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## U.S. Real Interest Rates and Default Risk in Emerging Economies

This paper empirically investigates the impact of changes in U.S. real interest rates on sovereign default risk in emerging economies using the method of identification through heteroskedasticity. Policy-induced increases in U.S. interest rates starkly raise default risk in emerging market economies. However, the overall correlation between U.S. real interest rates and the risk of default is negative, demonstrating that the effects of other variables dominate the anterior relationship.

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THE THEORETICAL ECONOMIC EFFECT of changes in U.S. real interest rates on default risk in emerging economies has been studied by, among others, Guimaraes (2011), and the channel is often cited as a nondomestic driver of country risk premia (Neumeier and Perri 2005). The mechanism runs that when U.S. real interest rates rise, the opportunity costs to those who buy emerging economies' debt increase, which raises interest rates in emerging economies. This direct effect increases the debt burden on emerging economies, raising the risk they will default on their debt and requiring emerging economies to offer even higher interest rates in compensation. Anecdotal evidence from the Latin American debt crisis of the 1980s and the Mexican crisis in 1994, both of which were preceded by sharp interest rate hikes in the U.S., suggests this theoretical channel might be an important empirical one.

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Empirically identifying this theoretical relationship is not trivial, however, owing to the usual endogeneity problems of reverse causality and common omitted variables. The latter is especially problematic because U.S. real interest rates and default risk in emerging economies are both affected by variables that cannot be easily measured, such as global market factors, risk appetite, and expectations about economic performance and the political scenario.

This paper identifies the effects of changes in U.S. real interest rates on default risk in emerging economies using the method of identification through heteroskedasticity as set out by Rigobon (2003) and Rigobon and Sack (2004). As discussed in detail in Section 1, we take data on U.S. real interest rates from inflation-indexed Treasury bonds, and proxy default risk using J.P. Morgan's Emerging Markets Bond Index Plus (EMBI+) premia in emerging economies over the period between 1998 and 2008. The idea behind the identification method is that there is a greater variance of changes in real interest rates on dates when the Federal Open Market Committee (FOMC) meets. The meetings of the FOMC can be seen as an extra shock to U.S. interest rates, which have an impact on the EMBI+ premia.

The key identifying assumption is that the timing of FOMC meetings does not affect the EMBI+ premia through any channel other than the changes in real interest rates. Other shocks that directly affect the EMBI+ premia are assumed to be uncorrelated with the timing of FOMC meetings. This assumption resembles the desired characteristics of an instrument in IV regressions. However, the timing of FOMC meetings affects the variance, not the level of shocks, so a usual IV strategy cannot be employed. The methodology of identification through heteroskedasticity yields a synthetic instrument based on differences in the covariance matrices of our data between dates when the FOMC does and does not meet.

Our findings are presented in Section 2, where we show that unexpected policy-induced increases in interest rates lead to greater EMBI+ premia and, by implication, default risk in emerging economies. A 1 basis point increase in 10-year U.S. real interest rates raises EMBI+ premia by around 1 basis point, which means that the cost of borrowing in emerging economies rises substantially more than in the U.S. This confirms the hypothesized theoretical relationship between changes in U.S. real interest rates and the risk of default and suggests that more attention ought to be paid to this relationship in the literature on default risk.

A positive correlation between default risk and U.S. real interest rates would imply that emerging economies should issue debt contingent on U.S. real interest rates because such a contingency would negate the increased default risk not associated with fundamental changes in emerging economies. Note, however, that this policy prescription depends not on the causal relationship between U.S. real interest rates and the EMBI+ premium, but on the correlation between both. Omitted variables that significantly affect this correlation would also affect the performance of debt contracts contingent on U.S. real interest rates.

In actuality, on dates when the FOMC does not meet, we observe a significant correlation with the opposite sign: changes in real interest rates are negatively related

to changes in EMBI+ premia. Moreover, the overall correlation between real interest rates and the EMBI+ premium is negative: a 2 basis point increase in the 10-year U.S. real rate is on average related to a 1 basis point decrease in the EMBI+. The results suggest that high real interest rates reflect favorable external conditions for emerging markets, which reduce the risk of default. This finding resonates with that of Longstaff et al. (2011), where global risk factors (proxied by U.S. markets) are shown to be the major determinant of sovereign credit-risk premia. Regardless of the precise reason for the negative correlation, the policy implication is clear: emerging economies should not issue debt contingent on U.S. real interest rates.

Previous academic work has attempted to establish the nature of the relationship between U.S. real interest rates and sovereign default risk by applying different methods to deal with the aforementioned endogeneity problems. Some of this work has relied on structural assumptions in vector autoregressions to identify the relationship (e.g., Uribe and Yue 2006). For our purposes, high-frequency data on financial prices can provide more information and allow for a cleaner identification strategy.<sup>1</sup>

An alternative to structural assumptions are “traditional” instruments in IV strategies, such as in Zettelmeyer (2004), where changes in the policy rate are employed as instruments for longer-term real interest rates. This methodology also needs to assume that changes in the instrument do not affect EMBI+ premia through alternative channels. Moreover, the instruments themselves must be exogenous, which is a stronger, and therefore less desirable, assumption than that employed in this paper.

Additional studies investigate the direct effect of changes in the U.S. federal funds target rate on emerging market spreads (Arora and Cerisola 2001). However, the theoretical relationship of interest is between default risk and the longer-term real interest rate, not the short-term nominal rate, which cannot be assumed to be endogenous. Moreover, even changes in the target rate might not be truly exogenous (see Rigobon and Sack 2004). In a more closely related exercise, Robitaille and Roush (2006) employ an event study approach using Brazilian data and find similar results to those of our paper.

## 1. DATA AND EMPIRICAL METHODOLOGY

We use the following data to investigate the relationship between U.S. real interest rates and the risk of default. Our measure of the interest rate,  $i$ , is from 10-year inflation-indexed Treasury bonds.<sup>2</sup> To quantify the risk of default,  $e$ , we use J.P. Morgan’s EMBI+, which is composed of medium-term debt of more than

1. Uribe and Yue (2006) also study the effect of interest rates and the EMBI+ premium on variables like output, and in that case our methodology cannot be applied.

2. Our analysis is robust to the use of alternative measures of the real interest rate based on inflation-adjusted nominal Treasury rates of 3 months and 10 years. See online Appendix A.

1 year to maturity.<sup>3</sup> All data are obtained from the Global Financial Database ([www.globalfinancialdata.com](http://www.globalfinancialdata.com)).

We want to obtain long data series with minimal concern for events that might obfuscate a potential relationship. For this reason, we select emerging economies that have not defaulted and use daily data running from January 1998 to December 2008. We are interested in how a change in the interest rate changes the EMBI+ premia, so our sample consists of values of  $\Delta e_t = e_{t+1} - e_{t-1}$  and  $\Delta i_t = i_{t+1} - i_{t-1}$  and is divided in two: the subsample *C* corresponds to the dates of monetary policy shocks, and the subsample *N* corresponds to dates with no shocks.<sup>4,5</sup>

There are two endogeneity concerns that mean a simple ordinary least squares regression will not identify the effect of changes in U.S. real interest rates on the risk of default (EMBI+ premia). First, changes in the EMBI+ premia can cause changes in the interest rate, for example, when default risk falls and in response investors switch demand from safe Treasury assets to emerging market debt. Second, and more importantly, the interest rate and the exchange rate are influenced by other common omitted variables. The following system of equations is a simple representation of both endogeneity issues:<sup>6</sup>

$$\Delta e_t = \alpha \Delta i_t + z_t + \eta_t, \quad (1)$$

$$\Delta i_t = \beta \Delta e_t + \gamma z_t + \varepsilon_t, \quad (2)$$

where  $\Delta i_t$  is the change in U.S. real interest rate;  $\Delta e_t$  the change in the EMBI+ premium;  $z_t$  a vector of omitted variables including, for example, external market conditions;  $\varepsilon_t$  a monetary policy shock; and  $\eta_t$  a shock to EMBI+.

The objective is to identify  $\alpha$  in equation (1). Our identification strategy is borrowed from Rigobon and Sack (2004), who show that the impact of monetary policy shocks on asset prices can be identified because the variance of shocks is substantially larger on the days in subsample *C*. Their paper uses the identification strategy to establish a significant response of 10-year Treasury yields to monetary policy shocks.

That monetary policy shocks can influence 10-year real interest rates means the variance of changes in these rates is significantly larger on the days in subsample *C*. This effect is not large, but is large enough to significantly affect the variance of  $\Delta i_t$ . We exploit this effect by combining it with the assumption that the policy shock to real interest rates affects EMBI+ neither through  $z_t$  nor  $\eta_t$ , but only through its effect on  $\Delta i_t$ .

3. EMBI+ tracks total returns for traded U.S. dollar—and other external currency—denominated Brady bonds, loans, Eurobonds, and local market instruments.

4. For additional justification for using data in differences rather than levels, see online Appendix B.

5. Set *C* contains the dates of scheduled and unscheduled FOMC meetings and the Federal Reserve chairman's semiannual monetary policy testimony to Congress. For a full list of these dates, see <http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm>

6. We show in online Appendix C that allowing for a richer lag structure does not materially affect the results.

TABLE 1  
DATA DESCRIPTIVES

	Standard deviation		Covariance with U.S. real rate	
	Set C	Set N	Set C	Set N
U.S. real rate	0.093	0.063	.	.
Emerging market	24.491	29.020	0.198	-0.211
Latin America	25.017	32.317	0.278	-0.253
Brazil	30.249	48.318	0.357	-0.278
Bulgaria	24.476	27.181	0.175	-0.117
Mexico	19.221	21.876	0.066	-0.214
Panama	12.486	14.849	0.028	-0.208
Peru	20.892	20.939	0.128	-0.185
Venezuela	43.545	50.526	0.852	-0.263

NOTE: A total of 131 observations in Set C, 2,604 days in Set N.

In sum, we assume that the variance of interest rate shocks ( $\varepsilon_t$ ) in subsample  $C$  is higher than the variance in subsample  $N$ , whereas the variances of  $\eta_t$  and  $z_t$  are the same across both subsamples. As is usual in other identification strategies for our underlying system of equations, we assume  $z_t$ ,  $\varepsilon_t$ , and  $\eta_t$  have no serial correlation and are uncorrelated with each other. Our assumptions can be written in terms of the second moments of the shocks in the two subsamples  $C$  and  $N$  in the following way:

$$\sigma_{\varepsilon}^C > \sigma_{\varepsilon}^N,$$

$$\sigma_{\eta}^C = \sigma_{\eta}^N,$$

$$\sigma_z^C = \sigma_z^N.$$

To help justify the underlying assumptions, Table 1 shows the increase in the variation in the U.S. real interest rate and the change in covariance between the real interest rate and EMBI+ premia over the subsamples. The fact that the standard deviations of EMBI+ premia appear to decrease from set  $N$  to set  $C$ , when we expect mild increases, suggests we require a more accurate statistical test of whether our assumptions on the variance of shocks over the two subsamples are valid.<sup>7</sup> Applying the test set out in Levene (1960), reported in Table 2, we established that the standard deviation of the real interest rate increases significantly in subsample  $C$ , whereas the variance of EMBI+ does not significantly change because the effect of the variance

7. We cannot apply standard tests of variance equality, because they require that the underlying data be normally distributed. As is reported in online Appendix D, demonstrated through plots of each variable's quantiles against those of the normal distribution and empirical tests of skewness and kurtosis, none of our series are normally distributed.

TABLE 2  
LEVENE (1960) TEST OF EQUAL VARIANCE

	Test statistic based on mean	<i>p</i> -value
U.S. real rate	12.371	0.000
Emerging market	0.215	0.643
Latin America	0.458	0.499
Brazil	2.273	0.132
Bulgaria	0.000	0.977
Mexico	0.031	0.860
Panama	0.021	0.884
Peru	0.908	0.341
Venezuela	0.635	0.801

NOTE: Null hypothesis is equal variance.

increase in equation (2) only weakly affects the variance of EMBI+ through the interest rate.<sup>8</sup>

We are not assuming that the FOMC ignores factors that affect emerging market default risk, nor are we supposing that FOMC decisions have no impact on emerging market prices—that is actually the effect we are estimating. We are precisely assuming that FOMC decisions do not directly reveal important information about emerging markets that might otherwise affect EMBI+ premia; they are only affecting EMBI+ premia through changes in U.S. real interest rates. The underlying view is that the Committee might have private information about how it will react to movements in emerging markets and how it plans to conduct monetary policies in general but does not know more than the market about emerging economies.

Now, consider the following variables:

$$\Delta I \equiv \left[ \frac{\Delta i'_C}{\sqrt{T_C}}, \frac{\Delta i'_N}{\sqrt{T_N}} \right]'$$

$$\Delta E \equiv \left[ \frac{\Delta e'_C}{\sqrt{T_C}}, \frac{\Delta e'_N}{\sqrt{T_N}} \right]'$$

$$w \equiv \left[ \frac{\Delta i'_C}{\sqrt{T_C}}, \frac{-\Delta i'_N}{\sqrt{T_N}} \right]'$$

A major result in Rigobon and Sack (2004) is that  $\alpha$  can be consistently estimated by a standard instrumental variables approach with the novel instrument,  $w$ , which is correlated with the dependent variable,  $\Delta I$ , but is correlated with neither  $z_t$  nor  $\eta_t$ . It is correlated with  $\Delta I$  because the greater variance in subsample  $C$  implies the positive correlation between  $(\Delta i'_C/\sqrt{T_C})$  and  $(\Delta i'_C/\sqrt{T_C})$  more than outweighs the negative correlation between  $(\Delta i'_N/\sqrt{T_N})$  and  $(-\Delta i'_N/\sqrt{T_N})$ . It is correlated with

8. Although the test results are presented using the sample mean of the data, similar results are obtained when using the 50th percentile or 10% trimmed mean.

TABLE 3  
THE RESPONSE OF EMBI+ PREMIA TO INTEREST RATE SHOCKS

	Coeff	SE	T-stat
Emerging market	0.868	0.179	4.840
Latin America	1.115	0.195	5.717
Brazil	1.334	0.269	4.969
Bulgaria	0.649	0.170	3.808
Mexico	0.607	0.138	4.394
Panama	0.496	0.094	5.264
Peru	0.659	0.140	4.697
Venezuela	2.279	0.318	7.162

NOTE: Each estimation uses 2,735 observations.

neither  $z_t$  nor  $\eta_t$  because the positive and negative correlation of each part of the vector cancel each other out.

The usual assumption in IV regressions is that the instrument affects the dependent variable only through the regressor. The key difference here is that instead of having a variable assumed to be correlated with  $\varepsilon$  and uncorrelated with any of the other variables, we assume that the variance of  $\varepsilon$  is larger on the days in subsample  $C$  and the variances of other variables are the same in both subsamples.

## 2. RESULTS

Table 3 presents the results from implementing our identification strategy, which reveals that policy shocks to real interest rates are positively correlated with emerging economies' EMBI+. This coincides with our original intuition that when the U.S. government tightens monetary policy, it is harder for emerging economies to borrow, and the risk of default proxied by EMBI+ increases.

The magnitude of the response is large: an unexpected increase in the 10-year real interest rate of 1 basis point leads to an increase in the EMBI+ premium of a similar order of magnitude.

Table 4 shows the results from analysis of the relationship between U.S. real interest rates and EMBI+ premia in each separate subsample of the data (the results across both samples are in Table 5). Crucially, the "normal" correlation between  $\Delta E$  and  $\Delta I$  is actually negative (and smaller in absolute value) in subsample  $N$ . Our interpretation is that increases in U.S. real interest rates are correlated with other things that are good for emerging markets and thus decrease their cost of borrowing. Future research ought to investigate which aspects of international financial markets, correlated with U.S. real interest rates, are most important to the risk of emerging market default.

The results in Table 3 are substantially different from the OLS estimates using only Set C presented in Table 4. Although the former shows a strong positive relation, the latter shows a mild and insignificant effect. Rosa (2011) notes that in some

TABLE 4  
SEPARATE ANALYSIS OF SUBSAMPLES

	Set C			Set N		
	Coeff	SE	T-stat	Coeff	SE	T-stat
Emerging market	0.230	0.224	1.029	-0.494	0.087	-5.700
Latin America	0.317	0.228	1.390	-0.591	0.096	-6.131
Brazil	0.406	0.275	1.474	-0.649	0.145	-4.492
Bulgaria	0.217	0.226	0.960	-0.274	0.081	-3.363
Mexico	0.089	0.177	0.503	-0.500	0.065	-7.692
Panama	0.036	0.114	0.311	-0.487	0.044	-11.186
Peru	0.146	0.191	0.766	-0.430	0.062	-6.937
Venezuela	0.924	0.389	2.371	-0.617	0.151	-4.076

NOTE: A total of 131 observations in Set C, 2,604 days in Set N.

TABLE 5  
FULL SAMPLE ANALYSIS

	Coeff	SE	T-stat
Emerging market	-0.423	0.082	-5.174
Latin America	-0.503	0.091	-5.535
Brazil	-0.547	0.135	-4.038
Bulgaria	-0.226	0.077	-2.934
Mexico	-0.443	0.062	-7.194
Panama	-0.437	0.041	-10.586
Peru	-0.375	0.059	-6.347
Venezuela	-0.467	0.143	-3.266

NOTE: Each estimation uses 2,735 observations.

applications, the results from employing the identification through heteroskedasticity methodology are not much different from a simple OLS using the subsample where the FOMC meets. That is not the case here because we are using the long-term interest rates, where endogeneity is likely to be much more important than when the policy rate is used, and the correlation between variables in the  $N$  sample is different from the causal effect.

### 3. CONCLUDING REMARKS

The strong and positive relation between exogenous changes in U.S. real interest rates and the EMBI+ premium highlights the importance of U.S. interest rate shocks. The fact that the overall correlation between U.S. rates and the EMBI+ premium is negative stresses the importance of other aspects of international financial markets, such as favorable external conditions to emerging economy borrowing. From a policy perspective, our result has implications for proposals to issue debt that is contingent on exogenous factors that affect the ability to repay. One of these ideas is that a higher

U.S. real interest rate makes it more difficult for emerging market economies to repay, so reducing emerging market debt payments when U.S. interest rates increase would be welfare improving. Our finding that the overall correlation is negative implies that making emerging market sovereign debt contingent on U.S. real interest rates would have an opposite result from the desired effect. Research on sovereign default should note that shocks affecting foreign real interest rates might have very different effects on emerging market default risk.

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