The dynamic pricing of sovereign risk in emerging markets: fundamentals and risk aversion

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Abstract
This paper introduces a new approach to pricing sovereign risk based on sovereign credit default swap (CDS) spreads. We estimate a dynamic market-based measure of sovereign risk and use it to decompose sovereign CDS spreads into expected losses from default and the market risk premia required by investors as compensation for default risk. Using a dynamic panel data model, we find that country-specific fundamentals primarily drive sovereign risk whilst global investors' risk aversion drives time variation in the risk premia. Consistent with this, we also find that the sovereign risk premia is more highly correlated than sovereign risk itself within emerging market regions. These results help us to explain the remarkable narrowing of emerging market spreads between 2002 and 2006 and to understand the pricing mechanism and channel of contagion for emerging debt markets.

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1. Introduction

Emerging market debt valuations now appear stretched relative to their historical relationship with fundamentals and liquidity. *Source: IMF (2004)*

Sovereign bond yield spreads are understood as a measure of a country's creditworthiness and is also readily interpreted as a measure of emerging market investors' required financial compensation for bearing sovereign risk. However, is that market assessed risk premium always justified by the *actual* levels of risk to which investors are exposed? From an asset pricing perspective, this is a crucial question to be addressed given the significant and increasing flow of institutional funds into emerging financial markets. Hence, this paper is focused on disentangling the components of risk and price of risk embedded within spreads in order to compare the effects of traditional prudential-macroeconomic fundamental variables and systematic investor risk aversion on actual levels of sovereign default risk and the risk premium demanded for that risk. Importantly, we find strong empirical evidence to indicate that global risk aversion is the dominant determinant of the true sovereign risk premium. The analysis of sovereign risk pricing is critical for better bond portfolio management as well as the risk management and regulation of financial institutions.

Whilst it is generally recognised in the academic literature that emerging market spreads cannot be fully explained by country-specific economic fundamental variables (Mauro et al., 2002, Sy, 2002, Baek et al., 2005 and Diaz-Wiegel and Gemmill, 2006), the divergence in market and fundamental assessments on sovereign risk has become an increasingly worrying concern for policy makers and emerging market observers. Over the period from 2002 to 2006, the average spread on the EMBI+ index, a widely monitored index of emerging market debt prices fell from about 1020 basis points to 170 basis points and there are market predictions that emerging market spreads could become inverted if this trend continues. Indeed even by 2004, sovereign spreads had narrowed to the point where serious concerns were expressed by the International Monetary Fund (2004) that market participants may be failing to adequately recognise the risks of emerging market debt. But how narrow was too narrow for emerging market spreads? The problem is that there is little basis for assessing whether sovereign risks are correctly priced other than the fact that spreads seem to be rather tight relative to past regularities in fundamentals and liquidity levels.

A common difficulty in analysing sovereign spreads is the question of how to distinguish between risk and the pricing of risk as financial compensation demanded by investors for bearing sovereign default risk. Financial asset prices are driven by both fundamentals and investors' appetite for risk. Hence, we may think of the level of sovereign risk as being driven by the country's economic fundamentals and the pricing of that risk as depending on investors' general risk aversion, something which may vary over time. Consistent with this conjecture, Mauro, Sussman and Yafeh (2002) demonstrate that spreads on sovereign bonds today co-move to a greater extent than they did historically as they are driven more by global events than country-specific fundamentals. Furthermore, market sentiment and risk appetite are also known to be important drivers of emerging bond spreads (Eichengreen and Mody, 1998, Baek et al, 2005, Diaz-Weigel and Gemmill, 2006). Yet, the sovereign debt literature on the whole, has largely focussed on the determinants of sovereign risk and has been silent on the pricing mechanics for this risk, often implicitly assuming that somehow sovereign spreads reflect risk but not risk premia (or vice versa).

This study attempts to fill in the vacuum in the emerging debt literature by proposing a framework for distinguishing market assessed sovereign risk from its risk premia. Our focus on fundamentals and risk aversion (appetite) makes this study the closest to that of Baek, et al.'s (2005) study on five Brady bond issuers. However, we improve upon their existing work by accounting for sovereign risk as well as its risk premia encapsulated within spreads. Furthermore, we distinguish our study by using a dynamic panel data model with a more extensive sample coverage of 24 emerging countries with sovereign credit default swap spreads and a battery of improved risk aversion measures over a more recent sample period from 2002-2006. Hence, we provide more comprehensive and timely empirical evidence on the differential effects of fundamentals and risk aversion on sovereign debt spreads. In doing so, we are able to contribute a much better understanding on recent developments within emerging debt markets.

The remainder of this paper is structured as follows. Section 2 reviews the literature on sovereign risk. Section 3 explains our model for deriving a dynamic measure of expected losses from sovereign default and a time-varying measure of sovereign default risk premia. Section 4 describes our data used. In section 5, we present our empirical results and finally, we provide conclusions and further work to be pursued in Section 6.

2. Related Literature

Our study is closely related to the growing literature on the determinants of corporate and sovereign credit spreads. In both streams of this literature, there is an increasing awareness that there is a significant component of credit spreads which is driven by common external factors as the default risk (or a set of fundamental variables determining creditworthiness) can only account for a small part of spreads. This phenomenon has been termed the "credit spread puzzle". Earlier work in Remolona, Scatigna and Wu-hereafter RSW (2007a) indicates that sovereign default risk is an even smaller component of sovereign spreads.

For instance, in the corporate spread sphere, Collin-Dufresne et al. (2001) find a dominant unobserved principal component in the residual variance of spread changes, after accounting for the typical set of variables used in structural based credit risk models. Elton et al. (2001) also find that default risk explains a small part of corporate bond spreads and that risk premium along with tax effects may play an important role. In the more recent literature on the pricing of credit risk in corporate bonds, Driessen (2005), Amato and Remolona (2003, 2005) and Berndt et al (2005) decompose corporate bond spreads into expected losses from default and the price of risk, namely the default risk premium. They all find that the latter exceeds the actual level of risk.

In the literature on sovereign spreads, Cantor and Packer (1996), Eichengreen and Mody (1998), Kamin and von Kleist (1999) have suggested that it is not only the macroeconomic-based country-specific fundamentals or country credit ratings encapsulating these factors which drive fluctuations in emerging market sovereign spreads but also shifts in market sentiment from time to time. Mauro, Sussman and

Yafeh (2002) demonstrate that spreads on sovereign bonds today co-move to a greater extent than they did historically as they are driven more by global events than country-specific fundamentals. With Brady bond prices, Diaz Weigel and Gemmill (2006) also find significance of international stock market comovements. Similarly, the principal component analyses in both Westphalen (2001) and McGuire and Schrijvers (2003) and the work of Garcia-Herrero and Ortiz (2007) also indicate that there is a sizeable common factor in the changes of emerging market spreads which is related to international developments. McGuire and Schrjvers (2003) suggest that "the common variation in emerging-market debt spreads is largely explained by changes in attitudes towards risk within the international investment community" (p. 77). In the same spirit, Baek et al. (2005) argued that "countries that are not necessarily experiencing changes in economic fundamentals may find changes in their bond yield spreads because of a change in the market's attitude towards risk". (p.547). In their empirical study, Baek et al. (2005) document that their index of risk appetite has a relatively large impact on Brady bond spreads. However, in their study they have attributed the spreads entirely to the risk premium.

The recent works of RSW (2007a,b) are two of the few existing studies to differentiate between the risk and risk premium components within sovereign credit spreads. In the spirit of the more advanced corporate credit risk pricing literature, they decompose sovereign credit default swap spreads into a sovereign default risk component (an expected loss measure calculated from the historical default rates associated with agency sovereign ratings) and the residual market risk premium. They establish in RSW (2007b) that their ratings implied expected loss (RIEL) measure is a better proxy for capturing sovereign risk over traditional alternatives like institutional investor ratings and linearly transformed agency ratings. Their measure for sovereign default risk also has advantages over structural-based estimates introduced in recent studies like Cumby and Pastine (2001), Gapen et al (2005), Oshiro and Saruwatari (2005) and Diaz-Weigel and Gemmill (2006) as it can be meaningfully interpreted relative to spreads and does not rely on unrealistic assumptions in the adaptation of the standard Merton model for entire countries. As such, we opt to extend the RSW spread decomposition framework to account for the pricing of real-time market information.

Furthermore, motivated by the strong consensus on the importance of global systemic risk factors on spreads, in this paper we aim to extend the current sovereign debt literature to better understand the channel through which risk appetite actually affects spreads as the current level of understanding on this remains unsatisfactory.

3. A dynamic market-based model of sovereign risk

The dynamics of sovereign risk pricing need to be analysed at a relatively high frequency to incorporate information updates in emerging debt markets. As such, we measure sovereign risk at the monthly frequency by deriving a market-based measure that extends the work of Remolona, Scatigna and Wu (2007b) on ratings implied expected losses (RIEL) for sovereign issuers. In their work, expected losses from sovereign defaults are modelled as a non-linear mapping of sovereign credit ratings. Specifically, a translation of default intensity across rating categories is calibrated using the average five-year ahead default rates of both sovereign and corporate issuers (as an estimate of the unconditional 5 year default probability). This measure conceivably captures a large part of market participants' long-term view on a country's creditworthiness as they evidently rely on published information from rating agencies. The link between country credit ratings and sovereign credit spreads is also firmly established in the sovereign debt literature (see Cantor and Packer, 1996, Cantor et al., 1997, Sy, 2002, Gande and Parsley, 2005, RSW, 2007b amongst others).

However, in this study we significantly extend the RIEL measure of RSW (2007b) for sovereign default risk because the relevant information for assessing an issuer's creditworthiness arrives at a higher frequency than that based solely on sovereign ratings guidance, which by rating agencies' own admission are slow to adjust to the arrival of new information in the market. Altman and Rijken (2004) suggest that rating agencies 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 in their ratings guidance. However, market participants on the other hand adjust their risk assessments quickly as information arrives and they price financial assets accordingly. The problem with such market assessments is that they are not directly observable.

Thus, in this study, we derive market-based expected losses from sovereign default (MBEL) in two stages – first by accounting for long- and short-term rating announcements and second by means of a market adjustment equation that is estimated with observable instrumental variables. This uniquely allows us to mimic the formation of investors' expectations on sovereign default risk at the monthly frequency based on changing economic conditions in emerging markets becoming known to emerging financial market participants.

3.1 Translating rating agency announcements

Whilst rating agencies provide credit ratings to signal an issuer's long-term fundamental creditworthiness they also provide more short-term signals via reviews and outlooks to forewarn investors of the likely change of an issuer's credit quality in the near term. The latter are made by rating agencies when a significant event or deviation from an expected trend has either occurred or is expected to affect an issuer's capacity to repay its debt.

Micu, Remolona and Wooldridge (2006) find that investors value both the timely signals (rating reviews and outlooks) as well as the stable signals (ratings) of issuer creditworthiness in the corporate credit market. This is consistent with rating agencies' view that ratings, watchlists and outlooks together give a complete rating guidance on the issuer's capacity to meet its financial obligations. However, as the rating reviews for sovereign ratings are called "Creditwatch" (by S&P) and "Watchlists" (by Moody's) we will use the terms "review" and "sovereign watch" interchangeably in this paper.[2]

Hence, in order to capture the additional information implied by sovereign rating outlooks and watches, we adjust and extend the ratings implied expected loss (RIEL)

[2] Fitch Ratings uses the term "Rating watch" but due to their limited coverage of sovereign issuers, we omitted them in the RSW-RIEL estimation, as showed in Remolona, Scatigna and Wu (2007b).

measure of Remolona, Scatigna and Wu (2007b) – RSW-RIEL. In our model, we assume that rating announcements have symmetric impacts on sovereign debt markets and that credit watches are more likely to lead to a subsequent ratings change than ratings outlooks. Guided by discussions with rating agencies, we assign a rating transition probability (p) of 0.3 for outlooks and 0.6 for credit watches and we compute the weighted RIEL average when there is a non-stable rating announcement. Specifically, we adjust a positive outlook or sovereign watch up by one notch in the rating scale and a negative outlook or sovereign watch down by one notch to infer the probabilities of default based on historical sovereign default experiences. It is important to note that sovereign outlooks and watches simply carry a different likelihood of a forthcoming rating change, not necessarily a different magnitude of change in the rating scale. Based on rating agencies' guidance, we assume that the sovereign watches last for 3 months and outlooks for 2 years or until the next actual rating change, whichever is sooner. Following the RSW-RIEL methodology and the findings of Sturzenegger and Zettlemeyer (2007) we use a constant loss given default rate of 45%. We calculate the expected value of ratings implied expected loss (RIEL) by adjusting for rating announcements – this can be represented as weighted averages shown:

$$E(RIEL_{adjusted\, i,t}) = \begin{cases} 0.7 \times PD_{0i,t} \times \overline{LGD} + 0.3 \times PD_{1i,t} \times \overline{LGD} & \textit{For Outlooks} \\ \\ 0.4 \times PD_{0i,t} \times \overline{LGD} + 0.6 \times PD_{1i,t} \times \overline{LGD} & \textit{For Watches} \end{cases} \tag{1}$$

where $PD_{0i,t}$ is the original annualized ratings implied probability of default and $PD_{1i,t}$ is the new rating outlook/watch implied probability of default for country *i* at time *t* and $\overline{LGD}$ is the constant loss given default scaling factor.

In this way, we improve upon the arbitrary adjustments made to linearly transformed sovereign rating scales in for example, Gande and Parsley (2005), Ferreira and Gama (2007) and Kim and Wu (2007). The advantage of our approach is that we use realistic assumptions to calibrate our ratings-based expected loss measure. We combine the adjusted RIEL series using both S&P and Moody's announcements in between actual rating changes. There is added informational value in this approach as

Cantor et al. (1997) have shown split ratings to be priced in the mid point. Hence, there is no reason to believe that split short-term credit announcements by rating agencies will have widely different effects.

3.2 Estimating a market-based measure of sovereign risk

Next, we assume that the aggregate market's expected loss (market based expected loss, MBEL) should adjust toward expected ratings implied expected loss. We model this market adjustment process using the following equation:

$$\lambda_t^M = (1-\phi)\widehat{\lambda}_{t+1}^R + \phi\lambda_{t-1}^M + v_t, \qquad (2)$$

where λ_t^M is the MBEL, $\widehat{\lambda}_{t+1}^R$ is the expected RIEL forecast (adjusted for outlooks and reviews) and ϕ is the adjustment coefficient (assumed to be between 0 and 1) and where for notational convenience we suppress the country subscript *i*.

In order to obtain estimates of the MBEL we rewrite equation (2) in terms of differences by subtracting λ_{t-1}^M from both sides to yield:

$$\lambda_t^M - \lambda_{t-1}^M = (1-\phi)\left[\widehat{\lambda}_{t+1}^R - \lambda_{t-1}^M\right] + v_t \qquad (3)$$

We apply two stage least squares (2SLS) to estimate equation (3), using the sovereign CDS spread S_t as a proxy for the MBEL, with the predicted values being our estimate for the MBEL. The estimated equation is thus:

$$S_t^* - S_{t-1}^* = (1-\phi)\left[\widehat{\lambda}_{t+1}^R - S_{t-1}^*\right] + u_t \qquad (4)$$

where S_t^* is the CDS spread adjusted by a factor k_j which measures the relative level of the adjusted RIEL with respect to the sovereign spread for each country j. This is to control for variations in default risk levels across countries.

$$k_j = \frac{average(RIEL_J)}{average(S_J)} \qquad j = 1,......,24$$

and

$$\lambda_{t+1}^{R} = f(F_t) + \varepsilon_t \qquad (5)$$

In estimating equation (4) we assume that the (forecasted) adjusted RIEL is a function of a set of observable economic fundamentals F_t available in the previous month (as shown in equation (5) and detailed below) which we use as instruments in the 2SLS estimation. Otherwise, the use of a regressor estimated with error in predicting MBEL will introduce unnecessary bias.

3.2.1 Country-specific fundamental factors

The fundamental variables used are country-specific economic variables which are available at a monthly frequency and deemed to be relevant in the country risk literature.[3] These are:

1) *Inflation rate.* This variable indicates how well a developing country is managing its monetary policy and to some extent its fiscal responsibility and economic stability. Higher inflation rates may indicate a sovereign borrower's implementation of imprudent policies (eg. Excessive spending and borrowing) and this would lead to higher default risk. Hence, we expect inflation will have a positive relationship with both sovereign risk.

2) *Industrial production.* Industrial output (seasonally adjusted) is one measure of a developing economy's economic strength. The more productive is the country, the more likely it will be able to repay its debt. Hence, we expect a negative relationship between industrial production and sovereign risk.

3 Other country—specific macroeconomic variables like current account balance, government budget balance, change in real exchange rates and external debt are also featured in Baek et al. (2005) but most of these variables are at best only available at the quarterly frequency. However, monthly real exchange rate changes are insignificant in all model specifications and have been omitted for brevity.

3) *GDP growth consensus forecasts.* This captures the expected levels of economic growth for developing countries and thus it should be negatively related to sovereign risk.

4) *Foreign exchange reserves.* Reserves are a measure of liquidity and indicate the ability of a developing country to repay its foreign debt denominated in hard currencies. Hence, the higher the level of reserves, the lower should be sovereign risk.

3.3 Deriving sovereign risk premia

Based on the analytical framework established in the corporate credit risk pricing literature, we make use of physical (actual observed probabilities of default) and risk-neutral measures (credit spreads incorporating risk aversion) (see Duffie and Singleton (2003) and references therein). Hence, we can uniquely define the sovereign default risk premium as the difference between the contemporaneous spread and our estimate of the market's actual view on expected loss:

$$\pi_t \equiv S_t - \hat{\lambda}_t^M \qquad (6)$$

where π_t is the sovereign risk premium, and as before, S_t is the CDS spread and $\hat{\lambda}_t^M$ is the predicted expected loss from default in the form of MBEL, again for notational convenience suppressing the country subscript *i* for brevity. In fact, a logarithmic expression of this relationship lends nicely to our interpretation of the sovereign risk premia as the price of sovereign default risk (that is, price per unit of expected loss).

3.4 Hypotheses testing

Our first testable hypothesis is that changes in this risk premium should depend on global risk factors as well as its own past but not separately on the fundamentals that determine the risk. A second hypothesis is that changes in sovereign risk should depend on country-specific fundamentals as well as its own past but not international risk aversion. To empirically test these two hypotheses, we estimate a dynamic panel regression model with the two following specifications:

$$\Delta \ln(\pi_t) = \delta_0 + \delta_1 \Delta \ln(\pi_{t-1}) + \delta_3 \Delta F_t + \delta_4 \Delta G_t + n_t + \varepsilon_t \quad (7)$$

$$\Delta \ln(\lambda_t^M) = \delta_0 + \delta_1 \Delta \ln(\lambda_{t-1}^M) + \delta_3 \Delta F_t + \delta_4 \Delta G_t + n_t + \varepsilon_t \quad (8)$$

where $\ln(\pi_t)$ is the log of the risk premium, $\ln(\lambda_t^M)$ is the log of sovereign risk, G_t is the new set of global investors' risk aversion (appetite) indicators and F_t is the set of country-risk fundamentals as previously detailed; δ_0 is the country-specific intercept and ε_t is a disturbance term. The logarithmic specification follows Berndt et al (2005), who find a relationship between default risk premia and default intensity in corporate bonds.

Note that in our model the measures of sovereign default risk plays an important role as it serves as a determinant of the market CDS spread (in the form of λ_{t+1}^R as defined in (5)) from which we extract the market risk premium π_t. It has the advantage of incorporating not only all information material to assessing a sovereign issuer's credit worthiness from rating agencies but also from the market as a whole.

We recognise that this model specification may present an 'errors in variable' type of problem so we estimate equations (7) and (8) as a dynamic panel data regression by using higher order lags of $\ln(\pi_t)$ and $\ln(\lambda_t^M)$ as instruments for the lagged changes in the spirit of Arrellano and Bond (1991). The G_t and F_t variables serve as their own instruments. Our empirical framework is consistent with the class of doubly stochastic models of default as it implicitly captures the degree of default correlation for the group of emerging market sovereigns (see Duffie and Singleton (2003)).

3.4.1 Identifying empirical global risk aversion proxies

Our hypotheses tests rely on reasonable empirical proxies for capturing the degree of investor risk appetites. Hence, we rely on alternative proxies of risk aversion in our dynamic panel estimation.

While there is a large literature purporting to analyse risk aversion (or sometimes risk appetite), much of it is based on ad-hoc measures that have little theoretical basis and often confuse risk aversion with liquidity.

In studying brady bond spreads, Baek et al. (2005) compute their own non-parametric risk appetite index (RAI) for capturing the market's overall attitude to risk. This form of risk aversion measure dates back to the first generation of risk aversion proxies constructed and utilised by financial analysts and practitioners. It is constructed as a Spearman's rank correlation measure between monthly stock market index returns and historic realised stock market volatility. The index is scaled to range from -100 to 100. The notion behind this construction is that a high return and high (low) volatility rank (resulting in a highly positive (negative) RAI) implies that investors were highly risk seeking (avoiding). Baek et al. (2005) find their RAI to be a more significant determinant of brady bond spreads than country-specific economic fundamentals. The inherent problem with this simplistic correlation coefficient measure is that it is designed to capture only international stock market investors' sentiment specific to a particular country. It may not accurately reflect global debt market participants' risk appetite for emerging market debt which is most relevant for our pricing exercise.

Hence, we turn to the empirical asset pricing literature to identify global factors that affect investors' risk aversion as there actually exists a rigorous strand of research on risk aversion. In the literature on empirical pricing kernels, Ait-Sahalia and Lo (1998) and Jackwerth (2000) show how a theoretically sound measure of investors' risk aversion can be derived by comparing the return distributions implied by options prices to return distributions estimated from the realised movements of the underlying asset prices. Tarashev et al (2003) apply this approach to index options in stock markets and derive monthly estimates of investors' effective risk appetite. They find that these indicators of risk attitude transcend national boundaries in their effects on international financial markets.

Separately, in examining emerging market debt spreads McGuire and Schrijvers (2003) find a significant common factor in the movements of these spreads over time.

They attempt to identify observable variables that are correlated with this common factor. Importantly, their results reveal a significant relationship with the implied volatility in equity index options on the S&P 500 index (the well-known VIX measure) which is loosely related to the more rigorous Tarashev et al (2003) measure. The VIX is regarded by market analysts as a direct gauge of fear in international financial markets. It provides information on the amounts that investors are willing to pay to protect their positions from price volatility.

Motivated by these existing works, we proceed to use the Tarashev et al (2003) effective risk appetite indicator and the commonly used VIX to proxy investor's degree of risk aversion in our analyses. However, these measures are purely focused on risk aversion in the stock market environment.

Hence, in addition to these next generation risk aversion measures based on equity market option prices, we also employ the Risk Tolerance Index (RTI) constructed by JP Morgan Chase specifically for gauging risk appetite across multiple asset classes in developed (G-10 countries) and emerging financial markets.[4] The G-10 RTI is constructed as a weighted average of the Z scores (number of standard deviations from the trend) for four underlying components: the VIX, EMBI+, US swap spreads and trade-weighted exchange rates whereas the emerging market RTI is an aggregation of only the first two components. In this way, risk tolerance across equity, emerging debt, interest rate derivative and currency markets are simultaneously captured in a timely manner. The higher are the index values above 1.5 (indicating more volatile international financial markets) the more risk averse are investors. We expect these broad-based risk tolerance indices used by institutional investors to be more specific proxies for capturing their risk aversion in the global investment climate. As such, there should be a significantly positive relationship between RTI and the risk premium demanded by investors over time.

4 This is a new indicator that JP Morgan Chase has constructed to replace the previous LCVI (Liquidity, Credit and Volatility Index). It is available at the daily frequency from the end of January 1998 (for the G-10 series) and the beginning of July 1996 (for the EM series).

4. Data

Our sample comprises 24 small and/or emerging markets from the regions of Latin America, Central and Eastern Europe, Asia and the Middle East and Africa (MEA) (see Appendix A for the list of sample countries studied). Our sample period is from January 2002 to May 2006 for which sovereign CDS market data are available for all countries in the sample at the monthly frequency.

We rely on sovereign foreign currency credit ratings history for each country including five-year issuer-weighted cumulative average default rates by ratings for sovereign and corporate issuers from *Moody's Investor Services* and *Standard and Poors* (S&P).

In addition, we use 5 year sovereign credit default swap (CDS) spreads sourced from the comprehensive *Markit* database. This unique 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. Zhu (2004) finds CDS spreads react particularly faster to bad news than spreads in the underlying cash market. CDS spreads have also been analysed by Pan and Singleton (2006) and Longstaff et al (2005) for sovereign and corporate obligors respectively.

The set of country-specific fundamental explanatory variables used include inflation, industrial production, GDP growth consensus forecasts and foreign exchange reserves. In addition, the risk aversion proxies employed are the effective risk appetite indicator, implied volatility on the S&P500 stock market index (VIX) and Risk Tolerance Indicator (RTI) for the G-10 developing countries and also for emerging markets. These variables are all available at the monthly frequency over our sample period. They are sourced separately from the Bank for international settlements, International Monetary Fund (IMF), Consensus Economics, Datastream, JPMorgan Chase and Standard & Poor's.

5. Empirical results and discussion

In this study, our main hypotheses are that the sovereign default risk premium should depend primarily on factors that affect investors' risk aversion whilst the sovereign risk should be more dependent on country-specific fundamentals. In this section, we derive default risk premia as detailed above and test whether they are significantly affected by other factors, in particular the country risk fundamentals and liquidity effects.

To test our hypothesis, we stage a quasi-horse race to find out which set of variables best explain sovereign risk and which ones best explain risk premia. We subject both our market based sovereign risk and risk premium estimates as dependent variables to be regressed against a set of country-specific fundamental variables and risk aversion proxies following the model specifications shown in equations (7) and (8). The estimated results are shown in Table 1.

<Insert Table 1 >

The fixed effects dynamic panel regression results for the two dependent variables in model specifications with alternative risk aversion proxies are reported in Table 1. As hypothesised, in the case of the sovereign risk equations we find that the proxies for risk aversion do not add significant incremental explanatory power for changes in sovereign risk itself. The risk appetite indicator is evidently significantly related to the risk premia in a negative manner. This is an intuitive result suggesting that as investors' risk appetites increase, the risk premium demanded as compensation for sovereign default risk falls. The VIX interestingly has a positively significant effect on both risk and risk premia. As global volatility is heightened, risk increases and this also becomes priced into emerging debt markets. This result suggests that the VIX is not a clean measure of risk aversion as it captures the volatility of global financial markets more generally. Based on the theoretical work of Ait-Sahalia and Lo (1998) and Jackwerth (2000), the Tarashev et al (2003) indicator is a slightly better proxy for capturing investors' effective attitude towards risk. The risk tolerance index (RTI) computed by JP Morgan for G-10 and emerging markets are also evidently suitable proxies for the large element of systemic risk aversion which is priced in emerging market debt by investors. As investors become more risk averse across multiple asset classes (in highly volatile times), the sovereign risk premium required for holding emerging market debt should increase. This is strongly supported by the highly significant and positive estimated coefficients for both the EM and G-10 RTI.

Our results from dynamic panel regression analyses using monthly data from February 2002 to May 2006 for 24 sample countries remain largely consistent with extant sovereign risk studies. The significant fundamental variables in the short-term horizon have the appropriate signs – positive for inflation and negative for foreign exchange reserves and industrial production – in explaining sovereign risk and to an insignificant extent, the risk premia. There appears to be a high level of persistence in both expected losses (sovereign risk) and the compensation for that with the higher order lags of risk and market risk premium being highly significant. The goodness of fit for regressions at the monthly frequency are reasonable for both risk and risk premium estimations and the fixed effects estimation is warranted based on the Hausman test.

Hence, we find our decomposition of sovereign spreads into time-varying market based expected losses and risk premia to be validated by the fact that the latter component is largely explained by variables related to investors' risk aversion while the other component is determined primarily by country-specific fundamentals. This contribution extends upon Baek, Bandopadhyaya and Du's (2005) finding that a risk aversion index can significantly explain stripped brady bond yield spreads. We find strong empirical evidence to suggest that risk appetite exerts an important influence through the pricing channel in emerging market debt. Our results suggest that investors' risk aversion affects primarily the price of sovereign risk and not the actual risk level itself. This explains why contagion occurs so readily in emerging debt markets in times of financial stress.

<u>A robustness check: controlling for liquidity</u>

We also augment our fixed-effects panel regressions for sovereign risk and risk premia to account for the potential influences of illiquidity in emerging debt markets. As Longstaff et al. (2005) have shown that there are default and liquidity components in corporate CDS spreads, we next attempt to control for any potential confounding effects from aggregate market liquidity.

The results of our control regressions are shown in Table 2. In addition to country-specific economic fundamentals, we find that market liquidity (as proxied by log net bond issuance) also explains market participants' perception of sovereign risk (MBEL). The positively significant coefficient suggests that the major side effect of liquidity is that as issuance increases, the average quality of issuers must decline as more and more lower rated issuers are able to access arms length financing in emerging markets. Nevertheless, our finding that global risk aversion determines primarily the pricing of risk remains robust to the effects of market liquidity.

<Insert Table 2>

5.1 Regional correlations of sovereign risk and risk premia

To shed further insights into sovereign risk pricing, we refine our analyses further to focus on the commonalities in the behaviour of sovereign risk and risk premia over time both within and across regions. We compare regional averages in the pair-wise correlations between countries in their estimated market-based sovereign risk and risk premia. The most telling result shown in Table 3 is that the correlations in risk premia systematically exceed correlations in sovereign risk. This provides further support for the common global risk aversion factor driving sovereign risk pricing. This also corroborates with Diaz-Weigel and Gemmill's (2006) and Mauro, Sussman and Yafeh's (2002) findings of significant market comovements in emerging market spreads over standard fundamental regressors. Another interesting discovery we find is that whilst the actual sovereign risk levels are the most divergent within the Asian region, sovereign risk premia is surprisingly highly correlated – even more so than in Latin American markets. This can perhaps be explained by market participants' common pricing for Asian sovereign debt post the Asian Financial crisis (which is akin to lumping sovereigns into a single 'Asian basket' in price formulation). The implication of this result is that market participants are clearly mispricing Asian sovereign debt the most – underpricing the risk in lower rated sovereigns that have remained fundamentally weak post-crisis (demanding a relatively lower risk premium) at the expense of higher rated sovereigns which are being potentially unfairly penalised by investors (with a relatively higher risk premium than is warranted by their restored sovereign risk levels).

<Insert Table 3 >

5.2 Understanding narrowing spreads

We pursue further graphical analyses on the Asian region to better understand the narrowing of spreads across emerging debt markets. In Figure 2, we show the CDS spreads and market based sovereign risk measures over time for sample Asian countries. Of these, China and Korea are investment grade issuers whilst Thailand and the Philippines are speculative (non-investment) grade.

The differences in the two grades of issuers are illuminating. For the investment grade group, whilst spreads have been falling in recent years, largely due to an actual decline in sovereign risk as economic conditions have improved, risk premium gaps have remained fairly stable. In contrast, the narrowing spreads of speculative grade issuers have largely come about from a major narrowing of the risk premium gaps. The actual levels of sovereign risk for non-investment grade issuers have not changed much at all but rather investors have become much more hungry for speculative grade debt. This reaffirms our previous finding that increasing global investor risk appetite has been pushing down the risk premia demanded for taking on sovereign default risk.

Furthermore, this is also consistent with our finding that aggregate correlations for sovereign risk premia in Asia are one of the highest of all emerging markets whilst the levels of sovereign risk are the most divergent. The findings are revealing – whilst speculative grade issuers are getting away with paying risk premia that are closer to the higher rated sovereigns, the higher rated sovereigns are actually becoming much less risky than the lower rated ones. Overall, the convergence in emerging market debt spreads have resulted from declining sovereign risk levels at the investment grade end and declining risk premia at the speculative grade end of the emerging market debt spectrum. To our best knowledge, this result has not been previously identified and should be of major interest to international policy makers and investors alike. This convergence if allowed to continue has the potential to pose significant risks for global financial instability. In other segments of global debt markets like mortgage debt, the systemic risks presented by mispriced sub-prime debt has become all too obvious.

<Insert Figure 2 >

This revelation in the channel through which risk appetite is priced into emerging market debt provides important implications for understanding financial contagion. Our results strongly suggest that contagion spreads through the market risk premia embedded within emerging market bond spreads. This study provides clear evidence to show that when there is a systemic change in global investors' attitude to pricing risks contagion can spread quickly through emerging debt market spreads even when developing countries are not necessarily experiencing deteriorations in economic fundamentals.

6. Conclusions

In this study, we decompose sovereign debt spreads into two market-based components over time: the expected loss from default and the default risk premium. We computed expected loss as a translation of default intensity using forward-looking credit ratings and announcements and the default histories associated with each rating. We then derived a higher frequency measure of expected loss from default by means of a dynamic market based model. We used this measure to decompose sovereign spreads at the monthly frequency into expected loss (sovereign default risk) and the residual market risk premium. Hence, expected loss can be interpreted as both a component of the sovereign debt spread as well as a measure of country risk.

We find strong evidence that sovereign risk and risk premia as measured behave differently. The former is driven largely by country-specific sovereign risk fundamentals and market liquidity while the latter moves beyond national boundaries with investors' global risk aversion. Further research is warranted on the microstructural effects of liquidity on sovereign debt valuations in the CDS market. We have simply presented a much needed new approach to formalising the pricing of sovereign debt in emerging markets to better understand the convergence behaviour of emerging market debt spreads.

This study contributes new international cross-country evidence on the mechanics of sovereign risk pricing in emerging markets. Hence, our findings are of direct interest to emerging market participants, major financial institutions and monetary policy makers around the world as there are clear implications for bond pricing and portfolio credit risk management. We contribute a much better understanding on the recent developments in emerging debt markets.

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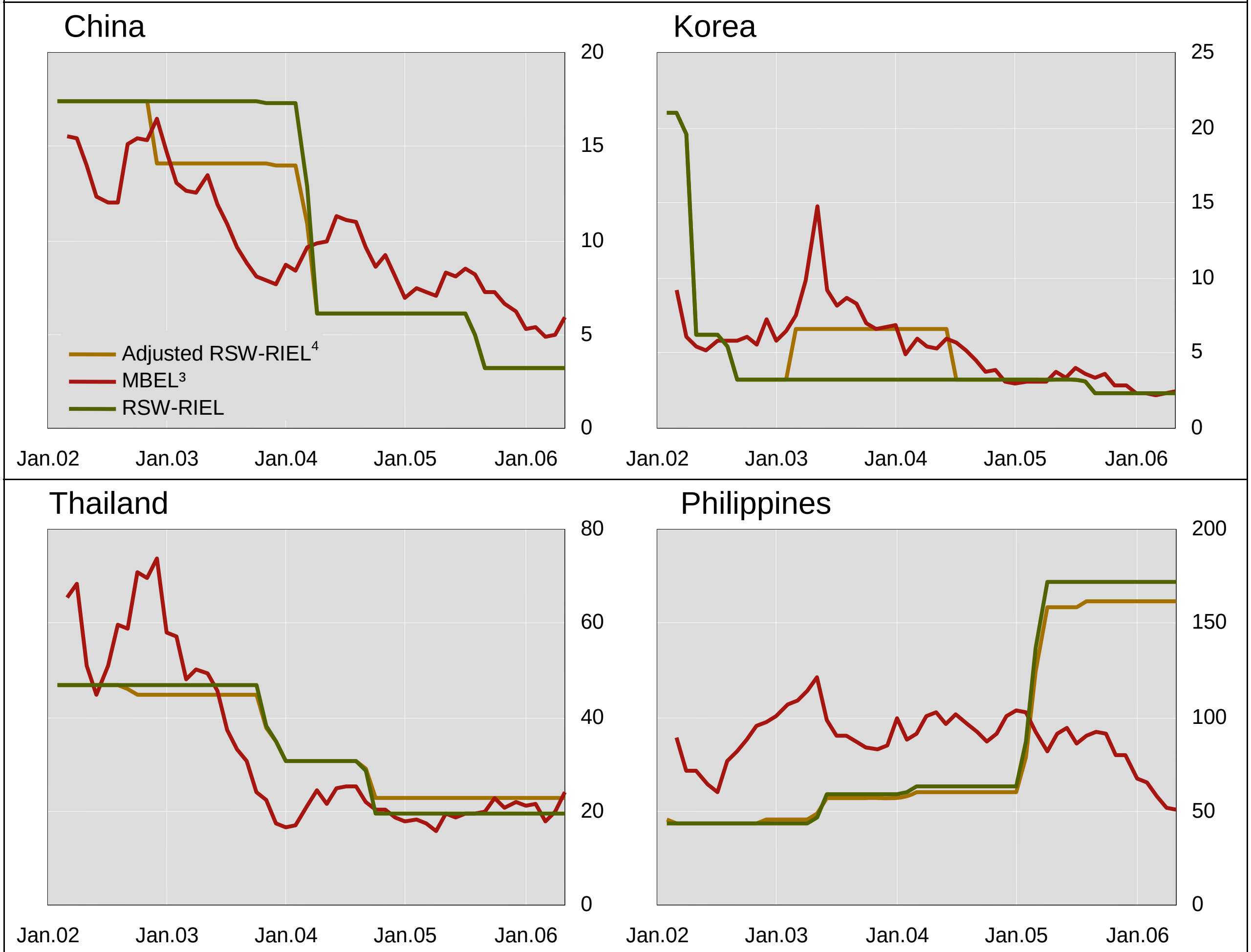
Figure 1: Comparing measures for expected losses: RSW-RIEL[1,2] and MBEL[1,3]



[1] In basis points. [2] Remolona-Scatigna-Wu (2007b) rating-implied expected loss. [3] Market-based expected loss. [4] Adjusted for outlooks and reviews.

Figure 2: CDS spreads and MBEL (In basis points)

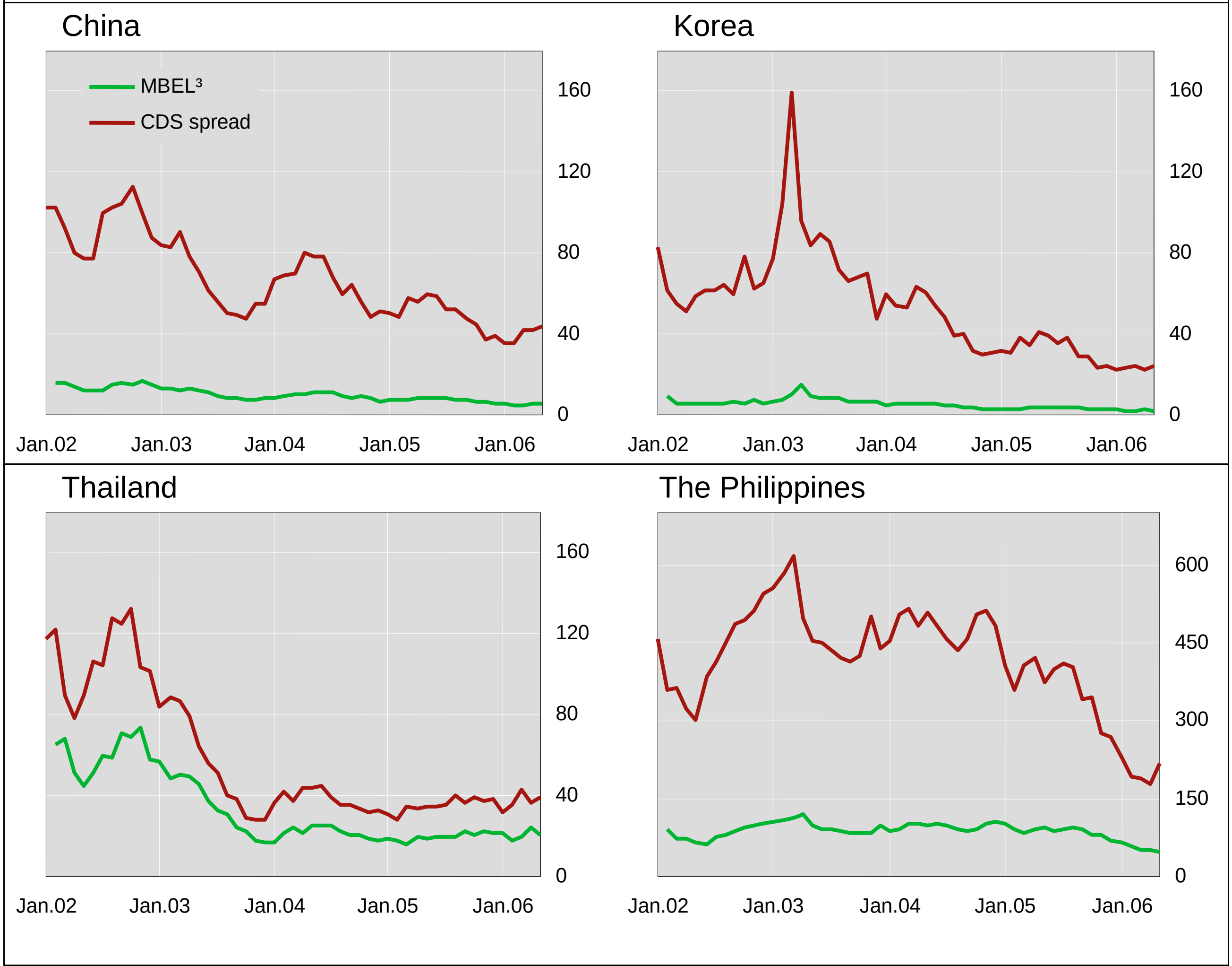


Table 1: Estimated regression results

This table presents the estimation results for equation (7) and (8). P-values are shown in parentheses and results are based on White cross-section standard errors. ***, ** and * denote significance level at the 1, 5 and 10% respectively. The sample period is from February 2002 - May 2006 at the monthly frequency.

Dep. variables	(1) Sov risk	Sov Risk Prem.	(2) Sov risk	Sov Risk Prem.	(3) Sov risk	Sov Risk Prem.
Fundamentals						
Lag Dep. variable	0.855**	0.708**	0.062	-0.370***	0.066	-0.386***
	{0.000}	{0.000}	{0.481}	{0.000}	{0.447}	{0.000}
Inflation rate	0.137*	0.226	0.711**	0.750	0.697*	0.768
	{0.097}	{0.154}	{0.045}	{0.290}	{0.053}	{0.274}
GDP growth consensus forecasts	-0.003	-0.007	-0.003	-0.028	-0.003	-0.0263
	{0.149}	{0.145}	{0.852}	{0.434}	{0.855}	{0.421}
Industrial production	0.000	-0.001	0.000	-0.004**	0.000	-0.003*
	{0.811}	{0.463}	{0.975}	{0.046}	{0.979}	{0.082}
Foreign exchange reserves	-0.056**	-0.175**	-0.101	-0.028	-0.092	0.020
	{0.010}	{0.000}	{0.181}	{0.870}	{0.220}	{0.910}
Risk aversion						
VIX	0.010**	0.023**				
	{0.002}	{0.000}				
Effective risk appetite	0.000	-0.043*				
	{0.980}	{0.061}				
G-10 RTI			0.0167	0.096***		
			{0.360}	{0.000}		
EM RTI					0.030	0.159***
					{0.195}	{0.000}
Hausman test	120.81***	166.42***				
	{0.000}	{0.000}				
Adjusted R-squared	0.99	0.97	0.42	0.18	0.75	0.22

Note: Adj. R-squares for the sov. Risk estimations under model specifications (2) and (3) were scaled by 10^3.

Table 2: The influence of liquidity on sovereign risk and risk premia

This table presents the estimation results for specification (3) from Table 1 augmented with bond market liquidity. P-values are shown in parentheses, based on White cross-section standard errors. The sample period studied is from Feb 2002- May 2006 with monthly data frequency.

Explanatory variables	Dependent variables	
	Log MBEL	**Log risk premium**[1]
<u>Fundamentals</u>		
Lagged log dependent variable	0.849**	0.644**
	{0.000}	{0.000}
Inflation rate	0.962*	0.731
	{0.058}	{0.630}
GDP growth consensus forecasts	0.007	-0.025
	{0.380}	{0.215}
Industrial production	-0.000	-0.001
	{0.587}	{0.405}
Foreign exchange reserves	-0.099**	-0.238**
	{0.000}	{0.000}
<u>Risk aversion</u>		
VIX index	0.010**	0.023**
	{0.005}	{0.000}
Risk appetite (Tarashev et al)	-0.003	-0.044
	{0.849}	{0.118}
<u>Liquidity</u>		
Net bond issuance	0.041*	0.047
	{0.056}	{0.241}
Adjusted R-squared	0.99	0.97

Table 3: Average pair-wise correlation coefficients for Sovereign Risk and Risk Premia

This table shows the average pair-wise correlations between countries for estimates of sovereign risk and risk premium within and across geographical regions and with the rest of the world.

			Correlation with:		
	Intra-region	**Rest of the world**	**Asia**	**Latin America**	**CEE**
Panel A: Sovereign risk based on MBEL estimates					
Asia	0.28	0.35			
Latin America	0.54	0.50	0.34		
CEE	0.62	0.52	0.37	0.56	
Middle East and Africa	0.52	0.53	0.37	0.58	0.58
World	*0.49*	*0.47*			
Panel B: Sovereign risk premia					
Asia	0.63	0.61			
Latin America	0.58	0.61	0.59		
CEE	0.65	0.61	0.62	0.61	
Middle East and Africa	0.62	0.61	0.64	0.61	0.60
World	*0.62*	*0.61*			

Appendix A List of 24 Emerging Market Countries studied

Asia	Africa/Middle East	Central/Eastern Europe	Latin America
China	Egypt	Bulgaria	Brazil
Indonesia	South Africa	Czech Republic	Chile
Korea		Hungary	Colombia
Malaysia		Poland	Dominican Republic
The Philippines		Russia	Ecuador
Thailand		Turkey	Mexico
		Ukraine	Panama
			Peru
			Venezuela