into a composite spread that is reasonably continuous. Another advantage is that these contracts do not suffer from declining maturities like conventional debt instruments. Moreover, we use only the five-year spreads because these contracts are the most liquid and account for a large proportion of the sovereign CDS market.

The extensive list of country risk fundamental explanatory variables along with data sources used in this study is shown in Appendix A. These variables are all available at the annual frequency from 2002 to 2005. These standard fundamental variables are selected to represent the main views on country risk expressed in the current literature. They cover macroeconomic, debt burden and history, governance, country-size and currency related variables.

## 4. Empirical results

In analyzing our results, we separate our findings into sub-sections on our ratings implied expected loss (RIEL) measure and then we compare and discuss the determinants of our RIEL measure with alternative country risk proxies. We also examine the relationship

between RIEL and sovereign CDS spreads across countries and across credit ratings.

### 4.1 The size of expected losses

Table 1 reports our estimates of RSW-RIEL for each sample country and region as an average for the period 2002 to mid-2006.

**Table 1: Sovereign ratings and ratings implied expected losses**

| | Latest rating, Moody's/S&P | Agreement between agencies | RSW-RIEL I[1] (basis points) | RSW-RIEL II[2] (basis points) |
|---|---|---|---|---|
| ***Asia*** | | | ***60.5*** | ***79.8*** |
| China | A2/A- | Split | 10.3 | 11.3 |
| Indonesia | B1/B+ | Same | 215.8 | 319.6 |
| Korea | A3/A | Split | 1.2 | 7.3 |
| Malaysia | A3/A- | Same | 18.3 | 11.6 |
| The Philippines | B1/BB- | Split | 76.4 | 105.1 |
| Thailand | Baa1/BBB+ | Same | 40.7 | 24.3 |
| ***Central and Eastern Europe*** | | | ***61.5*** | ***92.7*** |
| Bulgaria | Baa3/BBB | Split | 69.1 | 91.1 |
| Czech Republic | A1/A- | Split | 0.0 | 5.5 |
| Hungary | A1/A- | Split | 0.0 | 5.5 |
| Poland | A2/BBB+ | Split | 0.0 | 12.3 |
| Russia | Baa2/BBB | Same | 54.9 | 73.8 |
| Turkey | Ba3/BB- | Same | 145.3 | 224.6 |
| Ukraine | B1/BB- | Split | 160.8 | 236.4 |
| ***Latin America*** | | | ***126.9*** | ***174.1*** |
| Brazil | Ba3/BB | Split | 133.3 | 198.3 |
| Chile | Baa1/A | Split | 23.1 | 8.8 |
| Colombia | Ba2/BB | Same | 45.0 | 81.5 |
| Dominican Republic | B3/B | Split | 213.7 | 284.6 |
| Ecuador | Caa1/CCC+ | Same | 424.5 | 531.3 |
| El Salvador | Baa3/BB+ | Split | 31.7 | 44.8 |
| Mexico | Baa1/BBB | Split | 52.6 | 25.8 |
| Panama | Ba1/BB | Split | 45.0 | 73.6 |
| Peru | Ba3/BB | Split | 82.0 | 141.0 |
| Venezuela | B2/BB- | Split | 217.6 | 351.4 |

| | | | | |
|---|---|---|---|---|
| ***Middle East and Africa*** | | | ***66.0*** | ***119.1*** |
| Egypt | Ba1/BB+ | Same | 29.3 | 58.4 |
| Lebanon | B3/B- | Same | 149.1 | 325.8 |
| Morocco | Ba1/BB+ | Same | 41.5 | 70.7 |
| South Africa | Baa1/BBB+ | Same | 44.1 | 21.3 |
| ***Total average*** | | | ***86.1*** | ***123.9*** |

[1] Calculated using average (between Moody's and S&P) sovereign cumulative default rates. [2] Calculated using average corporate cumulative default rates.

Since ratings for some countries have changed over time, two countries with the same ratings at the end of the period will not necessarily have the same RIEL. The latest sovereign ratings by Moody's and S&P for the 27 sample countries are also shown. Emerging market sovereigns tend to be rated single A at best. In nearly 60 percent of the cases – the ratings are split. Especially in these cases of split ratings, it is more meaningful to use information from both rating agencies because market participants evidently do. Thus, we compute RIEL averaged across rating agencies. The third column shows the estimates based on the sovereign default experience and the fourth column that based on the corporate default experience. These estimates show an average RIEL of 86 basis points a year based on the sovereign default experience. The average RIEL based on the corporate default experience is 124 basis points, nearly 50% greater than that based on the sovereign default experience. Of the four regions that we consider, Latin America exhibits the highest average RIEL, followed by Middle East and Africa and then Central and Eastern Europe. Interestingly, Asian sovereigns carry the lowest average RIEL of all emerging market regions.

Expected losses implied by rating categories are shown in Table 2. RIEL calculated using Moody's and S&P's sovereign and corporate cumulative default rates separately are first shown followed by our

RSW-RIEL measure that averages RIEL across both rating agencies and issuer-types. As expected, ratings implied expected losses generally increase as credit quality declines. Furthermore, RIELs based on corporate default rates are generally higher than those using historical sovereign default rates across rating categories. On the basis of our RIEL calculations, S&P's rating and default information generally implies slightly higher expected losses for sovereign issuers than Moodys. For the A ratings category, RIELs based on sovereign default information alone are equal to zero as there has been no default by A-rated sovereigns. Thus, we propose our simple RSW-RIEL indicator of sovereign default risk to ameliorate the biases introduced by relying on a single rating agency and actual sovereign default experiences alone. We further investigate the performance of the RSW-RIEL measure in the subsequent analyses.

**Table 2: Sovereign ratings and implied expected losses, Jan 2002-Jun 2006**
In basis points

| **Rating Category** | | **Credit Quality** | **Moody's** | | **S&P** | | **RSW-RIEL[1]** |
|---|---|---|---|---|---|---|---|
| **Moody's** | **S&P** | **Grade** | **Sovereign** | **Corporate** | **Sovereign** | **Corporate** | |
| Aaa – A | AAA – A | Invest-ment | 0 | 5.0 | 0 | 6.6 | 5.0 |
| Baa | BBB | | 46.3 | 20.2 | 34.8 | 26.2 | 29.7 |
| Ba | BB | Specula-tive | 37.2 | 87.6 | 79.4 | 90.2 | 65.8 |
| B | B | | 131.7 | 285.4 | 166.6 | 271.5 | 201.9 |
| Caa and below | CCC and below | | 273.6 | 592.9 | 615.9 | 482.1 | 439.8 |

[1] Five-year sovereign spread. Sources: Markit; Moody's; S&P; authors' calculations.

### 4.2 Determinants of sovereign default risk

We examine how our measure of expected loss – RSW-RIEL behaves relative to alternative sovereign risk measures, such as averaged agency credit ratings and *Institutional Investor* country ratings.

We employ a panel regression framework with fixed effects, allowing for heteroskedastic residuals to examine the determinants of average RIEL and country credit ratings. Our sample of 27 sample countries and 4 years of annual data (2002-2005) gives us 108 cross-sectional and time series units.

We turn to fundamental variables identified in the literature as important determinants of country risk. These variables are listed and categorised in Appendix A. They measure real economic activity, inflation performance, economic development and size, budgetary, current account and international reserve positions, corruption perceptions, political risk, default and debt history as well as measures of original sin and currency mismatch. Thus, in addition to fundamental macroeconomic conditions and management, they cover three key perspectives on country risk prevailing in the country risk literature: debt intolerance, original sin and currency mismatches.[6] Generally, the *a priori* relationship between these variables and expected losses and country credit ratings are straightforward and we will not elaborate further. However, we should clarify that expected

[6] As explained below, Reinhart *et al* (2003) characterise debt intolerance as depending critically on whether a country has had a history of economic mismanagement. Eichengreen *et al* (2003) define original sin as the inability of a country to borrow in its own currency and argue that it is the critical determinant of country risk. Goldstein and Turner (2004) maintain that currency mismatches make those countries whose net worth is more sensitive to currency depreciation more vulnerable in a crisis.

losses are implicitly inversely related to credit ratings and so the estimated coefficients for the same explanatory variables should also have opposite signs when we compare the different dependent variables. Another aspect which warrants clarification is that the political risk and corruption perception indices are constructed so that higher values reflect better conditions (that is, less political risk and perceived corruption). Hence, the sign of the coefficients should be negative for RIEL and positive for country ratings.

We estimate different panel regressions for our three alternative sovereign risk measures to compare their responses to a set of fundamental country risk determinants. We follow the credit risk literature and assume a lognormal functional form as it is known to fit the fat tails of relevant financial distributions (see for example, Berndt *et al* (2005) and Pan and Singleton (2005)). Hence the models that we estimate are of the following specification:

$$Y_{i,t} = a_{0i} + a_1 F_{it} + u_{it} \qquad (3)$$

where $Y_{it}$, represents the natural logarithm of RIEL; average of Moody's and S&P's sovereign ratings; and *Institutional Investor* country ratings for country $i$ in year $t$ respectively. These sovereign risk measures are explained by $F_{i,t}$, a vector of country-specific fundamental {macroeconomic, debt burden, debt history, governance, size, currency-related} factors and $u_{i,t}$. is the error term.

The final panel regression results are presented in Table 3. In column 2 are the results with the log of RIEL as the dependent variable; in column 3 are those for linearly transformed sovereign credit ratings provided by both Moodys and S&P; and in the final column are those for country ratings surveyed by *Institutional Investor*. To maintain

sufficient degrees of freedom for meaningful interpretation, we present the most significant explanatory variables from our initial regressor list for all three dependent variables (in our general-to-simple modelling approach). Our results from the panel regression analysis using annual data are consistent with extant sovereign debt studies. Indeed we find that our measure of sovereign default risk is largely explained by country-specific fundamentals. The panel regression results are robust to heteroskedasticity, using White's correction method. The associated adjusted R-squares are tightly ranged from 95.3 to 97.8 percent for the three different estimations of equation (3) suggesting a good fit for our country risk model.

**Table 3 Country Risk Estimations**

| **Explanatory Variables** | **Dependent variables** | | |
|---|---|---|---|
| | **Log(RIEL)** | **Average Agency Ratings** | **Institutional Investor Ratings** |
| Log Nominal GDP | 3.23*** | -13.0*** | -46.1*** |
| | {0.009} | {0.000} | {0.001} |
| Log GDP per capita | -3.61*** | 15.0*** | 57.3*** |
| | {0.001} | {0.000} | {0.000} |
| Inflation | 0.016** | -0.036*** | 0.027 |
| | {0.011} | {0.000} | {0.741} |
| Current Account Balance / GDP | -0.018*** | -0.030 | -0.043 |
| | {0.003} | {0.127} | {0.490} |
| External Debt / GDP | 0.008** | -0.044** | -0.352*** |
| | {0.048} | {0.011} | {0.000} |
| Years since last default | -0.067* | -0.029 | 0.808** |
| | {0.064} | {0.305} | {0.037} |
| Lagged Corruption Perception | -0.689*** | 0.194 | 6.16*** |
| | {0.000} | {0.301} | {0.000} |
| Original Sin | 0.801** | -1.11* | |
| | {0.033} | {0.079} | |
| Currency Mismatch | | 0.174** | 1.28*** |
| | | (0.041} | {0.000} |
| Adj. R-squared | 0.953 | 0.978 | 0.963 |

Notes: P-values are shown in parentheses and *, ** and *** denote 10, 5 and 1% level of significance respectively. As the currency mismatch variable is simply a scaled version of the original sin measure, they are highly collinear and the panel regressions were estimated separately to ensure robustness (insignificant variable not shown).

In the log(RIEL) regression, the macroeconomic measures for country size (log GDP), economic development (log GDP per capita), inflation and current account balance are all significant at 1 and 5 percent levels and have the expected signs. Corporate governance history as proxied by lagged perceived corruption (but not political risk[7]) is highly significant and has the expected negative sign for expected losses. Furthermore, the estimated coefficients for relative external debt and default history proxied by the number of years since the last foreign currency default are both statistically and economically significant at the 5 and 10 percent significance levels respectively. The positive impact of external debt on expected loss conforms with *a priori* expectation and the negative coefficient suggests that the longer it is since the last sovereign default, the lower the expected loss. The estimated results corroborate with earlier findings that a history of economic mismanagement and poor debt performance clearly hampers the credit standing of sovereign issuers.

In using expected loss to measure sovereign risk, we find support for only the debt intolerance and original sin perspectives on country risk. The positive (negative) coefficient for external debt (past default) suggests that countries with relatively more outstanding debt and more recent defaults, will experience higher expected losses from sovereign default and hence difficulty with sustaining debt. On original sin, we employ the OSIN3 proxy used and defined in Borio and Packer (2004).[8] We find a significant positive coefficient at the 5 percent level that is consistent with the concept that countries with a

[7] As the political risk and corruption perception indexes are highly collinear, we do not estimate these together. In separate regressions with the political risk proxy for institutional quality/governance, we find this variable to be insignificant.

[8] OSIN3 quantifies the ratio of foreign currency debt to total debt outstanding with the appropriate assumption that all debt issued in a country's currency is counted as local currency issuance regardless of the nationality of the issuer.

lower capacity to borrow in domestic currencies should be riskier. However, on currency mismatch, we employ the proxy constructed with OSIN3 again in Borio and Packer[9] and we do not find that countries whose net asset positions are more vulnerable to exchange rate depreciations experience higher expected losses from sovereign default.

It should be noted that within the fixed effects panel regression framework, it is assumed that our model specification is freed of omitted variable biases. This is because differences across countries are treated as intercept shifts in the multivariate regression function. This enables a valid goodness of fit comparison for the three linear regressions, using the same sample and model specification at the annual frequency.

Thus, when we directly compare the estimation of our panel regression for log(RIEL) with that for alternative stand-alone ratings that are conventionally used in the existing sovereign risk literature (eg, Reinhart *et al* (2003), Borio and Packer (2004), Baek *et al* (2005) and Kim and Wu (2006), amongst others), we find that logarithmic expected losses behaves differently from the alternative linear ratings measures. For all three measures of sovereign risk, country size and economic development have the biggest economic influences. Importantly, the three dependent variables react in the same to a country's debt burden as both sets of ratings decline with increasing external debt *albeit* to a different extent. However, on the two currency related perspectives, the apparent conflicts in the country risk literature are illuminated. Average agency credit ratings as used

[9] As the currency mismatch measures in Borio and Packer (2004) are essentially scaled OSIN measures, we estimate the regressions with the currency mismatch and OSIN3 variable separately to ameliorate the degree of multicollinearity.

in Borio and Packer (2004) support both original sin and currency mismatch explanations for country risk whilst institutional investor ratings and RIEL only support currency mismatch and original sin respectively.

Overall, the RIEL measure is more sensitive than either of the two rating measures to the full set of country risk explanatory variables. The agency ratings better capture a country's macroeconomic fundamentals whilst the *Institutional Investors*' survey captures the more subjective corruption and debt management perceptions. The drawbacks of the institutional investor ratings have already been explained and the agency rating categories are designed to provide a *relative* (ie. ordinal) ranking of credit quality at each point in time rather than an equidistant linear measure like expected losses. In fact, sovereign credit ratings are known to be best modelled with logistic transformations in the ratings literature but they are more commonly transformed into a linear series in sovereign debt studies.[10] Moreover, credit ratings are not designed to predict the exact timing of defaults nor measure the absolute level of default risk. They primarily convey rating analysts' views on a country's economic and financial risks. Thus, we find empirical support for our innovative RIEL measure for sovereign default risk which takes advantage of rating agencies' assessment and default memory.

### 4.3 Relationship with sovereign credit spreads

[10] For example, Afonso (2003) compares the performance of the linear, logistic and exponential transformations for sovereign credit ratings and shows that the linear transformation is less accurate than the logistic form for higher rated countries.

In theory, sovereign spreads should just compensate investors for expected losses from default. If investors held perfectly diversified portfolios, their actual losses from default on the portfolio as a whole should be equal to expected losses. There would be no credit risk to worry about and therefore no premium necessary to compensate for such risk.

**Graph 1: Sovereign spreads and ratings implied expected losses by credit rating**
In basis points

Notes: [1] Averages of rating-implied expected losses (RIEL), calculated for the period Jan-2002 to Jun-2006, using cumulative default rates (from Moody's and S&P) and assuming a loss given default equal to 45%. The panel of countries included is described in Table 1. The rating scale represents an average across notches. [2] Five-year sovereign spread, averages over the same period and same panel of countries.

However, Graph 1 clearly shows that sovereign spreads are much bigger than measured expected losses. The average CDS spread for our entire sample is 439 basis points, nearly five times the average RIEL based on the sovereign default experience and three and half times the average RIEL based on the corporate default experience. Even if we made the extreme assumption of a loss given default of 100%, the average spread would still be twice the average RIEL. The multiple appears to be greater, the higher the country's credit quality. For example, Korea which is rated single-A, has an average CDS

spread of 55 basis points, more than 45 times one estimate of RIEL and 8 times the other estimate.

The empirical asset pricing literature has uncovered a similar phenomenon in corporate debt. Amato and Remolona (2003) find that for triple-B rated corporate bonds with 3-5 years to maturity, the average spread in 1997-2003 was 170 basis points, more than eight times the expected loss from default. They and Driessen (2005) have called this phenomenon the "credit spread puzzle". Driessen characterises the difference between spread and expected loss as the default risk premium and estimates an average premium of 189 basis points after accounting for tax and liquidity effects. Berndt *et al* (2005) also estimate an average premium of a similar magnitude, and moreover find that the risk premium varies dramatically over time. Amato and Remolona (2005) explain this premium as the compensation for the risk of unexpected credit losses -- or idiosyncratic jump risk -- in a world in which perfectly diversified debt portfolios are not available. They provide evidence from collateralised debt obligations (CDOs) showing that fully diversified portfolios are not achievable in practice.

There are clear patterns in the way sovereign spreads and expected losses relate to credit ratings. First, as shown in Graph 1, average spreads tend to be wider than average RIELs at every letter rating. Second, both average spreads and average RIELs widen as credit ratings decline. Finally, spreads widen more dramatically with lower ratings, and hence the differential between them and expected losses becomes larger. Following the asset pricing literature on corporate bonds, we may estimate sovereign risk premia by subtracting expected losses from sovereign debt spreads. Hence the pattern

described above confirms what one would expect: lower sovereign ratings tend to command higher risk premia. On a regional basis, we find that Latin American sovereigns exhibit the highest spreads, expected loss and also risk premium, followed by those from Middle East and Africa and then Central and Eastern Europe. Sovereigns in the Asian region require the lowest risk premia.

**Table 4: CDS spreads and risk premia (in basis points)**

| | Average CDS spread[1] | Risk premium[2] under RIEL I | Risk premium[2] under RIEL II |
|---|---|---|---|
| ***Asia*** | ***169.0*** | ***108.6*** | ***89.2*** |
| China | 66.9 | 56.6 | 55.6 |
| Indonesia | 289.1 | 73.2 | -30.5 |
| Korea | 54.8 | 53.6 | 47.5 |
| Malaysia | 128.9 | 110.7 | 117.3 |
| The Philippines | 416.2 | 339.8 | 311.2 |
| Thailand | 58.1 | 17.4 | 33.8 |
| ***Central and Eastern Europe*** | ***291.2*** | ***229.7*** | ***198.4*** |
| Bulgaria | 144.0 | 74.9 | 52.9 |
| Czech Republic | 18.7 | 18.7 | 13.2 |
| Hungary | 29.2 | 29.2 | 23.7 |
| Poland | 71.2 | 71.2 | 58.9 |
| Russia | 486.1 | 431.2 | 412.3 |
| Turkey | 1036.0 | 890.7 | 811.4 |
| Ukraine | 252.9 | 92.1 | 16.5 |
| ***Latin America*** | ***726.2*** | ***599.3*** | ***552.0*** |
| Brazil | 872.2 | 738.9 | 673.8 |
| Chile | 160.7 | 137.5 | 151.8 |
| Colombia | 994.1 | 949.1 | 912.6 |
| Dominican Republic | 1091.8 | 878.2 | 807.3 |
| Ecuador | 1592.3 | 1167.8 | 1061.0 |
| El Salvador | 196.0 | 164.3 | 151.2 |
| Mexico | 153.3 | 100.7 | 127.5 |
| Panama | 606.6 | 561.6 | 533.1 |
| Peru | 808.9 | 726.9 | 667.8 |
| Venezuela | 785.7 | 568.0 | 434.2 |
| ***Africa and the Middle East*** | ***384.9*** | ***318.9*** | ***265.9*** |
| Egypt | 222.3 | 193.0 | 163.9 |
| Lebanon | 914.5 | 765.4 | 588.7 |
| Morocco | 164.4 | 122.9 | 93.7 |

| | | | |
|---|---|---|---|
| South Africa | 238.6 | 194.5 | 217.2 |
| ***Total average*** | ***439.0*** | ***352.9*** | ***315.1*** |

[1] Five-year sovereign spread. [2] Calculated as the difference between the CDS spread and the RIEL I (II).

Theoretically, we can decompose sovereign spreads into expected losses and risk premia. Because we have scaled default probabilities by loss given default and expressed them in annual terms, our measure of risk can also account for the part of spreads that compensates investors for expected loss. The remaining part of the spread would then be the risk premium. Table 4 shows the average estimates for our sample of countries and for our two alternative ways of measuring RIEL. In nearly all cases, estimated risk premia are positive. Indeed they tend to account for a larger part of the spread than do expected losses. When we calculate risk premia on the basis of the RIEL derived from sovereign defaults, the average risk premia for our sample of countries is 353 basis points, accounting for about four-fifths of the spread. When we calculate it on the basis of the RIEL derived from corporate defaults, the average risk premia is 315 basis points, accounting for more than two-thirds of the spread.

### 4.4 Explaining sovereign credit spreads

For comparative purposes, we estimate fixed effects panel regressions to gauge the sensitivity of 5-year sovereign credit default swap (CDS) spreads to alternative sovereign risk proxies. Quantifying the relationship between spreads and sovereign default risk in a regression framework allows us to compare the spread demanded by our measure of expected loss. We control for market-specific factors - the size of the investor base (net debt issuance) and liquidity (debt outstandings) – as well as global risk aversion (VIX). It is well known in international asset pricing that the VIX (measured as volatility implied by options contracts on the S&P 500 index) is a good proxy

for investors' attitude towards global risks as increased risk taking is likely to lead to reduced hedging activity against volatility. More importantly, previous work by McGuire and Schrijvers (2003) and the IMF (2004) have established a strong relationship between the VIX and emerging market spreads. Furthermore, following the cues from the IMF's (2004) model for emerging market spreads, we include the amount of net debt issuance and debt outstandings to proxy for aspects of growth in the emerging market investor base (demand) and liquidity (trading activity and/or supply) respectively.

The estimated results using the three different sovereign risk proxies are shown in Table 5. The model specification used is shown in equation (4)

$$\log(S_{i,t}) = \alpha_0 + \alpha_1 Sov\_risk_{i,t} + \alpha_2 \log(Issuance_{i,t}) + \alpha_3 \log(Outstanding_{i,t}) + \alpha_4 VIX_t + \mu_{i,t} \quad (4)$$

where $\log(S_{i,t})$ is the natural logarithm of the CDS spread for country $i$ at time $t$ and $Sov\_risk$ is proxied by the natural logarithm of RIEL; averaged agency ratings; and institutional investor ratings respectively; *Issuance* is the country-specific net debt issuance; *Outstanding* is the total debt outstanding; *VIX* is the implied volatility index of S&P500 and $u_{i,t}$ are the i.i.d. disturbances. These estimated models are robust to heteroskedasticity using White's correction method.

As expected on the basis of our earlier decomposition results, the estimated coefficients for all three sovereign risk proxies in equation (4) are less than one in absolute terms but the size of the coefficient for the RSW-RIEL measure is the largest. This suggests that the ratings implied expected loss measure is a closer match to market

determined spreads and provides a better estimate of the proportion of spreads demanded for sovereign risk (given similar degrees of explanatory power for the three models). Of the alternative rating indicators, the *Institutional Investor* country rating performs the worst consistent with the results from previous country risk estimations. Both the RSW-RIEL measure and agency ratings are statistically significant and economically meaningful for explaining spreads but this can not be said for the *Institutional Investor* ratings. In a similar exercise performed by Sy (2002) with only agency ratings and JP Morgan Emerging Market Bond spreads, discrepancies were also shown between actual market spreads (market views) and rating predicted spreads (rating agencies' views).

**Table 5 Explaining CDS spreads**

| **Explanatory variables** | **Sovereign Risk Measures** | | |
|---|---|---|---|
| | Log (RIEL) (1) | Average Agency Ratings (2) | Institutional Investor Ratings (3) |
| Sovereign risk proxy (1,2 or 3) | 0.531 | -0.293 | -0.005 |
| | {0.000}*** | {0.000}*** | {0.751} |
| Log bond issuance | -0.053 | -0.060 | -0.03 |
| | {0.083}* | {0.074}* | {0.162} |
| Log bond outstanding | -0.135 | -0.182 | 0.111 |
| | {0.027}** | {0.001}*** | {0.163} |
| VIX | 0.059 | 0.056 | 0.08 |
| | {0.000}*** | {0.000}*** | {0.000}*** |
| Time series frequency | quarterly | quarterly | annual |
| Adj. R-squared | 0.96 | 0.97 | 0.97 |

Notes: The estimated panel regressions are of the form

$$\log(S_{i,t}) = \alpha_0 + \alpha_1 Sov\_risk_{i,t} + \alpha_2 \log(Issuance_{i,t}) + \alpha_3 \log(Outstanding_{i,t}) + \alpha_4 VIX_t + \mu_{i,t} \quad (4a)$$

where $\log(S_{i,t})$ is the natural logarithm of the CDS spread for country $i$ at time $t$ and *Sov_risk* is the natural logarithm of RIEL; averaged agency ratings; and institutional investor ratings respectively; *Issuance* is the country-specific total debt issuance; *Outstanding*, is the total amount of international securities outstanding; *VIX* is the implied volatility index of S&P500 and $u_{i,t}$ are the i.i.d. disturbances. The coefficients for bond outstanding and issuance have been estimated separately. P-values are shown in parentheses and *, ** and *** denote 10, 5 and 1% level of significance respectively.

Of the control variables, the estimated coefficients for the size of the investor base (net debt issuance), liquidity (debt outstandings) and

global risk aversion (VIX) are mainly statistically significant with the appropriate signs for explaining sovereign CDS spreads. As both the investor base and bond market liquidity increase, sovereign CDS spreads decline. The consistently positive and significant VIX coefficient corroborates with Baek *et al's* (2005) finding that a risk aversion index helps to explain Brady bond yield spreads.

These results have clear policy implications for emerging markets. The recent phenomenal decline in emerging market spreads have been driven in part by global investors' increasing risk appetite (declining risk aversion) for emerging market debt as also evidenced by increasing demand and trading for these investments. There is additional compensation (premia) demanded by investors in emerging market debt beyond that accounted for bearing expected sovereign risk. Thus, the narrowing in emerging market spreads may pose concerns for stability in the international financial system if the trend continues.

## 5. Conclusions

In this paper we have proposed an alternative measure of sovereign default risk. We derived expected loss from sovereign credit ratings and the default histories associated with each rating. Our sovereign risk measure behaves as we would expect with respect to both country risk fundamentals and sovereign credit spreads. We find new evidence that supports the debt intolerance and original sin hypotheses for country risk.

A limitation of our risk measure is the implicit assumption that recovery rates are orthogonal to the probability of default which still requires further research to validate.

We also demonstrated how to decompose sovereign debt spreads into their two components: the expected loss from default and the default risk premium. Hence, expected loss can be used as both a component of the spread as well as a measure of country risk itself. We show that this refined measure of sovereign default risk is more informative than conventional rating indicators alone.

Further work is needed in reconciling the fundamentals-based country risk literature with the credit risk pricing one by exploring the driving forces behind sovereign risk itself and the actual risk premia demanded by investors for its compensation – rationally or otherwise. In particular, we believe the role of risk aversion in sovereign risk pricing deserves further clarification. We leave this for subsequent research in this area.

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**Appendix A: Explanatory Variables for Country Risk**

| Categories | Variables | Unit | Source[1] |
|---|---|---|---|
| Macroeconomic | Log per capita GDP | $ | IIF, IMF, IFS, DRI, EIU, WEO |
| | CPI inflation rate (year on year) | % | |
| | Real GDP growth (year on year) | % | |
| | Government budget balance/GDP | % | |
| | International Reserves/Imports | % | |
| | Current account balance/GDP | % | |
| Debt burden | External debt/GDP | % | IIF, IMF, IFS, DRI, EIU |
| Debt history | Years since last foreign currency default | No. years | S&P, MOODY'S BIS |
| | Times inflation > 40% in 25 years | % | |
| Governance | Corruption [2] | 1–10 scale | TI, ICRG |
| | Political risk [2] | 1–100 scale | |
| Country size | Log nominal GDP | $ | WB |
| Currency-related | Original Sin[3] | % | BIS |
| | Currency Mismatch[3] | | |
| | Change in real exchange rate | | WEO |

[1] Sources: BIS= Bank for International Settlements; DRI=Data Resources Institute; EIU=Economic Intelligence Unit; ICRG=International Country Risk Guide;

IFS=International Financial Statistics (IMF); IIF=Institute for International Finance; IMF=International Monetary Fund; S&P=Standard and Poors; TI=Transparency International; WB=world Bank; WEO=World Economic Outlook (IMF). [2] Higher numbers represent better conditions. [3] We use OSIN3 and its scaled Currency Mismatch variable defined in Borio and Packer (2004).