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US Real Interest Rates and Default Risk in Emerging Economies

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Abstract
We empirically analyse the appropriateness of indexing emerging market sovereign debt to US real interest rates. We find that policy-induced exogenous increases in US rates raise default risk in emerging market economies, as hypothesised in the theoretical literature. However, we also find evidence that omitted variables which simultaneously increase US real interest rates and reduce the risk of default dominate the hypothesised relationship. We can only conclude that it's not a good idea to index emerging market bonds to US real interest rates.

Keywords: real interest rates; default, sovereign debt, identification through heteroskedasticity
JEL Classifications: F34, G15

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1 Introduction

When US real interest rates rise, the opportunity costs to those who buy emerging economies' debt increase, and in compensation they receive a higher interest rate on their investment. This increases the debt burden on emerging economies which, as it becomes heavier, raises the risk they will default on their debt. One apparent policy implication is that emerging economies should issue debt contingent on US real interest rates because, from a theoretical point of view, such a contingency would negate the increased default risk (Guimaraes; 2008).

On the other hand, however, high real interest rates may reflect favourable external conditions for emerging markets, which reduce the risk of default. For example, real interest rates are usually high when world economic growth is strong and, concurrently, investors' risk appetite is heightened on average, which makes investment in emerging countries all the more likely. Conversely, in times of world crises, interest rates are usually lowered to ease pressure on the financial sector.

Given this potential confounding effect, it is worthwhile investigating the relation between real interest rates and default risk before enacting a policy of indexing emerging market debt to US real interest rates. Our objectives in this paper are to establish (i) whether shocks to US real interest rates significantly increase the risk of default in emerging economies; (ii) whether omitted variables, such as favourable external conditions, also affect default risk and; (iii) if both exist, which effect dominates.

We take data on US 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 10 year period between 1998 and 2008.

We apply the method of identification through heteroskedasticity as set out by Rigobon and Sack (2004). The key identifying assumption is that the increase in the variance of real interest rates that occurs on dates when the Federal Open Market Committee (FOMC) meets are due to policy shocks, exogenous to EMBI+ movements. We are not assuming that the FOMC ignores factors that affect emerging market default risk, but that FOMC decisions are not directly revealing important information about emerging markets that might otherwise affect EMBI+ premia, but are only affecting EMBI+ premia through changes in interest rates. [1]

We find that unexpected policy-driven increases in US real interest rates lead to substantial increases in EMBI+ premia and, by implication, default risk in emerging economies. This confirms the hypothesised relationship between interest rates and the risk of default, and strongly emphasises its importance. From a practical perspective, the result suggests that more attention ought to be paid to this relationship in the literature on default risk.

However, on dates when the FOMC does not meet, we observe a significant correlation with the opposite sign: changes in the real interest rates are negatively related to changes in the EMBI+ premia. This result confirms the importance of other aspects of international financial markets, such as favourable external conditions, to emerging economy borrowing. Moreover, from a policy perspective, although a positive exogenous interest rate shock increases the risk of default, making emerging market sovereign debt contingent on US real interest rates is not a good idea, because, on average, when real interest rates are high in the US, the risk of default is lower in these countries.

2 Data and empirical methodology

We use the following data to investigate the relationship between US real interest rates and the risk of default. Our measure of the interest rate, i, is from 10-year inflation-

[1] Other empirical work investigating the relationship between US interest rates and emerging market spreads has relied on structural assumptions in vector autoregressions to identify effects. See Uribe and Yue (2006).

indexed Treasury bonds. To quantify the risk of default, e, we use J.P. Morgan's Emerging Markets Bond Index Plus (EMBI+), which is comprised of medium-term debt of more than one year to maturity.[2] All data are obtained from the Global Financial Database (*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 sub-sample C corresponds to the dates of monetary policy shocks, and the sub-sample N corresponds to dates with no shocks.[3]

There are two endogeneity concerns that mean a simple ordinary least squares regression will not identify the effect of changes in US 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:

$$\Delta e_t = \alpha \Delta i_t + z_t + \eta_t \tag{1}$$

$$\Delta i_t = \beta \Delta e_t + \gamma z_t + \varepsilon_t \tag{2}$$

Where Δi_t is the change in US real interest rate; Δe_t the change in the EMBI+ premium; z_t a vector of omitted variables including, for example, external market conditions; ε_t a monetary policy shock; and η_t a shock to EMBI+.

The objective is to identify α in Equation 1, for which our identification strategy is identical to that set out in 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 sub-sample C. Their paper used 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 sub-sample C. This

[2] EMBI+ tracks total returns for traded US dollar- and other external currency-denominated Brady bonds, loans, Eurobonds and local market instruments.

[3] Set C contains the dates of scheduled and unscheduled FOMC meetings and the Federal Reserve Chairman's semi-annual monetary policy testimony to Congress. For a full list of these dates, see *http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm*

effect is not large, but is large enough to significantly affect the variance of Δi_t.[4] We exploit this effect by combining it with the fairly mild assumption that the policy shock to real interest rates neither affects EMBI+ through z_t nor η_t, but only through its effect on Δi.

Thus the variance of interest rate shocks (ε_t) in sub-sample C is higher than the variance in sub-sample N; whilst the variances of η_t and z_t are the same across both sub-samples. As is usual in other identification strategies for our underlying system of equations, we assume z_t, ε_t and η_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 sub-samples C and N in the following way:

$$
\begin{aligned}
\sigma_\varepsilon^C &> \sigma_\varepsilon^N \\
\sigma_\eta^C &= \sigma_\eta^N \\
\sigma_z^C &= \sigma_z^N
\end{aligned}
$$

Now, consider the following variables:

$$
\begin{aligned}
\Delta I &\equiv \left[\frac{\Delta i'_C}{\sqrt{T_C}}, \frac{\Delta i'_N}{\sqrt{T_N}}\right]' \\
\Delta E &\equiv \left[\frac{\Delta e'_C}{\sqrt{T_C}}, \frac{\Delta e'_N}{\sqrt{T_N}}\right]' \\
w &\equiv \left[\frac{\Delta i'_C}{\sqrt{T_C}}, \frac{-\Delta i'_N}{\sqrt{T_N}}\right]'
\end{aligned}
$$

A major result in Rigobon and Sack (2004) is that α can be consistently estimated by a standard instrumental variables approach with the novel instrument, w, which is correlated with the dependent variable, ΔI, but is neither correlated with z_t nor η_t. It's correlated with ΔI because the greater variance in sub-sample C implies the positive correlation between $\left(\Delta i'_C/\sqrt{T_C}\right)$ and $\left(\Delta i'_C/\sqrt{T_C}\right)$ more than outweighs the negative correlation between $\left(\Delta i'_N/\sqrt{T_N}\right)$ and $\left(-\Delta i'_N/\sqrt{T_N}\right)$. It's neither correlated with z_t nor η_t because the positive and negative correlation of each part of the vector cancel each other out.

We first established that the standard deviation of the real interest rate increases significantly in sub-sample C, while the variance of EMBI+ is not significantly changed, because the effect of the variance increase in Equation 2 only weakly effects the variance

[4]The results from formally testing the change of variances across sub-samples are contained in an appendix posted on the authors' website.

of EMBI+ through the interest rate.

3 Results

Table 1 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 US government tightens monetary policy, it is harder for emerging economies to borrow, and the risk of default proxied by EMBI+ increases.

Table 1: The response of EMBI+ premia to interest rate shocks

	Co-eff	Std Err	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

Each estimation uses 2,735 observations.

The magnitude of the response is large: an unexpected increase in real interest rates of one basis point leads to an increase in the EMBI+ premium of a similar order of magnitude. This means that, in total, the cost of borrowing for emerging markets increases around twice as much.

Table 2 shows the results from analysis of the relationship between US real interest rates and EMBI+ premia in each separate sub-sample of the data. Crucially, the 'normal' correlation between ΔE and ΔI is actually negative (and smaller in absolute value) in sub-sample N. Our interpretation is that increases in US 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 US real interest rates, are most important to the risk of emerging market default.

In conclusion, we find that whilst the effect of an exogenous increase in the US interest rate does indeed significantly raise the risk of default, making emerging market debt contingent on US interest rates is not a good idea because, on average, when real interest rates are high in the US, the risk of default is lower in these countries.

Table 2: Separate analysis of sub-samples

	Set C			Set N		
	Coeff	Std Err	T-Stat	Coeff	Std Err	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

131 observations in Set C, 2,604 days in Set N.

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A Appendix

Table 3 presents some descriptive statistics on changes in the 10-year real interest rate and EMBI+ premia for sub-samples C and N.

Table 3: Data descriptives

	Standard deviation		Covariance with US real rate	
	Set C	Set N	Set C	Set N
US 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

131 observations in Set C, 2,604 days in Set N.

The increase in the variation in the US real interest rate and the change in covariance between the real interest rate and EMBI+ premia over the sub-samples are apparent from the table, but the fact that standard deviation of EMBI+ appears to decrease from set N to set C, when we expect it to mildly increase, suggests we require a more accurate statistical test of whether our assumptions on the variance of shocks over the two sub-samples are valid.

Importantly, however, we cannot apply standard tests of variance equality, because they require that the underlying data be normally distributed. As the plots of each variables' quantiles against those of the normal distribution in Figure 1 demonstrate, and the empirical tests of skewness and kurtosis confirm in Table 4, none of our series are normally distributed.

Levene (1960) provides a test where the null is equal variance when samples are drawn from a distribution that is not Gaussian normal. The results from this test are presented in Table 5, and show that the variance of the US real interest rate significantly increases, but the variance of all EMBI+ premia does not change significantly.[5]

On the basis of these results, we conclude that the standard deviation of the real interest rate increases significantly on the days when the variance of interest rate movements is greater. We cannot reject the null that the variance of EMBI+ is the same in both sub-samples. According to our assumptions, the policy shocks should yield only small increases

[5]The results are presented using the sample mean of the data, similar results are obtained when using the 50th percentile or 10% trimmed mean

in the variance of EMBI+, as the unexpected policy shocks to US real interest rates are only a small part of the variation of emerging market default risk, so the results of the tests on variances in both sub-samples, albeit not conclusive, are not at odds with the identifying assumptions.

Figure 1: Q-Q plots of each variable quantiles against normal distribution quantiles

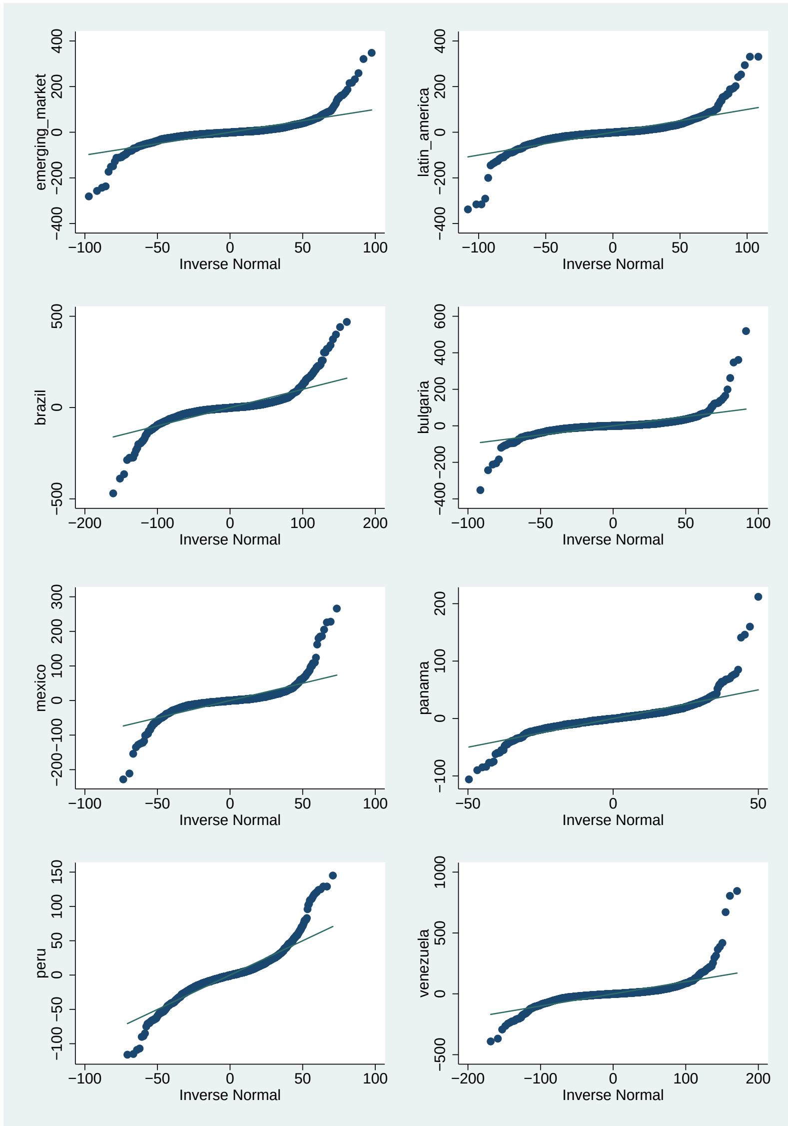

Table 4: Test of skewness and kurtosis

	skewness p-value	kurtosis p-value
US real rate	0.000	0.000
Emerging Market	0.000	0.000
Latin America	0.000	0.000
Brazil	0.000	0.000
Bulgaria	0.000	0.000
Mexico	0.000	0.000
Panama	0.000	0.000
Peru	0.000	0.000
Venezuela	0.000	0.000

Null hypothesis is normal distribution

Table 5: Levene (1960) test of equal variance

	Test statistic based on mean	p-value
US 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

Null hypothesis is equal variance

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