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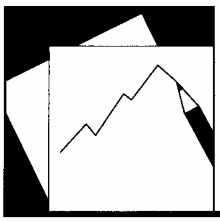

IMF Working Paper

Exchange Rate Policy and Sovereign Bond Spreads in Developing Countries

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Exchange Rate Policy and Sovereign Bond Spreads in Developing Countries

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Abstract

We test the hypothesis of a link between exchange rate policy and sovereign bonds. We analyze the effect of exchange rate policies on supply and credit spreads of sovereign bonds issued by developing countries. An exchange rate policy is captured by the de facto exchange rate regime and the real exchange rate misalignment. The main findings are: (1) real exchange rate overvaluation significantly increases sovereign bond issue probability and raises bond spreads; (2) spreads and the likelihood of issuing bonds depend on the exchange rate regime; (3) exchange rate misalignment under a hard peg significantly increases bond spreads; (4) in time of debt crises, exchange rate policy also greatly affects the sovereign bond market, especially through exchange rate overvaluation.

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I. INTRODUCTION

The increasing role of sovereign bonds as a source of financing for developing countries has been associated with a surge of debt and currency crises. The relationship, if any, between exchange rate policy and these crises remains unclear. Few theoretical papers have analyzed that problem, and most of the empirical literature on bond spreads and debt crises has not explored that link. We measure explicitly the impact of exchange rate policy on bond spreads using data on 51 developing countries.

Sovereign bonds have become an increasingly important source of financing for developing countries. Following the widespread sovereign debt crises in the 1980s, international bond markets have started growing in both value and coverage.[2] One critical feature of these sovereign bonds is their substantial credit spreads owing to sovereign default risk.[3] Figure 1 shows the 10 highest and 10 lowest country average spreads on bonds issued. The spreads are significant with large difference across countries.

As most sovereign bonds are denominated in U.S. dollars, euros, or other hard currencies, the exchange rate policy of bond issuer countries is intimately related to the assessment of sovereign bond default risk. Many defaults are triggered by devaluations or take place because of speculative attacks on exchange rate arrangements. Reinhart (2002) shows that defaults and currency crises are strongly linked in developing countries.

There is a vast research agenda on how the market assesses sovereign default risk in developing countries. Edwards (1984), Cline (1995), Cline and Barnes (1997), Easton and Rockerbie (1999), and others investigate the determinants of sovereign debt spreads in sovereign loans. To study global bond market, Eichengreen and Mody (1998) and Kamin and Kleist (1999) analyze bond spreads on primary market using data on individual bonds issued in developing countries. Uribe and Yue (2003) find that world interest rate and domestic fundamentals account for 40 percent of movements in bond spreads. Research on credit ratings, another important measure of sovereign risk, finds that countries with higher credit ratings have lower spreads and that credit ratings respond strongly to domestic macroeconomic fundamentals (Cantor and Packer, 1996, Eichengreen and Mody, 1998).

However, few empirical studies incorporate the exchange rate policy into the assessment of sovereign default risk. Some works, for example Edwards (1984), include exchange rate devaluation as one determinant of spreads, but the impact of devaluation is not significant. Some authors have studied the liability dollarization and the effect of real exchange rates on the ability to pay dollar debt. Calvo (1998) and Arrelano (2003) find

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[2] The amount of bonds issued by developing countries has risen to $61.47 billion in 2002 compared with $8.91 billion a decade ago. In 2001, the amount of newly issued sovereign bonds in developing countries peaked at $113.92 billion.

[3] Among 65 developing countries that issue sovereign bonds, 30 have run into debt crisis at least once since the 1980s according to Standard & Poor's.

that in Argentina real exchange rate appreciation is associated with a sudden stop in capital flow and high interest rate. Obstfeld and Taylor (2003) investigate the impact of the interwar gold standard on London bond market. But none of the works study the full impact of exchange rate policy (regime and exchange rate level) on sovereign bonds.

Jahjah and Montiel (2003) explore the link between debt crises and exchange rate policy in a theoretical framework. They model the government's fiscal and debt-servicing policy, as well as exchange rate policy. The interaction between exchange rate policy and debt repayment may differ depending on the degree of exchange rate misalignment and investors' expectation. The authors show that under a hard peg, the absence of an exchange rate instrument can lead to default equilibrium, especially if the country experiences a serious exchange rate misalignment. However, a more flexible exchange rate regime yields multiple equilibria, one of which is characterized by exchange rate misalignment, high interest rates, and default. Exchange rate regimes that "go to the extreme" are prone to debt crises; however, the dynamics of the crises differs substantially.

Our study is the first empirical work that explicitly investigates exchange rate policy in the study of bond spreads. We test the hypothesis of a link between exchange rate policy and sovereign bonds, in particular, the economic arguments developed by Jahjah and Montiel (2003). Specifically, we incorporate exchange rate regime classifications and measures of exchange rate misalignment in the determinants of bond spreads. Exchange rate regimes and real exchange rate misalignment are key measures of exchange rate policy because of three channels through which the exchange rate policy impacts sovereign credit spreads. First, when a country experiences a real exchange rate appreciation, it tends to borrow more. At the same time, borrowing costs may rise if the overvaluation puts pressure on the exchange rate policy. Second, the cost of adjusting the exchange rate varies across exchange rate regimes. Countries with hard-pegged currencies are more vulnerable to negative shocks, which lead to higher default risk and bond spreads. More flexible arrangements can better accommodate shocks.[4] Third, a government may choose a particular exchange rate arrangement to buy itself a reputation (Giavazzy and Pagano, 1986). Successful pegs impose more fiscal discipline on a country than does a free-floating currency. Hard pegs eliminate bank financing and harden the budget constraint of the government, leading to a larger dependence on international credit.

The empirical analysis generates favorable results for the hypothesis on the link between exchange rate policy and sovereign bond spreads. The main findings are: (1) an overvalued real exchange rate significantly increases sovereign bond issue probability and generally raises bond spreads. The magnitude of this effect depends on the exchange rate regime; (2) different exchange rate regimes have different impacts on spreads and on

[4] Edwards and Levy Yeyati (2003) show empirical evidence that the terms of trade shocks have a larger effect on economic performance in countries with more rigid exchange rate regimes, than in countries with a flexible exchange rate regime.

the likelihood of issuing bonds; (3) in time of debt crises, the exchange rate policy still affects bond spreads, while most fundamentals lose their impact; (4) we perform a robustness test with different exchange rate misalignment measures and more macroeconomic variables, and we correct for potential endogeneity problem. Our results remain unchanged.

The remainder of the paper is as follows. In Section II we describe the dataset and methodology. The main empirical analysis is carried in Section III. In Section IV we summarize the paper and conclude.

II. THE DATA

A. Description of Data Set

We use spreads on bonds issued in the primary market by 51 developing countries over the 1990–2001 period. Bond data come from Capital Data's Bondware. A bond spread is measured by the difference between yield on the issued bond and the U.S. Treasury bond with comparable maturity. We use country-average bond spreads weighted by dollar amounts. Because these spreads are attained from the primary market, they represent the actual borrowing costs for emerging market countries. There are two reasons why we choose to work with primary market spreads. First, to our knowledge there are no bond index data for secondary markets that cover a large sample of countries.[5] Second, using primary market spreads, we can study the debt issue decisions of the government as well as bond pricing at the same time.

We use two sets of data to proxy the exchange rate policy: exchange rate regime and exchange rate misalignment. Exchange rate regime classification is not easy because many countries deviate from the announced exchange rate regime.[6] In order to identify the impact of alternative exchange rate regime on sovereign debt, we should analyze actual, as opposed to legal, exchange rate arrangements. Two classifications of *de facto* exchange rate regimes are employed in our analysis. The first is from Reinhart and Rogoff (2002) who classify exchange rate arrangements based on the official exchange rate and parallel market rates. The second classification is from Bubula and Otker-Robe (2002) who base their classification on the IMF nomenclature adopted in 1999. We refer to the classification based on Reinhart and Rogoff (2002) as RR regimes and the one based on Bubula and Otker-Robe (2002) as BO regimes. There are small differences in the sample depending on the classification used. Countries covered in our sample are listed in Appendix I. We aggregate exchange rate regimes from both classifications into

[5] J.P. Morgan's EMBI global and EMBI+ are constructed for 23 countries starting in 1994 (or later depending on the countries). Data on primary bond markets start in 1980 and cover all developing countries that have issued sovereign bonds.

[6] Calvo and Reinhart (2002) and Alesina and Wagner (2003) study the reason why countries do not follow their *de jure* exchange rate regimes.

three groups: hard peg, intermediate, and free floating regimes.[7] Our aggregation is summarized in Table 1.[8]

Table 1. Exchange Rate Regime Classification

Aggregate class	Reinhart and Rogoff (2002)	Bubula and Otker-Robe (2002)
Fixed regimes	(1) No separate legal tender	(1) Formal dollarization
	(2) Pre-announced peg or currency board arrangement	(2) Currency union
		(3) Currency board arrangement
Intermediate regimes	(3) Pre-announced horizontal band that is narrower than or equal to +/-2%	(4) Conventional fixed pegs vis-à-vis a single currency
	(4) De facto peg	(5) Conventional fixed pegs vis-à-vis a basket
	(5) Pre-announced crawling peg	(6) Horizontal bands
	(6) Pre-announced crawling band that is narrower than or equal to +/-2%	(7) Forward-looking crawling pegs
	(7) De factor crawling peg	(8) Backward-looking crawling pegs
	(8) De facto crawling band that is narrower than or equal to +/-2%	(9) Forward-looking crawling bands
	(9) Pre-announced crawling band that is wider than or equal to +/-2%	(10) Backward-looking crawling bands
	(10) De facto crawling band that is narrower than or equal to +/-5%	(11) Tightly managed floats
	(11) Moving band that is narrower than or equal to +/-2% (i.e., allows for both appreciation and depreciation over time)	
Floating regimes	(12) Managed floating	(12) Other managed float with no predetermined exchange rate path
	(13) Freely floating	(13) Independently floating

Note: Exchange rate regimes are aggregated to 3 groups: fixed regimes, intermediate regimes, and floating regimes. We use two sets of exchange rate classifications. One is from Reinhart and Rogoff (2002) and the other one is from Bubula and Otker-Robe (2002).

[7] We also conducted the empirical analysis using the exchange rate regimes grouped into four classes: hard peg, conventional peg, intermediate and free floating. The inclusion of conventional peg as an individual group does not change the results. The estimation is available upon request.

[8] Two adjustments are made to RR classification. A free falling regime is defined as one with monthly inflation rate greater than 40%. Because inflation is one regressor, we categorize this group (79 observations in our sample) using the secondary classification. Nine observations are in the dual-market regime. As no secondary classification is available, we discard these data. Our empirical analysis is robust to exclusion of these two groups.

The second measure of the exchange rate policy is the real exchange rate misalignment. Data for real effective exchange rate is from the IMF Information Notice System and is measured by units of U.S. goods per domestic goods.[9] We compute exchange rate misalignment as the difference between log of the actual exchange rate and its trend. As recorded in Hinkle and Montiel (1999), there is no universal method to compute exchange rate misalignment. In the empirical analysis, we conduct a robustness test using log-linear detrended exchange rates to measure misalignment.

We also include a set of control variables. We use real interest rates on ten-year U.S. Treasury bonds as the proxy for global economic condition. For domestic economic indicators, we use the ratio of debt to GDP, the ratio of debt service to exports, the GDP growth rate, and inflation.[10] Because the focus of this work is to test the impact of exchange rate policy on sovereign bonds, as a benchmark we include these controls variables which have been found to be important determinants of bond spreads in the literature. We also use the short-term debt to total debt ratio. It measures the maturity composition of debt. When this ratio is high, countries are more likely to issue new debt as there is more debt to roll over. All the data are from *International Financial Statistics* and *Global Development Finance*.

[9] Details on the methodology are in Zanello and Desruelle (1997).

[10] Ratio of government deficit to GDP is also a common determinant of sovereign bond spreads. This ratio indicates the foreign borrowing needs. But it is found to be insignificant in both the bond issue equation and the spread equation in our study. The result is available upon request.

Box 1. Control Variables Used in the Basic Analysis

(a) U.S. interest rate: a proxy of world interest rate. Because borrowing countries face international investors who are diversifying portfolios, the global economic conditions will affect both bond issue probability and the sovereign default risk premium.

(b) GDP growth: A higher growth of per capita GDP is argued to result in a lower sovereign credit spreads. GDP growth is also found to be an important explanatory variable that increases bond issue probability.

(c) Debt to GDP ratio: an indicator of country solvency. It is expected to have a positive effect on spreads but a negative effect on issue probability. The higher this ratio is, the higher sovereign default probability is. At the same time, the country is not willing to increase debt load.

(d) Debt service to exports ratio: It measures possible liquidity problems. It is expected to have a positive effect on both spreads and issue probability. Spreads increase if a country runs into liquidity problems and defaults. In order to boost liquidity, the need to raise more money increases, thus the country issues new bonds.

(e) Inflation: It is argued that with other things given, a higher inflation rate indicates a larger probability of a balance of payments crisis, and consequently a higher probability of default. The impact on the probability of a bond issue is not clear.

B. Preliminary Data Analysis

A first look at the data anticipates our main result on exchange rate policy and sovereign bonds. Table 2 shows the regime distribution of the full sample, categorized into RR classification and BO classification. The results using both classifications show a similar number of fixed regimes, intermediate regime and free floating regimes. The table also reflects how the regimes distribute according to bond issue decision. When a country is in an intermediate exchange rate regime, the probability of issuing bonds is smallest relative to countries with fixed-peg and free-floating regimes. Table 3 reports the statistics of bond spreads. Using both classifications we find that fixers and free floaters have higher average bond spreads than intermediate regimes. The correlation of bond spreads and exchange rate misalignment is the highest and positive for hard pegged countries. These results are consistent with our hypothesis. Under a hard peg, a bad shock increases the likelihood of default because no exchange rate adjustment is possible. On the other hand, a flexible exchange rate regime may leave the economy more dependent on investors' expectations, which can in turn increase spreads. Therefore, both "corners" face high borrowing cost. Exchange rate overvaluation, at the same time, increases default risk for countries in a fixed regime because the cost of exchange rate adjustment is higher relative to default cost.

Table 2. Distribution of Regimes, 1990–2001

	RR			BO		
	All	Issuers	Non-issuers	All	Issuers	Non-issuers
Fixed	72	33	39	57	28	29
Intermediate	336	156	180	352	159	193
Flexible	105	58	47	144	68	76
Total	513	247	266	552	255	297

Note: RR is from Reinhart and Rogoff (2002). BO is from Bubula and Otker-Robe (2002). Issuers refer to observations with non-zero bond spreads. Non-issuers refer to observations with zero bond spreads.

Table 3. Descriptive Statistics of Bond Spreads

	RR		RR	
	Mean spreads (basis points)	Corr (spreads, exchange rate misalignment)	Mean spreads (basis points)	Corr (spreads, exchange rate misalignment)
Fixed	334	0.45	332	0.43
Intermediate	288	0.20	287	0.13
Flexible	323	-0.16	354	0.12

Note: Bond-issue observations have non-zero bond spreads. Mean spreads is the sample average of non-zero bond spreads for bond issuers. Correlation of spreads and exchange rate misalignment is computed with non-zero bond spreads.

Because we use primary market data, there is a sample selection problem. We observe bond spreads only when countries issue bonds. Countries tend to do so only when conditions are favorable and financing need is high. Table 4 summarizes statistics of issuer and non-issuer countries. It highlights some characteristics that influence countries' bond-issue decisions. It suggests that bond issues are more likely when the exchange rate is overvalued, when GDP growth is high, when the borrower has a low debt/GDP ratio but there is more short-term debt to roll over, when debt service/exports is high, and when U.S. interest rates are low. In the empirical analysis, we present an econometric model that takes the selection bias into account.

Table 4. Descriptive Statistics of Issuers (BI=1) and "Non-issuers" (BI=0), 1990–2001

Mean	Exchange rate misalignment	U.S. treasury rate	GDP growth	Debt /GDP	Debt service /Exports	Short-term debt/Total debt
BI=1	0.013	6.27	2.89	42.89	21.52	19.27
BI=0	-0.005	6.69	2.05	58.49	16.54	16.38

Note: BI=1 when a country issues some bonds and has non-zero spreads. BI=0 when a country does not issue any bond. The table gives the average of country characteristics and international condition for issuers and non-issuers.

III. EMPIRICAL ANALYSIS

A. Econometric Methodology

Sovereign bond spreads is a measure of default risk. As in Eaton and Gersovitz (1981), Edwards (1984) and subsequent literature, we assume that the log of spreads is a linear function of variables, X , that affect default probability

$$\log(spread) = \alpha X + u \tag{3.1}$$

where u is a random error. The regressors in the baseline model are exchange rate misalignment, exchange rate regime dummies and control variables. Exchange rate misalignment is computed using the HP filter. The regime dummies are FIX (fixed exchange rate regime) and INT (intermediate exchange rate regime). FIX (INT) equals 1 if at time t the country is on fixed regime (intermediate regime) and 0 otherwise.

Because we observe spreads only when the country issues a bond, there is a sample selection problem. If we simply apply the model specified in equation (3.1), the result is biased. When a nonzero spread is not observed for a country in a given year, we may assume that the missing spreads are random occurrences and ignore them, but if the gaps occur according to some unknown but systematic selection method, equation (3.1) leads to biased and inefficient estimates. To deal with the sample selection problem, first we create a binary variable for bond issuance: *BI* equals 1 when we observe a nonzero spread for a country at time t , and zero otherwise. We assume

$$BI = 1\left[\beta X_0 + v > 0\right] \tag{3.2}$$

where X_0 is a set of observed variables which "select" whether a country issues a bond in a given year or not. In the basic model, X_0 includes all the variables in X as well as one identification variable. We use the ratio of short-term debt to total debt to identify the model. v is a random error. Log(spread) is observed only when BI=1.

We assume u and v are bivariately normally distributed, then equations (3.1) and (3.2) consist of a standard Heckman (1979) sample selection model. We can estimate (3.2) as a probit model to get the probability of a bond issue. Then, the value of Mill's ratio (reflecting the conditional probability of the observation being in the observed sample) is incorporated in an OLS regression of (3.2) using observed log (spreads) only. This is Heckman's two-stage method (Heckman, 1979). Alternatively, an efficient method is to estimate equations (3.1) and (3.2) jointly using maximum likelihood method. We use maximum likelihood method to estimate the model in the following analysis.

B. Baseline Model

In this subsection, we estimate the baseline model using exchange rate policy variables and control variables described in Box 1, which are conventional in the literature.[11] In the subsequent two subsections, debt crises dummies and more control variables are included in the estimation.

The first estimation incorporates exchange rate misalignment and exchange rate regime as independent regressors. Table 5 presents the results. Table 5a gives the bond issue probability as a function of the explanatory variables. Table 5b is the estimation result of a bond-spread determination equation. The second column in the tables shows the result using the RR classification. The sample covers 48 countries in 1990–2001. We also run regression using BO exchange rate regime classification and a sample of 51 countries over the same time period. The result is shown in the third column.

Table 5. Model with Exchange Rate Misalignment and Regimes

Table 5a. Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.617	-1.611
	(-3.84)	(-3.32)
GDP growth	.020	.021
	(2.00)	(2.19)
Debt/GNP	-.016	-.016
	(-5.18)	(-5.23)
Debt service/Exports	.040	.044
	(5.79)	(6.55)
Inflation	-.0002	-.0001
	(-1.10)	(-0.70)
Short-term debt/Total debt	.014	.014
	(2.94)	(3.26)
Exchange rate misalignment	3.350	3.287
	(4.62)	(4.68)
FIX	-.256	.192
	(-1.06)	(0.82)
INT	-.360	-.034
	(-2.14)	(-0.25)
Constant	2.997	2.271
	(3.19)	(2.27)
Number of bond spreads	247	255
Number of observations	513	552

Note: t-statistics are shown in parentheses. Exchange rate misalignment is H-P filtered real exchange rate. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

[11] See Eichengreen and Mody (1998), Edwards (1984), for example.

Table 5. Model with Exchange Rate Misalignment and Regimes (continued)

Table 5b. Determinants of Bond Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.263	-1.101
	(-3.84)	(-3.36)
GDP growth	-.037	-.039
	(-3.93)	(-4.34)
Debt/GNP	.0002	-.001
	(0.10)	(-0.35)
Debt service/Exports	.010	.010
	(3.18)	(2.95)
Inflation	.0004	.0004
	(2.71)	(2.75)
Exchange rate misalignment	1.118	1.031
	(2.22)	(2.21)
FIX	.034	.023
	(0.25)	(0.18)
INT	-.154	-.173
	(-1.57)	(-2.04)
Constant	7.638	7.424
	(12.82)	(12.74)
Number of bond spreads	247	255

Note: t-statistics are shown in parentheses. Exchange rate misalignment is H-P filtered real exchange rate. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

The two regressions yield similar results. Most of the results on control variables are as expected. The coefficients on the U.S. interest rate are negative on both issue and pricing equations.[12] GDP growth has a significant positive coefficient on bond-issue probability and a significant negative coefficient on bond-spread equations. The debt to GDP ratio significantly decreases bond issue probability, but has no significant effect on spreads. The debt service to exports ratio significantly increases both bond spreads and bond issue probability. A higher inflation rate implies a higher spread. Lastly, a higher short-term debt to total debt ratio increases bond issue probability significantly. Thus, the whole model is well identified.

The estimated coefficients of the exchange rate misalignment and regime dummies disclose the impact of exchange rate policy on sovereign bonds. Large exchange rate misalignments significantly increase bond issue probability. When a country experiences

[12] Eichengreen and Mody (1998) and Kamin and Kleist (1999) document such a relation between U.S. interest rates and bond issue/spreads. Eichengreen and Mody explain this result using a demand and supply argument. When the U.S. interest rate increases, there are fewer sovereign bond issuer countries in the market. Given the demand for bonds in emerging markets, the reduction in supply then lowers bond spreads.

exchange rate appreciation, borrowing on international markets becomes more advantageous. A country with an overvalued exchange rate may also increase the financial needs for external capital as exports become less competitive. Exchange rate misalignment has a positive coefficient on bond spreads. Qualitatively, it shows that a larger exchange rate overvaluation increases country default risk.

The results on the exchange rate regime dummies reflect how the fixed and intermediate regimes affect issue probability/bond spreads relative to a free-floating regime. INT has significant and negative coefficients in the bond-issue equation of RR regression and in the bond spreads equation of both regressions. Countries with intermediate exchange rate flexibility may have the lowest issue probability compared with other exchange rate arrangements. At the same time, the borrowing cost is the lowest for intermediate regime countries. We also find that countries in a fixed regime have higher spreads, compared with a free-floating regime, but the effect is not significant. This finding indicates that countries which "went to extreme" have borne some cost in sovereign bond financing in the past 12 years.

It is interesting to study why exchange rate misalignment has opposite signs in bond issue equation and price equation. Exchange rate appreciation is a double-edged sword. It makes external financing cheaper as debt-service costs in local currency appear to be lower, but the harm brought to the economy by exchange rate misalignment increases the likelihood of default. When the gain from correcting the misalignment is high and there is little cost associated with default, default probability increases significantly. Our results are the combination of these two forces.

To better identify the effect of real appreciation and explain the result on exchange rate regime, we disaggregate the exchange rate misalignment to be exchange rate regime specific. The goal is to test whether the exchange rate misalignment and the exchange rate regimes influence sovereign bonds altogether. Instead of using exchange rate misalignment and exchange rate regime in an additive way as in the baseline model, we study the interaction between exchange rate misalignment and the exchange rate regimes. Table 6 presents the regression results. We include three new regressors: the product of exchange rate misalignment and the three exchange rate dummies. The sum of these new explanatory variables is the exchange rate misalignment.

The combination of exchange rate overvaluation and nonflexible regimes tends to increase bond issue probability. The coefficient on exchange rate overvaluation in intermediate regime is positive and highly significant. In contrast, countries with free-floating regimes do not find issuing bond more appealing with exchange rate appreciation.

Table 6. Model with Regime-Specific Exchange Rate Misalignment and Regimes

Table 6a. Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.459	-1.374
	(-2.88)	(-2.77)
GDP growth	.021	.021
	(2.06)	(2.11)
Debt/GNP	-.016	-.016
	(-5.03)	(-5.04)
Debt service/Exports	.040	.044
	(5.62)	(6.41)
Inflation	-.0001	-.0001
	(-0.55)	(-0.26)
Short-term debt/Total debt	.013	.016
	(2.78)	(3.58)
Exchange rate misalignment	3.269	4.016
× FIX	(1.37)	(1.38)
Exchange rate misalignment	5.533	5.376
× INT	(5.55)	(5.47)
Exchange rate misalignment	.159	.131
× FLOAT	(0.15)	(0.12)
FIX	-.152	.169
	(-0.61)	(0.70)
INT	-.293	-.052
	(-1.73)	(-0.38)
Constant	2.584	2.084
	(2.71)	(2.25)
Number of bond spreads	247	255
Number of observations	513	552

Note: t-statistics are shown in parentheses. Exchange rate misalignment × FIX equals to the exchange rate misalignment if the regime is FIX, and is zero otherwise. Exchange rate misalignment × INT and Exchange rate misalignment × FLOAT are defined similarly. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

When a country has a hard peg or limited exchange rate adjustment flexibility, the exchange rate appreciation tends to be persistent.[13] At the time of paying back debts, the country may benefit from exchange rate overvaluation. Therefore, exchange rate overvaluation makes bond issuing more attractive to a country in fixed or intermediate regimes. But with a free-floating exchange rate regime, market pressure will quickly push the currency back to its equilibrium level, thus bond issue probability does not increase with overvaluation.

[13] Upon real external shock, the adjustment in equilibrium real exchange rate takes longer in countries with a fixed exchange rate. See Edwards and Levy Yeyati (2003).

Exchange rate misalignment in a fixed exchange rate country increases bond spreads. An overvaluation yields low growth and loss of government revenue. When a country is in a hard-peg regime, perceived as credible, the damages of overvaluation are more important and persistent. Therefore, debt sustainability is hurt and default probability increases. On the other hand, owing to the exchange rate flexibility, exchange rate overvaluation does not have a great impact on bond spreads for countries with free-floating regimes. The coefficients on the interaction between exchange rate misalignment and FLOAT are not statistically significant. The effect of exchange rate overvaluation in an intermediate regime is between the above two cases.

Table 6. Model with Regime-Specific Exchange Rate Misalignment and Regimes (continued)

Table 6b. Determinants of Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.243	-1.144
	(-3.84)	(-3.54)
GDP growth	-.035	-.039
	(-3.79)	(-4.32)
Debt/GNP	.0002	-.0001
	(0.08)	(-0.49)
Debt service/Exports	.008	.009
	(2.74)	(2.94)
Inflation	.0004	.0004
	(2.78)	(2.88)
Exchange rate misalignment	2.151	2.405
× FIX	(1.88)	(1.99)
Exchange rate misalignment	1.480	.862
× INT	(2.20)	(1.40)
Exchange rate misalignment	-.168	.860
× FLOAT	(-0.22)	(1.36)
FIX	.007	-.070
	(0.04)	(-0.46)
INT	-.141	-.162
	(-1.39)	(-1.87)
Constant	7.600	7.510
	(12.88)	(12.83)
Number of observations	247	255

Note: t-statistics are shown in parentheses. Exchange rate misalignment × FIX equals to the exchange rate misalignment if the regime is FIX, and is zero otherwise. Exchange rate misalignment × INT and Exchange rate misalignment × FLOAT are defined similarly. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

Besides the influence of exchange rate arrangement through overvaluation, there are some additional differences on sovereign bonds across regimes. The default risk premium is lower for an intermediate regime when BO classification is used. Countries in

intermediate regimes are also found to have a lower bond issue probability with RR classification.

Overall, a positive exchange rate misalignment increases bond issue probability. The effect takes place mainly when the country does not have full exchange rate flexibility. Exchange rate overvaluation increases default risk premium, especially when the country has a hard peg. The lack of exchange rate flexibility exacerbates the effect of exchange rate overvaluation on sovereign bonds. This is the main channel through which a fixed exchange rate regime affects the bond-issue decision and bond spreads.

C. Analysis with Debt Crises

There have been many sovereign debt crises both on bank loans and on sovereign bonds. In this subsection, we check whether the exchange rate policy variables interact with debt crises in affecting bond spreads and how exchange rate policy influences bond spreads in times of crises. We include debt crises dummies in the regression to examine whether the significance of exchange rate policy variables is reduced when crises variables are included in the model.

We define a debt crisis event as having occurred if a country is classified as being in default by Standard and Poor's[14] or if it has access to non-concessional IMF financing in excess of 100 percent of quota. This debt crisis definition includes not only cases of outright default or coercive restructuring but also situations where near-default was avoided through the provision of large scale official financing by the IMF.[15] The debt crises dataset is taken from Manasse and others (2003).

[14] Standard & Poor's rates sovereign debt issuers as in default if a government fails to meet principal or interest payment on external obligations on the due date (including exchange offers, debt equity swaps, and buy back for cash).

[15] In near-default, a country may face difficulties in servicing its debt even though the outright default was avoided through international financial support. Such episodes are not recorded among S&P debt crises, but they have a great impact on sovereign bond issuing and pricing.

Table 7. Model with Debt Crises

Table 7a. Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.290	-1.232
	(-2.50)	(-2.44)
GDP growth	.021	.021
	(2.05)	(2.12)
Debt/GNP	-.014	-.015
	(-4.34)	(-4.62)
Debt service/Exports	.042	.046
	(5.79)	(6.55)
Inflation	-.0001	.0000
	(-0.13)	(0.01)
Short-term debt/Total debt	.014	.016
	(3.01)	(3.53)
Debt crises dummy	-.395	-.270
	(-2.15)	(-1.48)
Exchange rate misalignment	3.582	4.234
× FIX	(1.56)	(1.50)
Exchange rate misalignment	5.588	5.328
× INT	(5.57)	(5.43)
Exchange rate misalignment	-.036	.175
× FLOAT	(-0.03)	(0.16)
FIX	-.148	.151
	(-0.59)	(0.62)
INT	-.296	-.110
	(-1.78)	(-0.76)
Constant	2.203	1.835
	(2.26)	(1.95)
Number of bond spreads	247	255
Number of observations	513	552

Note: t-statistics are shown in parentheses. Debt crises dummy is constructed according to Manasse and others (2003) and S&P. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

We estimate the baseline model with a debt crisis dummy. Results are summarized in Table 7. With both classifications, debt crises increase bond spreads significantly and reduce the likelihood of issuing bonds. Financial distress plays an important role on primary market of sovereign bonds. A country in crisis is not willing to issue new bonds.[16] Simultaneously, with higher default probability, the country has to provide a higher rate of return on its sovereign bond if it chooses to issue one.

[16] In our sample with RR classification, there are 35 bond issues among the 93 observations during debt crises periods. This ratio is low compared with the full sample, which is 219 issuances out of 444 observations.

Table 7. Model with Debt Crises (continued)

Table 7b. Determinants of Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.406	-1.305
	(-4.51)	(-4.18)
GDP growth	-.031	-.037
	(-3.55)	(-4.18)
Debt/GNP	.0001	-.001
	(0.06)	(-0.33)
Debt service/Exports	.006	.006
	(1.98)	(2.05)
Inflation	.0002	.0002
	(1.56)	(1.71)
Debt crises dummy	.424	.404
	(3.86)	(3.82)
Exchange rate misalignment	1.628	1.836
× FIX	(1.44)	(1.57)
Exchange rate misalignment	1.553	0.758
× INT	(2.31)	(1.62)
Exchange rate misalignment	.357	0.875
× FLOAT	(0.48)	(1.44)
FIX	.-049	-.043
	(-0.34)	(-0.29)
INT	-.172	-.103
	(-1.73)	(-1.20)
Constant	7.890	7.763
	(13.81)	(13.70)
Number of bond spreads	247	255

Note: t-statistics are shown in parentheses. Debt crises dummy is constructed according to Manasse and others (2003) and S&P. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

The impact of exchange rate policy remains significant. Coefficients on exchange rate misalignment for FIX and INT are positive in both bond issue probability and spreads equation. And they are highly significant for overvaluation in intermediate regimes. According to RR classification, intermediate exchange rate regime countries, in general, pay significantly lower spreads on sovereign bonds but are less likely to issue bonds on the international market.

Table 8. Model in Debt Crises Period

Table 8a: Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.031	-1.680
	(-0.81)	(-1.30)
GDP growth	-.063	-.062
	(-1.23)	(-1.25)
Debt/GNP	-.049	-.052
	(-3.72)	(-3.96)
Debt service/Exports	.043	.037
	(2.23)	(2.07)
Inflation	.0002	-.0001
	(0.46)	(-0.16)
Short-term debt/Total debt	-.029	-.018
	(-1.07)	(-0.68)
Exchange rate misalignment	1.854	2.670
× FIX	(0.28)	(0.35)
Exchange rate misalignment	3.085	4.414
× INT	(1.21)	(1.54)
Exchange rate misalignment	-4.940	-3.167
× FLOAT	(-1.81)	(-1.52)
FIX	1.550	1.228
	(1.66)	(1.56)
INT	.309	.490
	(0.53)	(1.23)
Constant	3.508	5.105
	(1.31)	(2.00)
Number of bond spreads	40	42
Number of observations	108	111

Note: t-statistics are shown in parentheses. The sample is restricted to the debt crises period, defined according to Manasse and others (2003) and S&P. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

We also conduct the empirical analysis by restricting the sample to periods of crisis.[17] Table 8 provides the estimation results. Most of the explanatory variables for bond spreads become insignificant. The implication is that during debt crisis periods, fundamentals do not play an important role, as in normal times. This leaves space for investors' expectations or market sentiment to exert a great impact on bond market.[18]

[17] Unlike currency crises, debt crises usually last a long time. The average length of a debt crisis is 5 years. Therefore, there are sufficient observations in debt crises.

[18] Eichengreen and Mody (1998) also find that much of change in bond spreads is due to changes in market sentiment. This empirical finding is consistent with theoretical studies with self-fulfilling debt crises. See Jahjah and Montiel (2002) for example.

Table 8. Model in Debt Crises Period (continued)

Table 8b. Determinants of Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-.787	-.981
	(-1.98)	(-2.18)
GDP growth	-.013	-.010
	(-0.90)	(-0.58)
Debt/GNP	-.0001	.004
	(-0.01)	(0.70)
Debt service/Exports	-.007	-.002
	(-0.25)	(-0.78)
Inflation	.0001	.0001
	(0.75)	(1.18)
Exchange rate misalignment	1.826	2.100
× FIX	(1.35)	(1.33)
Exchange rate misalignment	-.235	.224
× INT	(-0.34)	(0.28)
Exchange rate misalignment	1.307	0.078
× FLOAT	(1.32)	(0.11)
FIX	-.571	-.462
	(-1.91)	(-1.50)
INT	-.203	.037
	(-1.18)	(0.29)
Constant	7.755	7.827
	(9.39)	(8.80)
Number of bond spreads	40	42

Note: t-statistics are shown in parentheses. The sample is restricted to the debt crises period, defined according to Manasse and others (2003) and S&P. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

The coefficients on exchange rate misalignment and exchange rate regime also disclose the link between exchange rate policy and the bond market in times of financial stress. Exchange rate misalignment in hard-peg or intermediate regime countries does not increase bond issue probability, which is different from the full sample. On the contrary, overvaluation in a free-floating regime significantly decreases the likelihood of a bond issue. In debt crises, exchange rate overvaluation is not an advantage in bond issuing. Investors expect that overvaluation leads to nominal devaluation that would affect the country's capacity to service the debt, in particular when the exchange rate can float freely, therefore few bonds are issued in such situation. A fixed exchange rate regime decreases bond spreads significantly. For a country with a hard-pegged currency in debt crisis, the gain from credibility and a promise of fiscal policy discipline is larger than the cost of giving up the exchange rate adjustment tool. Thus, we see a lower borrowing cost for hard-pegged countries in debt crisis.

D. Robustness Test

In the first robustness test, we add more macroeconomic control variables. We include reserves/total debt, the rate of devaluation for nominal exchange rate, and a political risk rating among the regressors. Reserves to total debt ratio reflects how much external debt the government can support. The nominal exchange rate devaluation has been used to measure the impact of exchange rate policy on bond spreads (see Edwards 1984).[19] We include this variable in order to examine whether exchange rate misalignment is a better measure for exchange rate policy. Political risk ratings provide an assessment of the political stability of the countries.[20]

The results are summarized in Table 9. The ratio of reserves stock to total external debt decreases bond spreads significantly. Thus reserve/total debt is an important debt sustainability index. The rate of devaluation is not significant in explaining bond spreads or bond issue probability. Nominal devaluation rate does not affect sovereign borrowing behavior or bond pricing. This result is consistent with Edwards (1984). Political risk ratings both increase bond issue probability and lower the bond spreads significantly. Because the unstable government is impatient to obtain funds for current expenditure, there is a high chance that the debt burden will be left to a later government or avoided by default. Anticipating these possible unfavorable events, sovereign bonds issued by high-risk countries are charged at a higher return.[21]

We find that exchange rate misalignment for intermediate regimes significantly increases issue probability. And countries with a RR classified intermediate regime have lower bond-issue likelihood. On bond spreads, exchange rate misalignments in hard pegged countries increase bond spreads significantly, as consistent with the result in the baseline model. Using BO classification, we find a significant decrease in bond issue probability when a country is in an intermediate regime. In summary, after we control for reserves/debt, rate of devaluation, and political risk, we still find that exchange rate policy affects bond spreads and the issue decision.

All of our findings also hold with the alternative set of misalignment measures. To check the robustness of the results to the method of computing misalignment, we also estimate

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[19] Nominal exchange rate devaluation is expected to have a negative effect on bond spreads as an indicator of the willingness to adjust the exchange rate, but Edwards does not get a significant estimate on devaluation.

[20] The political risk-ratings are from the PRS Group's *International Country Risk Guide* (ICRG) risk-rating system, where 12 components of political risks are evaluated. The lower the total risk point, the higher the risk is.

[21] The exchange rate policy variables are less significant, particularly in the spread determination estimation. The reason may be that more unstable political regimes are more likely to follow unsustainable policies such as more rigid exchange rate arrangements and appreciations of the exchange rate. Or unstable government use more rigid exchange rate arrangements as a commitment device.

the model using another measure of exchange rate misalignment that is a log-linearly detrended real exchange rate. The estimates are recorded in Table 10. The empirical analysis is robust.

E. Accounting for Endogeneity

In the above analysis, we treat all the variables as strictly exogenous for both bond issue decision and spread determination. But the relation we have found in the data may be caused by reversed causality. In particular, the choice of exchange rate regime may be a response to a debt crisis or a mechanism to lower borrowing costs. Therefore, we correct for endogeneity of exchange rate regimes using a feasible generalized two-stage IV estimator.

We first run a multivariate Logit model of the exchange rate regimes choice, D, which can take value FIX, INT or FLOAT. Assume the probability of one outcome can be expressed as:

$$\begin{aligned}
\Pr(D = FLOAT) &= \frac{1}{(1+\exp(Y_t\beta_1)+\exp(Y_t\beta_2)} \\
\Pr(D = FIX) &= \frac{\exp(Y_t\beta_1)}{(1+\exp(Y_t\beta_1)+\exp(Y_t\beta_2)} \\
\Pr(D = INT) &= \frac{\exp(Y_t\beta_2)}{(1+\exp(Y_t\beta_1)+\exp(Y_t\beta_2)}
\end{aligned} \tag{3.3}$$

where Y_t is the vector of variables used to explain the choice of an exchange rate regime. β s are the associated coefficients. The relative probability of choosing FIX (INT) to the FLOAT is $\exp(Y_t\beta_1)$ $(\exp(Y_t\beta_2))$.

We use all the exogenous regressors in the baseline model and additional instrument variables to construct Y_t. It is important to find variables that affect choice of the regimes but are not related to sovereign bond. We use the ratio of the country's GDP over the U.S. GDP (size), the ratio of reserve to monetary base[22] and Past negative GDP growth dummy.[23] Size matters because smaller countries tend to be more open and have flexible exchange rate arrangement. Reserve over base money reflects the sustainability of a credible peg. And the dummy variable for past negative GDP growth is related to exchange rate regime choice because it measures the government's incentive to inflate. Table 11 reports the estimate of the Logit model using RR exchange rate regimes. Coefficients are interpreted as a variation in the relative probability of choosing one regime over a free-floating regime. Most variables are highly significant and of the expected sign.

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[22] See Levy-Yeyati and Sturzenegger (2003).

[23] See Poirson (2003).

From the Logit model, we can estimate predicated probabilities of choosing a fixed or intermediate regime. We use the estimated probabilities as instrument variables for the regime dummies and estimate the Heckman model in a second stage, as shown in Table 12. The fixed regime and intermediate regime countries have a smaller probability of issuing bonds. And the intermediate regime dummy has significant negative coefficients on bond spreads. In general, exchange rate real appreciation increases bond issue probability and spreads. When exchange rate regime and misalignment are combined, overvaluation significantly increases bond spreads in a fixed-peg regime and increases bond issue probability in the intermediate regime. The relation between exchange rate policy and sovereign bond issue and spreads is robust to the correction of endogeneity for exchange rate regimes.

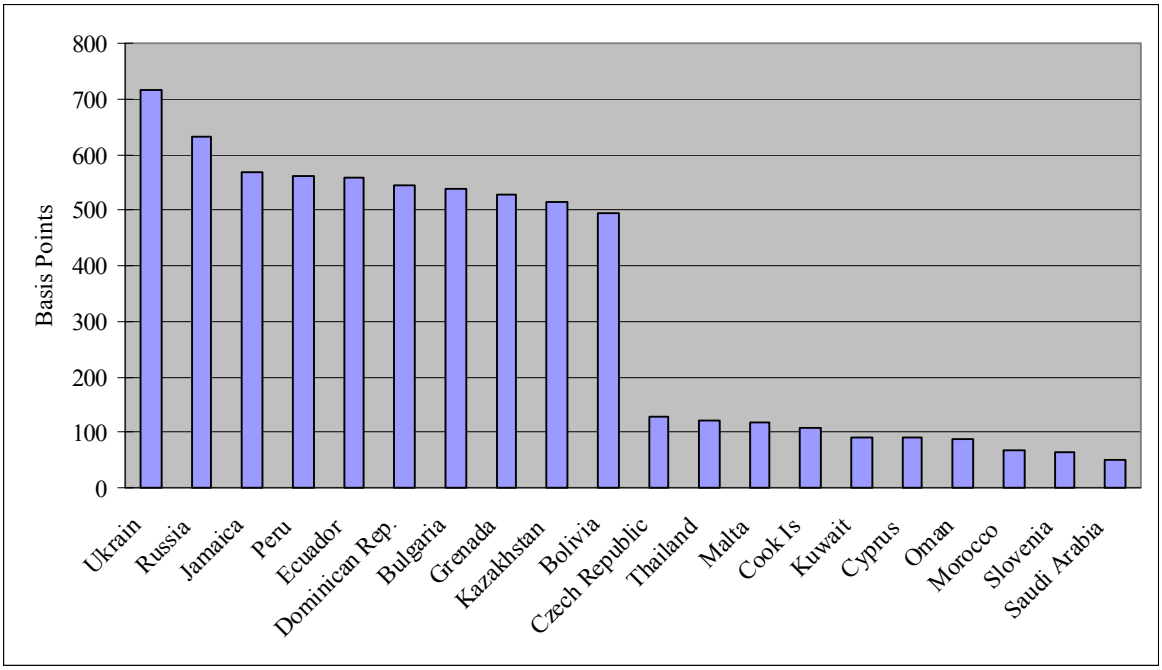
IV. CONCLUSION

This study is the first empirical work on the impact of exchange rate policy on sovereign bond spreads. The exchange rate policy is jointly defined by the exchange rate regime and a measure of exchange rate misalignment. The main conclusion is that there is a significant impact of exchange rate policy on sovereign bond issue decisions and bond spreads. Exchange rate policy affects sovereign bond spreads in a significant and interlaced way. When the real exchange rate is overvalued, countries tend to issue more debt. But depreciation risk associated with an overvalued real exchange rate has a negative impact on debt sustainability, and thus increases bond spreads, especially under hard pegs. The impact of exchange rate misalignment varies across different exchange rate regimes. Regimes with a fixed exchange rate or limited exchange rate flexibility tend to transmit real exchange rate overvaluation into higher borrowing cost from the market. When we restrict the sample to crisis periods, the results are reversed. Exchange rate overvaluation under a free floating regime leads to a higher borrowing cost. While countries with a hard-peg regime enjoy lower bond spreads. Credibility gains and a promise of fiscal policy discipline help to reassure international investors. Thus, we observe a lower borrowing cost for hard-pegged countries in debt crises.

To conclude, the choice of an exchange rate policy is not neutral with respect to bond spreads and bond issuing decisions. Attempts to gain credibility on the international market through the use of a pegged exchange rate have gained popularity. Overvaluation under hard pegs incites governments to borrow more on the international market; however, foreign investors internalize the risks associated with the misalignment, increasing borrowing costs. Our results emphasize that the choice of a hard peg does not necessarily lead to cheaper borrowing costs, if there is a severe risk of currency misalignment.

Figure 1. Average Sovereign Bond Spreads of New Issues by Developing Countries

(20 countries with highest and lowest bond spreads)



Data source: J.P. Morgan EMBI Global composite index. Figure shows the average weekly stripped spreads from 12-31-1997 to 8-6-2003.

List of Countries in Sample with RR Classification

Argentina	Croatia	Guatemala	Latvia	Pakistan	South Africa
Bolivia	Czech Republic	Hungary	Lithuania	Panama	Sri Lanka
Brazil	Dominican Republic	India	Malaysia	Peru	Thailand
Bulgaria	Ecuador	Indonesia	Malta	Philippines	Tunisia
Chile	Egypt	Jamaica	Mauritius	Poland	Turkey
China, P.R	El Salvador	Jordan	Mexico	Romania	Ukraine
Colombia	Estonia	Kazakhstan	Moldova	Russia	Uruguay
Costa Rica	Grenada	Korea	Morocco	Slovak Republic	Venezuela

List of Countries in Sample with BO Classification

Argentina	Croatia	Hungary	Malaysia	Peru	Trinidad and Tobago
Barbados	Czech Republic	India	Malta	Philippines	Tunisia
Bolivia	Dominican Republic	Indonesia	Mauritius	Poland	Turkey
Brazil	Ecuador	Jamaica	Mexico	Romania	Ukraine
Bulgaria	Egypt	Jordan	Moldova	Russia	Uruguay
Chile	El Salvador	Kazakhstan	Morocco	Slovak Republic	Venezuela
China, P.R.	Estonia	Korea	Oman	South Africa	
Colombia	Grenada	Latvia	Pakistan	Sri Lanka	
Costa Rica	Guatemala	Lithuania	Panama	Thailand	

Table 9. Model with Additional Control Variables

Table 9a: Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.001	-.698
	(-1.40)	(-1.01)
GDP growth	.030	.023
	(1.24)	(1.02)
Debt/GNP	-.021	-.018
	(-4.74)	(-4.32)
Debt service/Exports	.042	.042
	(4.05)	(4.28)
Inflation	-.0003	-.001
	(-0.28)	(-0.59)
Short-term debt/Total debt	.024	.030
	(2.46)	(3.42)
Reserves/Total debt	.003	.001
	(0.60)	(0.18)
Rate of devaluation	.0003	.001
	(0.22)	(0.66)
Political risk ratings	.051	.044
	(4.08)	(4.00)
Exchange rate misalignment	2.800	2.343
× FIX	(0.88)	(0.60)
Exchange rate misalignment	5.049	5.000
× INT	(4.76)	(4.78)
Exchange rate misalignment	.540	-.528
× FLOAT	(0.45)	(-0.43)
FIX	.126	.393
	(0.40)	(1.21)
INT	-.405	-.108
	(-2.09)	(-0.70)
Constant	-2.067	-2.242
	(-1.53)	(-1.69)
Number of bond spreads	233	238
Number of observations	461	485

Note: t-statistics are shown in parentheses. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

Table 9. Model with Additional Control Variables (continued)

Table 9b. Determinants of Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.163	-1.156
	(-3.39)	(-3.41)
GDP growth	-.041	-.042
	(-3.83)	(-4.03)
Debt/GNP	-.002	-.002
	(-0.61)	(-0.69)
Debt service/Exports	.004	.006
	(1.64)	(2.33)
Inflation	.0001	.0001
	(0.37)	(0.43)
Reserves/Total debt	-.006	-.006
	(-3.11)	(-3.10)
Rate of devaluation	.0002	.0003
	(0.43)	(0.50)
Political risk rating	-.012	-.013
	(-2.07)	(-2.42)
Exchange rate misalignment	2.370	2.796
× FIX	(2.12)	(2.23)
Exchange rate misalignment	1.121	.681
× INT	(1.65)	(1.11)
Exchange rate misalignment	-.446	.610
× FLOAT	(-0.64)	(1.04)
FIX	.040	-.058
	(0.27)	(-0.35)
INT	-.139	-.179
	(-1.43)	(-2.13)
Constant	9.199	9.003
	(12.56)	(12.03)
Number of bond spreads	233	238

Note: t-statistics are shown in parentheses. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

Table 10. Model with Alternative Measure of Exchange Rate Misalignment

Table 10a: Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.280	-1.164
	(-2.45)	(-2.27)
GDP growth	.021	.020
	(2.03)	(2.07)
Debt/GNP	-.016	-.015
	(-4.96)	(-4.80)
Debt service/Exports	.039	.044
	(5.45)	(6.33)
Inflation	-.0002	-.0001
	(-0.73)	(-0.46)
Short-term debt/Total debt	.012	.015
	(2.60)	(3.31)
Exchange rate misalignment	3.175	4.017
× FIX	(1.58)	(1.63)
Exchange rate misalignment	3.336	3.700
× INT	(4.92)	(5.29)
Exchange rate misalignment	.590	.076
× FLOAT	(0.76)	(0.10)
FIX	-.204	.150
	(-0.81)	(0.62)
INT	-.226	.034
	(-1.34)	(0.24)
Constant	2.320	1.704
	(2.37)	(1.78)
Number of bond spreads	247	255
Number of observations	513	552

Note: t-statistics are shown in parentheses. The exchange rate misalignment is log-linearly detrended real exchange rate. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

Table 10. Model with Alternative Measure of Exchange Rate Misalignment (continued)

Table 10b. Determinants of Spreads

Explanatory Variables	RR Classification	BO Classification
Log of U.S. Treasury rate	-1.134	-.990
	(-3.42)	(-2.99)
GDP growth	-.035	-.038
	(-3.79)	(-4.22)
Debt/GNP	.0002	-.001
	(0.10)	(-0.32)
Debt service/Exports	.008	.009
	(2.70)	(2.77)
Inflation	.0004	.0004
	(2.64)	(2.74)
Exchange rate misalignment	1.385	1.597
× FIX	(1.56)	(1.63)
Exchange rate misalignment	1.055	.744
× INT	(2.26)	(1.66)
Exchange rate misalignment	-.114	.612
× FLOAT	(-0.22)	(1.36)
FIX	.003	-.065
	(0.02)	(-0.41)
INT	-.116	-.160
	(-1.21)	(-1.90)
Constant	7.398	7.230
	(12.14)	(11.88)
Number of observations	247	255

Note: t-statistics are shown in parentheses. The exchange rate misalignment is log-linearly detrended real exchange rate. The second column shows the result using the RR classification. The third column shows the result using the BO classification.

Table 11. Multivariate Logit Model for RR Exchange Rate Regimes, 1990–2001

Explanatory Variables	FIX (RR)	INT (RR)
Size	-34.400	-11.18
	(-2.69)	(-1.79)
Reserve base	3.079	5.454
	(1.10)	(2.14)
Past negative GDP growth	-.891	-1.082
dummy	(-2.34)	(-3.94)
log of U.S. Treasury rate	1.139	2.740
	(0.83)	(-2.74)
GDP growth rate	.144	.093
	(4.33)	(3.57)
Inflation	-.0005	-.002
	(-1.26)	(-1.96)
Total debt/GDP	.019	.005
	(2.65)	(0.94)
Debt service/Exports	-.039	-.005
	(-2.27)	(-0.50)
Exchange rate misalignment	7.825	5.882
	(3.85)	(4.45)

Note: t-statistics are shown in parentheses. The second column shows the result for FIX on in the RR classification. The third column shows the result on INT in the RR classification.

Table 12. Model with RR Exchange Rate Regime Instrument

Table 12a: Determinant of Bond Issue Probability

Explanatory Variables	RR Classification	RR Classification
Log of U.S. Treasury rate	-2.156	-2.121
	(-4.03)	(-3.92)
GDP growth	.074	.076
	(4.59)	(4.55)
Debt/GNP	-.003	-.002
	(-0.71)	(-0.54)
Debt service/Exports	.019	.019
	(2.49)	(2.35)
Inflation	-.0003	-.0001
	(-1.28)	(-0.20)
Short-term debt/Total debt	.011	.010
	(2.37)	(2.18)
Exchange rate misalignment	5.553	
	(5.79)	
Exchange rate misalignment × FIX IV (RR)		4.863
		(0.52)
Exchange rate misalignment × INT IV (RR)		8.521
		(4.11)
Exchange rate misalignment × FLOAT IV (RR)		.204
		(0.11)
FIX IV(RR)	-5.945	-5.822
	(-4.25)	(-4.04)
INT IV (RR)	-.558	.033
	(-1.07)	(0.06)
constant	4.526	4.005
	(4.42)	(3.82)
Number of bond spreads	258	258
Number of observations	556	556

Note: t-statistics are shown in parentheses. FIX IV (RR) is the fitted value for FIX and INT IV (RR) is the fitted value for INT in Table 11. The second column shows the result using the exchange rate misalignment and regimes. The third column shows the result using the interaction between exchange rate misalignment and regimes.

Table 12. Model with RR Exchange Rate Regime Instrument (continued)

Table 12b: Determinants of Spreads

Explanatory Variables	RR Classification	RR Classification
Log of U.S. Treasury rate	-.765	-.901
	(-2.02)	(-2.36)
GDP growth	-.035	-.032
	(-2.95)	(-2.76)
Debt/GNP	-.003	-.003
	(-1.16)	(-1.18)
Debt service/Exports	.013	.014
	(3.94)	(4.29)
Inflation	.0002	.0002
	(0.89)	(1.19)
Exchange rate misalignment	1.272	
	(2.04)	
Exchange rate misalignment		11.570
× FIX IV (RR)		(1.93)
Exchange rate misalignment		-.358
× INT IV (RR)		(-0.32)
Exchange rate misalignment		2.852
× FLOAT IV (RR)		(1.59)
FIX IV (RR)	1.083	.336
	(1.28)	(0.38)
INT IV (RR)	-.791	-.730
	(-2.16)	(-1.91)
constant	7.103	7.312
	(10.68)	(11.07)
Number of bond spreads	258	258

Note: t-statistics are shown in parentheses. FIX IV (RR) is the fitted value for FIX and INT IV(RR) is the fitted value for INT in Table 11. The second column shows the result using the exchange rate misalignment and regimes. The third column shows the result using the interaction between exchange rate misalignment and regimes.

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