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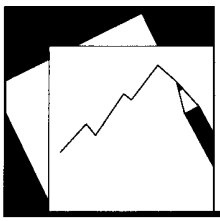

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Determinants of Emerging Market Sovereign Bond Spreads: Fundamentals vs Financial Stress

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Determinants of Emerging Market Sovereign Bond Spreads: Fundamentals vs Financial Stress

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Abstract

This paper analyses the determimants of emerging market sovereign bond spreads by examining the short and long-run effects of fundamental (macroeconomic) and temporary (financial market) factors on these spreads. During the current global financial and economic crisis, sovereign bond spreads widened dramatically for both developed and emerging market economies. This deterioration has widely been attributed to rapidly growing public debts and balance sheet risks. Our results indicate that in the long run, fundamentals are significant determinants of emerging market sovereign bond spreads, while in the short run, financial volatility is a more important determinant of sperads than fundamentals indicators.

JEL Classification Numbers: E43, F34, G15, H63

Keywords: Sovereign bond spreads, Emerging markts, Financial crisis

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I. INTRODUCTION

During the current global financial and economic crisis, sovereign bond spreads for both developed and emerging market economies widened dramatically. This deterioration has been attributed to the adverse impact of both large public interventions in support of domestic financial systems and fiscal stimulus packages, which led to rapidly growing public debt and balance sheet risks. Countries with large debt stocks and unsound banking sectors were affected the most. These developments have prompted renewed interest in the determination of sovereign bond spreads. This paper sheds light on this topic by investigating the short- and long-run effects of fundamental (macroeconomic) and temporary (financial market) factors on sovereign bond spreads.

Many studies have examined the relationship between sovereign bond spreads and various macroeconomic indicators and variables. These studies examine whether debt and fiscal variables, reserves, GDP growth, and interest rates of various maturities play an important role in explaining sovereign bond spreads (see, for example, Baldacci, Gupta, and Mati 2008; Eichengreen and Mody 1998; Kamin and Kleist 1999; and Min 1998). Although they find some empirical regularities, especially in the case of specific countries or regions and for certain time horizons, they by no means settle the debate over the stable and significant determinants of sovereign bond spreads.

An extension of these studies is the identification of short- and long-term determinants of sovereign bond spreads with a dynamic error correction model (examples include Dell'Aricia, Goedde, and Zettelmeyer 2000; Ferrucci 2003; and Goldman Sachs 2000). Ferrucci (2003) concludes that markets take into account macroeconomic fundamentals when pricing sovereign risk. The external debt to GDP ratio, the degree of openness, the ratio of amortizations to reserves, and the ratio of the current account to GDP are all significantly correlated with sovereign spreads; the interest payments to external debt ratio and the fraction of short-term external debt are also correlated with sovereign spreads, albeit more weakly. Ferrucci also finds that nonfundamental factors play an important role, as suggested by the strong empirical relationship between sovereign spreads and external factors such as global liquidity conditions and U.S. equity prices.

Researchers have also examined financial sector and crisis-related determinants of sovereign bond spreads. Ebner (2009) finds significant differences in government bond spreads in Central and Eastern Europe during crisis and noncrisis periods. According to his work, market volatility, political instability or uncertainty, and global factors explain the rise in spreads during crisis periods, when macroeconomic variables lose some of their importance. Dailami, Masson, and Padou (2008) propose a framework in which the probability of default is a nonlinear function of the risk-free rate (U.S. Treasuries), implying that the U.S. interest rate alone is not a sufficient explanation of the spread level. Interactions with the severity of the debt dynamics, global liquidity conditions, the appetite for risk, and shock indicators are also important, and a distinction has to be made between crisis and noncrisis periods.

Mody (2009) investigates the links between sovereign bond spreads in euro countries and financial vulnerability. He finds that financial fragility (measured by the ratio of the equity index of the country's financial sector to the overall equity index) is strongly correlated with spread changes. Between the time of the introduction of the euro and July 2007, for example, markets considered the probability of euro countries' sovereign default to be negligible. Following the onset of the current crisis, sovereign spreads in euro countries rose, as investors sought risk-free assets. After the rescue of Bear Stearns, in March 2008, a differentiation in spreads across countries emerged, caused mainly by differences in the prospects of the domestic financial sector. Differences widened in September 2008 (when Lehman Brothers failed), as some countries paid an increased penalty for high public debt to GDP ratios.

A related topic that has received considerable attention is the relationship between sovereign spreads and default risk. Sovereign bond spreads are widely considered a comprehensive measure of a country's overall risk premium, stemming from market, credit, liquidity, and other risks. Caceres, Guzzo, and Segoviano (2010) model sovereign spreads on joint probabilities of distress, extracted from credit default swap spreads, controlling for global risk aversion and macroeconomic fundamentals. Their approach helps assess the extent to which the large fluctuations in euro sovereign spreads reflect changes in global risk aversion and the rise in country specific risk. The results show that early in the crisis, the surge in global risk aversion was a significant factor influencing sovereign spreads. Recently, country-specific factors have started playing a more important role.

Our model extends the Ferrucci (2003) framework by incorporating a financial stress index, which attempts to capture the state of a country's financial health. Doing so allows us to better explain movements of emerging market sovereign spreads relating to financial vulnerabilities, as well as the short- versus long-term implications of financial crises. Our findings indicate that financial sector vulnerabilities, measured by the Emerging Markets Financial Stress Index developed by staff of the International Monetary Fund (Balakrishnan et. al (2009), IMF (2009c)), appear to be a crucial factor in explaining movements in spreads in the short run. This finding is consistent with the view that financial crisis periods may adversely affect the ability of sovereign issuers to service their debt, which is reflected in the premium on their bond yields. We also find that global liquidity conditions—measured by the volatility index VIX and two U.S. government securities' yields—have a large impact on short-term sovereign bond spreads. In the long run, macroeconomic factors that affect a country's liquidity and sustainability and thus its debt repayment capacity, as well as political risk, are significant determinants of emerging market sovereign bond spreads. The latter result is consistent with previous studies.

The paper is organized as follows. The second section explains the theoretical framework. The third section presents the variables used, and describes the data. The fourth section outlines the calibration and model estimation. The fifth section discusses the estimation

results based on a static fixed-effects model and the pooled mean group approach. The last section presents some concluding remarks.

II. METHODOLOGICAL FRAMEWORK

We propose a model of sovereign borrowing that formalizes the consumption choice of a small open economy. The economy smoothes its consumption path over time by borrowing from abroad when domestic resources are scarce and paying back its debt when resources are abundant. In this setting foreign lenders focus on the ability of the economy to generate enough foreign exchange resources to service its external obligations and its government's ability to generate enough domestic resources to purchase the foreign exchange required for servicing its external obligations. We formalize this framework by enhancing Ferrucci (2003).

The starting point of our analysis is the simple relationship between the probability of default p on emerging market sovereign bonds and the risk-free interest rate of equal maturity r (the U.S. Treasuries rates). Specifically, based on the overarching assumption that the expected return of an emerging market sovereign bond (exchange rate-adjusted interest rate *i*) should yield the same return as U.S. Treasuries $1 + r = (1 + i)(1 - p) + 0 \cdot p$, we adjust the probability of default to factor in the possibility that the country may be facing financial distress, during which default would be more likely

$$1 + r = (1 + it)(1 - p\, I_t) + 0\, p\, I_t, \qquad (1)$$

where I_t is a financial stress index. We assume that the financial stress index takes values greater than 0 such that $1 - pI_t > 0$ in the short run and 1 in the long-run, implying that in the short run, extraneous financial conditions could ameliorate or amplify the probability of default. For example, a high distress period, such as the ongoing financial crisis, could temporarily increase the probability of sovereign default, which would raise domestic interest rates in order to restore parity with the risk-free interest rate. In the long run, the probability of default is constant and determined solely by macroeconomic fundamentals, as shown below.

The spread over U.S. Treasuries can be written as

$$s_t = i_t - r = \left(\frac{1+r}{1-p \cdot I_t}\right) - 1 - r = (1+r)\left(\frac{1}{1-p \cdot I_t} - 1\right) = (1+r)\frac{p \cdot I_t}{1-p \cdot I_t}. \qquad (2)$$

We assume that markets close access to financing for two periods if a sovereign defaults. Therefore, the government will be able to finance its funding needs through debt issuance each period only if it is current on its debt payments during that period and did not default

during the previous period. Given that primary public spending (G_t) and interest payments on the existing external debt stock (iD_t) are financed by tax revenues (T_t) and debt issuance (D_{t+1}—D_t) if the government has financial market access, the government budget constraint in period t is given by

$G_t \le T_t + D_{t+1} \;\; \forall t \in N, t > 0$ with probability $p \cdot I_{t-1}$ that the government defaulted during the previous period, and

$G_t + (1 - pI_t)(1+i)D_t \le T_t + (1 - pI_t)D_{t+1} \;\; \forall t \in N, t > 0$ with probability $1 - p \cdot I_{t-1}$ that the government did not default during the previous period and probability $1 - p \cdot I_t$ that the government is not in default during the current period.

The maximization problem for a small open economy is

$$\text{Max} \quad U_0 = \sum_{t=0}^{T} \beta^t u(C_t)$$

subject to

$$G_0 = T_0 + D_1$$

$$G_t + (1 - p \cdot I_{t-1})(1 - p \cdot I_t)(1 + i_t)D_t \le T_t + [p \cdot I_{t-1} + (1 - p \cdot I_{t-1})(1 - p \cdot I_t)]D_{t+1}, t > 0$$

$$Y_t = C_t + G_t$$

$$T_t = f(Y_t)$$

$$Y_t = (1+g)Y_{t-1},$$

where U_0 is an intertemporal welfare function depending on consumption (C_t), and β is the discount factor.

The first two constraints are government budget constraints. For simplicity, we assume that all external debt is public. The third constraint is the usual accounting identity, equating total domestic output (Y_t) to the sum of private and government consumption. The last two equations in the formulation are required to close the model and define tax revenues as a function of output and the evolution of output over time (which for simplicity is assumed to be exogenous).

In this setup, the solution to the maximization problem should satisfy

$G_0 = T_0 + D_1$ in period t = 0 and

$$G_t + (1 - p \cdot I_{t-1})(1 - p \cdot I_t)(1 + i_t)D_t = T_t + [p \cdot I_{t-1} + (1 - p \cdot I_{t-1})(1 - p \cdot I_t)]D_{t+1}, t > 0 .$$

In the steady state,

$$((1-p)^2\, i - p)D = T - \text{G and } \left(r(1-p) - p^2\right) = \frac{T-G}{D}. \quad (3)$$

Using equation (2), we can express p as a function of s:

$$p = \frac{s}{s + (1+r)}, \quad (4)$$

in which the probability of default and the sovereign bond spread increase jointly. The long-run solution of equation (3) then implies the following:

- If the ratio of fiscal balance to domestic output, $\frac{T-G}{Y}$, increases, p and s should decrease (that is, a stronger fiscal position should decrease both the probability of sovereign default and the sovereign spread).
- A higher debt to GDP ratio is associated with a higher probability of default and wider sovereign bond spreads.
- If the stock of debt is greater than the fiscal deficit, an increase in the risk-free interest rate (r) should lead to a higher probability of sovereign default and larger sovereign bond spreads. Given that this condition is almost always satisfied, it is safe to conclude that the risk-free interest rate and the sovereign bond spreads are positively correlated.[1]

These three relationships determine the expected theoretical signs of (T−G)/Y, D/Y, and r, p, and s in the long run. We look at p and s as functions of $(T-G)/Y$, D/Y, and r. In the short run, the spread is also affected by the financial stress index, with higher values of the index implying a wider spread.

III. Variable Selection and Data

We use the following variables to explain the spread levels:

- External debt/GDP
- Interest payments on external debt/reserves
- Short-term debt/reserves
- External debt amortization/reserves

[1] None of the countries included in the empirical analysis violated this condition during the period covered by the study.

- Fiscal balance/GDP
- Current account balance/GDP
- Trade openness
- Financial fragility (financial stress index)
- Risk-free rate and external liquidity conditions (U.S. 3-month Treasury bill rate and 10-year government bond yield, and volatility index VIX).
- Political risk

A. Macroeconomic Variables

Our theoretical framework indicates the selection of fundamental factors, such as the risk-free rate (r), the stock of debt (D), gross domestic product (Y), and the fiscal balance (T – G), as the main determinants of sovereign bond spreads. In addition, liquidity and sustainability indicators need to be included in order to assess a country's capacity to repay its debt. Liquidity indicators measure issuers' ability to fulfill their current obligations. Notably, the stock of international reserves plays a role by providing a buffer of foreign liquidity that could be used to repay debt.[2] We therefore include (as ratios to reserves) external debt amortization, interest payments, and the amount of short-term debt, which—together with the fiscal balance and the current account balance—characterize the country's gross financing needs. We expect these variables to have a positive impact on sovereign spreads, with greater financing needs implying greater compensation for risk.

External solvency is linked to a sustainable level of external indebtedness and factors that affect it, such as the current account balance and trade openness (proxied by the ratio of exports plus imports to GDP). In particular, a low degree of openness can affect the trade surplus and therefore increase the probability of external default. Therefore, we expect both the current account and trade openness to have negative signs.

[2] We omitted some variables used in the literature. More complex models include external competitiveness indicators, such as exchange rates (Bordo, Meissner, and Weidenmier 2009; McGee 2005), which affect trade activity and fiscal sustainability. Our model includes a trade-related indicator—trade, defined as the ratio of the sum of exports and imports and GDP—as a proxy for competitiveness. Because many indebted emerging market economies are commodity exporters, other studies use an index of commodity prices. We approximate this activity by openness and GDP.

B. Financial Fragility and Crisis Periods

Employing only macroeconomic fundamentals to explain spreads, without incorporating political and crisis considerations, does not adequately capture debt dynamics and the probability of default (and therefore the effect on spreads). Using zero-one binary variables often used in econometric work (see Mody 2009) does not always provide a good measure of intensity of stress and often ignores the ambiguity of "near-miss" events, such as the emerging market sell-off in June 2006, which increased price volatility in countries with large current account deficits but had just minor macroeconomic implications. We therefore use the Emerging Markets Financial Stress Index developed by Balakrishnan and others (2009), which provides a high-frequency measure of stress in emerging economies. The components of the index include the following:

- The exchange market pressure index, which increases as the exchange rate depreciates or international reserves decline
- Default risk measures (sovereign bond spreads)
- The banking sector beta, based on the standard capital asset pricing model, computed over a 12-month rolling window (a beta higher than 1 indicates that banking stocks move more than proportionately with the overall stock market, suggesting that the banking sector is riskier than the market as a whole)
- Stock price returns, calibrated such that falling equity prices correspond to increased market stress
- Time-varying stock return volatility, wherein higher volatility captures heightened uncertainty.

In all estimations we modify the financial stress index by excluding its sovereign bond spread component, in order to avoid endogeneity problems. Higher values of this index indicate greater distress.

Also, political instability has been found to undermine the issuers' credibility and increase default probability (Baldacci, Gupta, and Mati 2008). Adding a measure of political risk would thus be appropriate, with increased political uncertainty expected to widen sovereign bond spreads.

C. Data Description

The data set covers 14 countries between the first quarter of 1997 and the second quarter of 2009. The dependent variable is the secondary market spread, as provided by JPMorgan's Emerging Markets Bond Index (EMBI). This spread is measured by an index that includes sovereign and quasi-sovereign (guaranteed by the sovereign) instruments that satisfy certain liquidity criteria in their trading. The spread of an instrument (bond) is calculated as the premium paid by an emerging market over a U.S. government bond with comparable

maturity features. A country's spread index is then calculated as the average of the spreads of all bonds that satisfy the inclusion criteria, weighted by the market capitalization of the instruments. One of the benefits of such an index is that the time series are continuous, without breaks as bonds mature.

The right-hand-side variables of the model comprise country-specific macroeconomic fundamentals and external liquidity indicators, as well as political risk and financial stress indices (Table 1). We used several sources, including the IMF's International Financial Statistics database, the IMF Global Data Source, the Haver Statistics database, and the World Bank database, to compile the series.

Simple summary statistics of the variables (Figure 1 and Table 2) reveal that EMBI spreads are highly positively correlated with the ratios of external debt (public and private) to GDP and public debt (external and domestic) to GDP. Interest payments to reserves, short-term debt to reserves, and, to a lesser extent, amortization to reserves also appear to have a positive correlation with EMBI spreads, as do the indices of political risk and financial stress. The fiscal balance and the current account are not highly correlated with the spreads and are likely to appear insignificant in the estimations. The ratios of external and public debt have a very high positive correlation (0.8). To minimize replication, we present the results using the ratio of total external debt, for which we have longer series. The three liquidity measures—short-term debt, interest payments, and amortization to reserves—are also highly correlated, suggesting that they should be used in the estimations one at a time.

IV. Calibration and Model Estimation

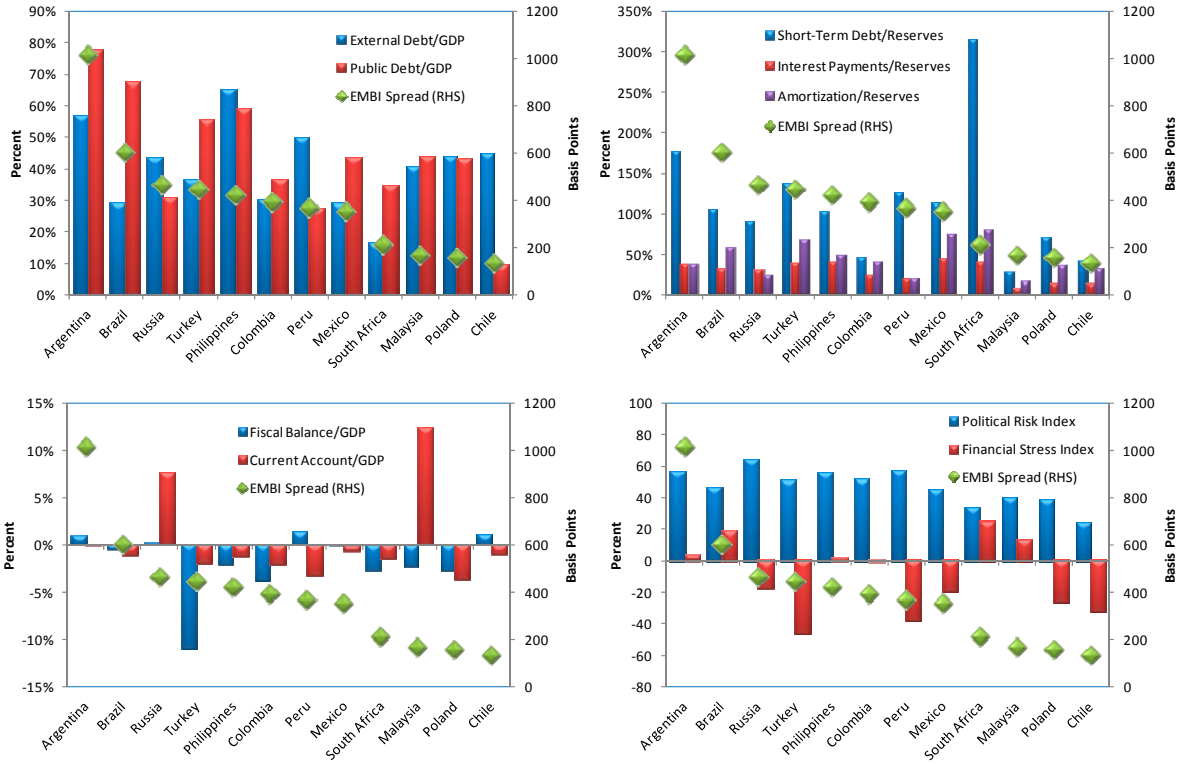
As in Ferrucci (2003) and Dailami, Masson, and Padou (2008), we use the pooled mean group (PMG) estimator of Pesaran and Smith (1995) and Pesaran, Shin, and Smith (1999) to capture the structure of the quarterly frequency data. The PMG estimator distinguishes short-term from long-term parameters of the model and allows the short-term parameters to vary across countries while keeping long-term elasticities constant. Using such a model instead of static fixed-effects estimators has several benefits: the dynamic aspect of the model controls for possible cointegration; the model imposes commonality on the long-run coefficients without restricting the short-term coefficients, which is more plausible economically; and the separation of long-term and short-term views allows the specificity of some variables across countries in the short term to be taken into account. Baltagi and Griffin (1997) and Boyd and Smith (2000) show that pooled estimators have desirable properties and may outperform their heterogeneous counterparts. They find that pooled models tend to produce more plausible estimates even for panels with relatively long time series and that they offer overall superior forecast performance. This estimation method is appropriate for frameworks in which cross-country variation is needed in the short-term dynamics but commonality is needed in the long run, assuming that an equilibrium (steady state) is reached. These assumptions seem consistent with the nature of our analytical problem.

Table 1. Description of the Variables

Variable	Description	Unit	Frequency	Interpolation	Source
Spreads	Secondary market spreads, calculated as premium paid over U.S. government bond with comparable features	Basis Points	Quarterly	No	Bloomberg (JPMorgan EMBIG Index), Ferrucci (2003)
GDP	Nominal GDP, in current prices	Dollars	Quarterly	No	Haver Statistics database; *International Financial Statistics* (IMF 2009b)
External debt	Stock of external debt	Dollars	Annual	Yes	*Global Development Finance* (World Bank 2009)
Public debt	Stock of public debt to GDP	Percent	Annual	Yes	*World Economic Outlook* (IMF 2009c)
Short-term debt	Short-term external debt	Dollars	Annual	Yes	*Global Development Finance* (World Bank 2009)
Interest	Interest payments on external debt	Dollars	Annual	Yes	*Global Development Finance* (World Bank 2009)
Reserves	Stock of International reserves, excluding gold	Dollars	Quarterly	No	*International Financial Statistics* (IMF 2009b)
Amortization	Principal repayments on external debt	Dollars	Quarterly	No	*International Financial Statistics* (IMF 2009b)
Fiscal balance	Fiscal balance to GDP	Percent	Quarterly	No	*International Financial Statistics* (IMF 2009a)
Current account	Current account balance	Dollars	Quarterly	No	*International Financial Statristics* (IMF 2009b)
Openness	Exports + imports/GDP	Percent	Quarterly	No	*International Financial Statristics* (IMF 2009b)
Political risk index	Total political risk score (0–100), evaluating a range of factors relating to political stability and effectiveness; higher score indicates greater political risk	Index	Quarterly	No	The Economist Intelligence Unit (2009)
Financial stress index	Standard components: exchange market pressure index (which depends on exchange rate and change in reserves); sovereign spreads (excluded); banking sector beta stock returns; stock return volatility	None	Quarterly	No	Balakrishnan and others (2009)
VIX	Chicago Board Options Exchange (CBOE) Volatility Index (VIX)	Index	Quarterly	No	CBOE
U.S. 3-month Treasury bill	U.S. 3-month Treasury bill rate	Percent	Quarterly	No	Federal Reserve
U.S. 10-year government bond	U.S. 10-year government bond rate	Percent	Quarterly	No	Federal Reserve

Source: Author's compilation.

Figure 1. Determinants of EMBI Spreads



Source: Authors.

Table 2. Summary Statistics, by Country

Variable mean	Argentina	Brazil	Bulgaria	Chile	Colombia	Malaysia	Mexico	Peru	Philippines	Poland	Russian Fed.	South Africa	Turkey	Venezuela, R.B. de	All countries	
															Mean	Observations
EMBI Spread	1,017	746	602	465	444	419	393	380	367	353	214	169	156	136	410	988
External debt/GDP	0.567	0.292	0.870	0.446	0.302	0.407	0.289	0.500	0.653	0.437	0.433	0.164	0.369	0.433	0.490	1,363
Public debt/GDP	0.781	0.676	0.408	0.097	0.366	0.435	0.434	0.275	0.591	0.428	0.309	0.344	0.554	0.416	0.515	785
Short-term debt/reserves	1.765	1.061	1.071	0.425	0.463	0.282	1.134	1.253	1.037	0.705	0.903	3.157	1.372	0.506	1.168	1,204
Interest payments/reserves	0.381	0.319	0.284	0.132	0.239	0.073	0.451	0.192	0.405	0.134	0.299	0.410	0.393	0.245	0.317	1,204
Amortization/reserves	0.381	0.596	0.288	0.325	0.400	0.163	0.741	0.189	0.492	0.356	0.229	0.801	0.675	0.282	0.445	1,339
Fiscal balance/GDP	0.010	-0.006	-0.008	0.012	-0.038	-0.022	0.000	0.014	-0.021	-0.027	0.003	-0.026	-0.109	0.006	-0.016	928
Current account/GDP	0.000	-0.011	-0.076	-0.011	-0.020	0.123	-0.006	-0.033	-0.012	-0.036	0.076	-0.016	-0.019	0.018	-0.006	1,046
Political risk index	56.8	46.6	44.4	24.4	51.8	40.0	45.1	57.2	55.4	39.0	64.6	33.4	51.1	66.5	52.5	899
Openness	0.063	0.173	0.935	0.509	0.269	1.765	0.114	0.289	0.755	0.598	0.482	0.434	0.309	0.106	0.399	1,046
Financial stress index	0.036	0.191		-0.324	-0.009	0.135	-0.200	-0.382	0.017	-0.263	-0.171	0.251	-0.466		-0.094	565
VIX															21.497	988
U.S. 3-month Treasury bill rate															0.039	1,404
U.S. 10-year government bond yield															0.057	1,404
Spread between U.S. 10-year and 3-month rates															0.018	1,404

Pairwise correlation	1	2	3	4	5	6	7	8	9	10	11	12	13	14
EMBI spread	1.0													
External debt/GDP	0.3	1.0												
Public debt/GDP	0.4***	0.8***	1.0											
Short-term debt/reserves	0.4***	0.1***	0.1***	1.0										
Interest payment/reserves	0.4***	0.1***	0.1	0.7***	1.0									
Amortization/reserves	0.2***	0.0	0.0	0.5***	0.8***	1.0								
Fiscal balance/GDP	-0.1**	0.0	-0.1***	-0.1**	-0.2***	-0.2***	1.0							
Current account/GDP	0.0	-0.1***	-0.1	-0.1*	0.0	0.0	0.0	1.0						
Political risk index	0.6***	0.3***	0.4***	0.1***	0.3***	0.1***	0.0	0.2***	1.0					
Openness	-0.4***	0.1***	-0.2***	-0.1***	-0.2***	-0.2***	-0.1***	0.2***	-0.4***	1.0				
Financial stress index	0.3***	0.0	0.0	0.1	0.2***	-0.1	-0.1*	-0.1***	0.0	-0.1*	1.0			
U.S. 3-month Treasury bill rate	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	-0.1***	-0.1	1.0		
Spread between U.S. 10-year and 3-month rates	0.2***	0.0*	0.1**	0.1***	0.0	0.0	-0.1*	0.0	0.0	-0.1**	0.1**	-0.6***	1.0	
U.S. 10-year government bond yield	0.3***	0.1**	0.0	0.3***	0.3***	0.0	0.0	0.0	0.1*	-0.2***	0.0	0.8***	0.0	1.0

Source: Authors.

Note: EMBI = Emerging Markets Bond Index.
*** Significant ate 1% level; **significant at the 5% level; * significant at the 10% level.

Many researchers have used the basic log model, which is

$$\log s_{it} = \alpha + \sum_{j=1}^{J} \beta_j x_{jit} + \varepsilon_{it} \,. \tag{6}$$

Because of the time series dimension of the panel data set, it is likely that the correct model includes lagged dependent variables, which would bias the standard fixed-effects estimation. If we assume that the parameters vary across countries, we can use the following dynamic panel representation of the model:

$$\log s_{it} = \mu_i + \lambda_i \log s_{it-1} + \sum_{j=1}^{J} \gamma_{1ji} x_{jit} + \sum_{j=1}^{J} \gamma_{2ji} x_{jit-1} + u_{it} \,.$$

By rearranging, we get the error correction equation, which is

$$\Delta \log s_{it} = \phi_i \left[\log s_{it-1} - \alpha_i - \sum_{j=1}^{J} \beta_{ji} x_{jit} \right] - \sum_{j=1}^{J} \gamma_{2ji} \Delta x_{jit} + u_{it}$$

where $\phi_i = -(1-\lambda_i)$ $\alpha_i = \dfrac{\mu_i}{1-\lambda_i}$ $\beta_{ji} = \dfrac{\gamma_{1ji} + \gamma_{2ji}}{1-\lambda_i}$

(this representation of the model applies to both stationary and I(1) series). The term in brackets is the long-term relationship between the spread s and the vector X of the explanatory variables, with β_{ji} representing the long-run elasticity of variable *j* and country *i*. The assumption of long-run commonalities requires that these elasticities not vary across countries, which means that for all *i*, $\beta_{ji} = \beta_j$. Therefore, the equation to estimate is

$$\Delta \log s_{it} = \phi_i \left[\log s_{it-1} - \alpha_i - \sum_{j=1}^{J} \beta_j x_{jit} \right] - \sum_{j=1}^{J} \gamma_{2ji} \Delta x_{jit} + u_{it} \,. \tag{7}$$

V. Discussion of Results

We use two different approaches to estimate the coefficient: the fixed-effects model for estimation of equation (6) and the PMG model for estimation of equation (7). In general, the estimation methods show some important regularities for the determinants of sovereign bond spreads.

A. Fixed-Effects Model

The benchmark specification of the estimation of equation (6) (specification 2 in Table 3) includes all variables. Specifications (3)–(7) exclude certain variables (liquidity indicators, interest rates) that were found to be collinear. Specification 1 is provided as a comparison with the benchmark, especially to demonstrate the impact of adding the financial stress index to the estimations. The benchmark specification is satisfactory in terms of explanatory power (R^2 of 0.824), sign, and significance level. Among the fundamental variables, the coefficients

of the external debt to GDP ratio, interest payments on external debt to reserves, and external debt amortization to reserves are statistically significant and, except for the external debt amortization to reserves, have the expected signs.

The sum of all liquidity indicators is positive, however, suggesting that in general, greater financing needs relative to liquid resources increase sovereign bond spreads. This implication is confirmed by specifications (3)–(5), in which the three liquidity indicators used one at a time have positive signs, and two of them (short-term debt to reserves and interest payments to reserves) are highly significant.

The coefficient of the volatility index VIX is positive and significant, confirming that global liquidity conditions are important determinants of EMBI spreads. Other global variables (e.g., the 3-month U.S. Treasury bill rate) do not appear to be significant determinants of sovereign spreads in the benchmark specification. However, when some of the domestic liquidity variables are not included in the regressions, the impact of both the 3-month U.S. Treasury bill rate and the spread between the 10-year U.S. government bond yield and the 3-month U.S. Treasury bill rate becomes large and highly significant (specification 5). In particular, a 1 percentage point increase in the 3-month Treasury bill rate increases EMBI spreads by about 7.5 percentage points; a 1 percentage point increase in the term spread between the 10-year U.S. government bond and the 3-month Treasury bill increases spreads by additional 7 percentage points. Therefore, both U.S. policy conditions and the slope of the yield curve affect emerging markets' liquidity conditions, as well as their sovereign bond spreads.

The financial stress index is also highly significant and positively correlated with the spread level, indicating that the idiosyncratic financial environment in a country can affect the financing conditions of the sovereign. A substantial drop in the coefficient of determination (R^2) is observed when the estimation excludes the index (5 percent), suggesting that the variable plays an important role in explaining the spread level.

This set of estimations indicates that the fiscal balance is not consistently statistically significant across all specifications, as suggested by the theoretical framework. Not all of these findings conform with those of previous studies, which find that local factors play a much less important role than external factors in determining spreads on international sovereign bonds. However, an increase in the ratio of debt to GDP by 1 percentage point increases spreads by about 2.8 basis points. Provided that the increase in the debt ratio is caused by a higher fiscal deficit, its impact is already factored in. Specifications in which interest payments are excluded show significant coefficients for the fiscal balance, suggesting a colinearity impact.

Table 3. Fixed-Effects Estimation

Coefficient	-1	-2	-3	-4	-5	-6	-7
External debt/GDP	2.856***	2.811***	2.626***	2.813***	2.915***	2.809***	2.795***
	(0.142)	(0.166)	(0.168)	(0.151)	(0.140)	(0.165)	-0.159
Short-term debt/reserves	-0.0578	-0.058	0.206***			-0.057	-0.055
	(0.067)	(0.078)	(0.062)			(0.078)	-0.078
Interest payments/reserves	2.055***	2.019***		1.189***		2.010***	2.028***
	(0.268)	(0.282)		(0.191)		(0.278)	-0.281
Amortization/reserves	-0.499***	-0.599***			0.159*	-0.597***	-0.604***
	(0.115)	(0.120)			(0.088)	(0.119)	-0.119
Fiscal balance/GDP	0.107	0.256	-0.052	0.237	-0.494	0.26	0.269
	(0.354)	(0.360)	(0.377)	(0.370)	(0.350)	(0.359)	-0.358
Current account/GDP	-0.13	0.442	0.379	0.392	0.084	0.45	0.443
	(0.378)	(0.504)	(0.535)	(0.518)	(0.510)	(0.502)	-0.504
Political risk index	0.0130***	0.0185***	0.020***	0.0181***	0.024***	0.019***	0.019***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	-0.003
Openness	-0.958***	-0.737***	-0.674**	-0.899***	-0.604***	-0.731***	-0.727***
	(0.198)	(0.276)	(0.286)	(0.280)	(0.231)	(0.274)	-0.274
Financial stress index		0.041***	0.047***	0.044***	0.052***	0.041***	0.042***
		(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	-0.009
VIX	0.0445***	0.0372***	0.041***	0.037***	0.031***	0.037***	0.037***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	-0.003
U.S. 3-month Treasury	-2.496	-0.137	3.999*	1.691	7.463***	0.26	
bill rate	(1.952)	(2.060)	(2.104)	(2.080)	(1.965)	(0.979)	
Spread between U.S. 10-year and 3-month rate	-3.883	-0.599	2.434	0.483	7.121**		
	(2.566)	(2.731)	(2.864)	(2.800)	(2.825)		
U.S. 10-year government bond yield							0.043
							-1.99
Constant	3.423***	3.208***	2.883***	3.092***	2.617***	3.188***	3.197***
	(0.213)	(0.235)	(0.245)	(0.239)	(0.222)	(0.216)	-0.232
Observations	532	438	438	438	512	438	438
R-squared	0.809	0.824	0.801	0.813	0.786	0.824	0.824
Number of countries	14	12	12	12	12	12	12

Source: Authors.

Note: The dependent variable is the log of the EMBI spreads. Standard errors are in parentheses. EMBI = Emerging Markets Bond Index.
*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

B. Pooled Mean Group Model

The PMG method, which allows short-run parameters to vary across countries, is used to estimate equation (7).[3] The estimated long-term coefficients are compared with the coefficients obtained with the fixed effects. The long-run relationship between the variables is significant $\left(\frac{1}{N}\sum_{i=1}^{N}\phi_i \neq 0\right)$, implying that the spread level cannot be explained only by short-term variations (Table 4).

For the PMG estimations, specification (2), containing all selected variables, shows several important differences with the fixed effects estimation. First, the fundamental variables (the debt ratio and the current account ratio), all liquidity indicators (summing to a positive effect), and the political risk index are significant in the long run but not the short run. As expected, these variables determine the steady-state level of the sovereign bond spreads.

The long-run coefficient of the degree of openness is significant in the long run (with a negative sign) in specifications (3)-(4), in which the liquidity variables are included one at a time. The results for openness also show interesting dynamics between the short and the long run. Although openness is associated with better economic performance and therefore lower sovereign spreads in the long run, it brings about substantial volatility in the short run, which puts pressure on the sovereign's financing conditions.

Liquidity conditions remain important determinants of sovereign spreads in the long run. The long-run coefficient of the volatility index is positive and highly significant. The long-run coefficients of the 3-month U.S. Treasury bill rate and the term spread between the 10-year U.S. bond and the 3-month Treasury bill rate are positive and significant in specifications (3)–(5), in which other liquidity variables are used one at a time.

Second, the volatility and the financial stress indices are the only variables whose short-term coefficients are significant in specification (2). The financial stress index is significant only in the short run. As suggested by the theoretical framework, it thus has no effect on the steady-state conditions, implying that the volatility experienced in stock market returns and the foreign exchange market has only a short-lived impact on sovereign spreads. The average error correction coefficient, $\phi_i = -(1-\lambda_i)$, i.e., -0.53 in the benchmark equation (2) of Table 4, indicates that about 50 percent of the adjustment to the steady state takes place each period (quarter), and about 95 percent of the effect of a potential shock to the financial stress index would dissipate within a year.

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[3] Fisher-type unit root tests (Dickey-Fuller and Phillips-Perron), which are appropriate for unbalanced panel data, reject the unit root hypothesis at the 5 percent level for all variables. Pesaran, Shin, and Smith (1999) show that consistency and asymptotic normality of the PMG estimator are established under standard conditions given stationarity.

Table 4. Pooled Mean Group Estimation

Coefficient	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Long-term coefficients							
External debt/GDP	2.655***	2.205***	5.779***	1.404***	2.537***	2.238***	2.088***
	(0.368)	(0.420)	(0.503)	(0.492)	(0.395)	(0.422)	(0.346)
Short-term debt/reserves	-0.973***	-0.938***	0.222**			-0.957***	0.0498
	(0.128)	(0.146)	(0.095)			(0.150)	(0.093)
Interest payments/reserves	6.497***	6.754***		3.867***		6.637***	3.449***
	(0.537)	(0.584)		(0.573)		(0.585)	(0.498)
Amortization/reserves	-1.435***	-1.520***			-0.168	-1.459***	-0.556***
	(0.141)	(0.154)			(0.272)	(0.155)	(0.168)
Fiscal balance/GDP	3.254***	3.258***	2.273***	3.648***	2.733***	2.900***	3.063***
	(0.724)	(0.761)	(0.556)	(1.068)	(0.962)	(0.778)	(0.904)
Current account/GDP	-3.364***	-3.278***	-0.994	-1.914*	-3.033***	-3.139***	3.921***
	(0.779)	(0.893)	(1.246)	(1.073)	(0.900)	(0.910)	(0.922)
Political risk index	0.018***	0.018***	0.014**	0.029***	-0.004	0.021***	0.019***
	(0.004)	(0.004)	(0.006)	(0.006)	(0.007)	(0.004)	(0.004)
Openness	-0.756**	-0.396	-4.879***	-1.792***	-0.651	-0.594	-2.561***
	(0.358)	(0.408)	(0.783)	(0.528)	(0.473)	(0.408)	(0.551)
Financial stress index		-0.019*	-0.001	-0.033**	-0.044***	-0.024**	-0.019
		(0.012)	(0.017)	(0.014)	(0.016)	(0.012)	(0.011)
VIX	0.023***	0.026***	0.032***	0.034***	0.044***	0.028***	0.035***
	(0.003)	(0.004)	(0.006)	(0.005)	(0.006)	(0.004)	(0.004)
U.S. 3-month Treasury bill rate	-2.977	-2.939	5.743*	13.97***	12.14***	-2.363*	
	(2.450)	(2.520)	(3.387)	(3.463)	(3.848)	(1.215)	
Spread between U.S. 10-year and 3-month rate	-0.151	-0.124	-0.131	15.31***	2.532		
	(2.999)	(3.133)	(4.598)	(4.676)	(4.951)		
U.S. 10-year government bond yield							0.28
							(2.322)
Error Correction (phi)	-0.480***	-0.532***	-0.327***	-0.398***	-0.322***	-0.530***	-0.507***
	(0.085)	(0.094)	(0.076)	(0.079)	(0.112)	(0.092)	(0.076)

Short-term coefficients							
External debt/GDP	1.736	2.192*	0.751	2.334**	1.736*	1.915	1.526
	(1.074)	(1.171)	(1.203)	(1.094)	(0.936)	(1.202)	(1.344)
Short-term debt/reserves	0.750	1.020	0.446			1.262**	0.401
	(0.556)	(0.626)	(0.479)			(0.592)	(0.936)
Interest payments/reserves	-2.371	-4.357		-2.666		-4.776	-0.172
	(3.139)	(3.771)		(2.951)		(3.304)	(2.820)
Amortization/reserves	0.767	1.095			0.452	1.069	0.388
	(0.797)	(0.945)			(0.585)	(0.904)	(0.789)
Fiscal balance/GDP	-0.133	0.030	0.781*	0.560	0.339	0.055	0.292
	(0.498)	(0.510)	(0.448)	(0.453)	(0.403)	(0.511)	(0.435)
Current account/GDP	0.973	0.875	0.641	0.778	1.073	0.639	-1.078
	(1.847)	(2.197)	(1.874)	(1.757)	(0.912)	(2.047)	(1.551)
Political risk index	-0.009	-0.008	-0.009**	-0.006	-0.004	-0.008*	-0.005
	(0.007)	(0.007)	(0.004)	(0.007)	(0.005)	(0.005)	(0.007)
Openness	-0.177	0.304	1.627***	1.700***	2.171**	0.481	0.786
	(0.687)	(0.504)	(0.444)	(0.586)	(0.965)	(0.542)	(0.820)
Financial stress index		0.014***	0.011*	0.021***	0.02***	0.011***	0.014***
		(0.004)	(0.006)	(0.006)	(0.006)	(0.004)	(0.005)
VIX	0.022***	0.020***	0.021***	0.016***	0.011***	0.020***	0.019***
	(0.003)	(0.004)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
U.S. 3-month Treasury bill rate	3.270	4.077	2.231	-4.606	-0.705	5.348*	
	(3.106)	(3.943)	(4.265)	(4.006)	(2.740)	(2.757)	
Spread between U.S. 10-year and 3-month rate	-1.622	-0.911	-0.025	-4.670**	-1.556		
	(1.778)	(2.574)	(2.008)	(2.180)	(2.132)		
U.S. 10-year government bond yield							-1.617
							(2.256)
Constant	1.734***	1.889***	1.345***	1.039***	1.144***	1.824***	1.965***
	(0.317)	(0.339)	(0.299)	(0.204)	(0.316)	(0.318)	(0.273)
Observations	517	425	425	425	499	425	425
Number of countries	14	12	12	12	12	12	12

Source: Authors.

Note: The dependent variable is the log of the EMBI spreads. Standard errors are in parentheses. EMBI = Emerging Markets Bond Index. VIX= volatility index.

*** Significant at the 1% level; ** significant at the 5% level; * significant at the 10% level.

Overall, these model specifications point toward a strong long-term relationship between emerging market sovereign bond spreads and macroeconomic fundamentals such as debt and debt-related variables, trade openness, liquidity conditions, and political risk. However, part of the variation in sovereign bond spreads—notably in the short run—seems to be explained by the financial health of the country, as proxied by the financial stress index. This effect likely reflects the fact that financial difficulties are assumed to increase the probability of default and, consequently, sovereign bond spreads. These results are consistent with findings in other studies, in particular Ferrucci (2003).

VI. Concluding Remarks

This paper analyzes the short- and long-term relationship between emerging market sovereign bond spreads and a set of macroeconomic and financial stress variables, using EMBI secondary market spreads. We introduce a theoretical framework that helps us form priors about the variables used in the model. In our empirical work, we use a fixed-effects model and a dynamic model, the PMG estimation technique, which allows us to distinguish short- from long-term effects. We allow the short-run parameters to vary across countries, which is appropriate given the clustered short-term nature of the data. The results are satisfactory in terms of sign, significance, and explanatory power.

In particular, the regressions suggest that in the short run, financial fragility is a more important determinant of spreads than fundamental indicators. The short-term coefficient of the financial stress index appears to be highly significant in all estimations, while the short-term coefficients of fundamental variables are less robust. This is an innovative result that extends the findings of Mody (2009) and other researchers who use dummy variables for crisis periods to show the correlation between financial volatility and sovereign spreads. We also find that liquidity conditions could have important bearing on short-term sovereign spreads, particularly through the effect of the global volatility index.

Our findings confirm that in the long run, fundamentals are significant determinants of emerging market sovereign bond spreads. However, other factors, such as political instability, corruption, and asymmetry of information, may also affect the spread level, given their potential impact on the ability of governments to repay their bondholders. In this regard, we show that political risk is an important long-term determinant of sovereign bond spreads.

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