ABSTRACT

Given the current stabilization policies, the Brazilian economy gives a vivid example of the impact of several factors, such as the degree of institutionalization of the budgetary and monetary policies that are followed since the implementation of the Real Plan, on its policy-credibility and, as such, on the market's perception of the default risk on its external debt. This paper elaborates on the research question: "Risk premium on sovereign bonds and budgetary discretion vs. rules for a developing country: a theoretical model and application to Brazil". First, a theoretical model is developed, modeling the risk premium on sovereign bonds depending on the type of fiscal policy regime (weak or tough) in a signaling setting. Then, from the theoretical model an empirical model is derived, which is estimated with data for Brazil. The theoretical model gives a framework of modeling credibility of a government, signaling its type, as well as the credibility whether the government, independent of its type, comes in the situation that the costs of repaying the debt become unfavorably high, that defaulting seems unavoidable. The preliminary conclusions that can be drawn from the empirical results are favorable to modeling the risk premium in terms of a government's fiscal policy credibility, and confirm earlier results that for Brady bonds a country's solvency is of more importance, and for Eurobonds its (short run) liquidity.

KEY WORDS

Default risk; Risk premium; Sovereign debt; Credibility; Exchange rate stability; Budgetary rules vs discretion.

CONTENT

RISK PREMIUM ON SOVEREIGN BONDS AND BUDGETARY DISCRETION VS. RULES FOR A DEVELOPING COUNTRY: THE CASE OF BRAZIL*

Jolanda Eline Ygosse Baptista

I. INTRODUCTION

Within the group of less developed countries (LDCs) that have faced difficulties in paying back international sovereign debt in the past, or even outright defaulted on outstanding international debt, Brazil is for many reasons an interesting case for assessing the risk premium in terms of its fiscal policy framework. For one, Brazil is a federal state, making fiscal policy standards less transparent for the international investor. For example, the extent to which a state can be bailed out by the federal government in case of a bankruptcy (or even in case of blunt unwillingness to repay its outstanding debt) will indirectly affect the ability of the federal government to repay its sovereign debt. Thus, the institutional setting of the fiscal policymaking process is of great importance in predicting (unfavorable) changes in key economic variables such as debt-GDP ratio of a country, or its debt-export ratio, which are indicators of a country's solvency, and as such important variables explaining a country's risk premium on sovereign debt. The degree of institutionalization of a country's fiscal policy becomes therefore a key factor in analyzing its fiscal policy credibility. In terms of signaling models, the more a government shows a willingness to fight the government debt and deficit, for example by implementing a reform program in order to cut costs and promote

* The NPP would like to thank the student that participated in the research that produced this report as assistant, Ana Paula Soler Moreno.

budgetary responsibility of the government, on federal as well as state level, the more effectively it signals its "type". Its type can be typically "weak" or "tough".

It should be recognized however that a government cannot pursue controlling the government's outstanding debt and deficit at any costs, and completely ignore economic growth and employment objectives. Therefore, even a government that signals a "tough" type, will eventually lose its credibility of pursuing a tight fiscal policy if the costs in terms of unemployment and recession become severely high. Thus, the paper tries to model credibility in two ways: first, in terms of the type of government or policy stance that is signalled, second, to what extent – given the signalled type of government policy – such policy can be upheld due to unfavorable economic circumstances, or more specific, higher costs than the government had anticipated and found acceptable. This implies that the model allows for a multi-period setting, in which credibility evolves over time, with the outcomes possibly driven by different factors at each time. The updating process is therefore explicitly modeled. The interaction of monetary policy choices with fiscal policy is more complicated. For example, it is quite straightforward to see that a tight monetary policy, or as in the case of Brazil until 1998 the strict (crawling) peg to the dollar in order to fight inflation affects a tough fiscal policy in two opposite ways: it signals the preferences of the government, but it also makes keeping the tough fiscal policy difficult because of the inherent high interest rates and its adverse effect on the country's outstanding debt. As for now, this interaction is left as a side issue, and the focus is on the credibility of fiscal policy and its impact on the country's risk premium on sovereign debt. Another issue not treated in this paper, is the electoral impact on the model. It could be argued that in the absence of a social consensus on the need to lower the debt burden and the fiscal vulnerability of the country to adverse shocks, a government that signals to be of the "tough" type will be replaced by a government that is expected to signal a "weak" type. If anticipated, this would already change government's behavior as well as that of international investors, resulting in an *ex ante* loss of credibility of fiscal policy reforms. For Brazil it is indeed not unrealistic to assume a lack of consensus on fiscal reform issues, given

the discrepancies in views of the different leading political parties. However, as the elections in the nineties showed the voters' consensus on the need of fighting inflation, it is not completely unthinkable that there is a social consensus among the voters on the need of fiscal reforms in order to provide Brazil with sound grounds for economic growth.

The paper is set up as follows. In section II the theoretical model is developed. This model is then estimated for Brazil in section III. Finally, in section IV the main conclusions of the paper are given.

II. THEORETICAL MODEL

The model uses as starting point the assumption that the yield spread charged on an LDC bond (denoted *s*) reflects the (subjective) probability of default. This probability is denoted *p*. Other factors specific to the market for international bonds are captured in the variable γ.

$$s = f(p, \gamma) \tag{1.1}$$

Assuming for simplicity risk neutrality of investors and perfect competition, it follows that the relationship between the yield spread and the probability of default on an LDCs bond can be written as:

$$s = \left\{ \frac{p}{1-p} \right\} \gamma \tag{1.2}$$

For the spread (*s*) being the yield differential of an LDC's bond (*i*) with as proxy for a risk free return a US Treasury bond of comparable maturity (i^*), hence: $s=i-i^*$, and for $\gamma = 1+i^*$. See Edwards (1984) and Ygosse (1997) for example.

Some thought should be given on how to model the probability of default reflecting both the type of government (weak or tough) as well as the deterioration of key economic variables. Earlier empirical research shows strong evidence that the risk premium as reflected in the spread of LDC sovereign debt can be explained by variation in a country's debt-export ratio, reflecting a country's solvency (denoted (*b*)), and its foreign assets[**] over imports, reflecting a country's short run international liquidity (denoted (*l*)). See for example the empirical work in Edwards (1984) and Ygosse (1997)). For a full description of the dataset used, see the data-appendix. It should be noted that the ratios debt/export and reserves/import show a much sharper relationship with the risk premium, than if for example GDP was used for scaling the debt and reserve variables. Especially for countries with relative low volumes of exports and imports (as ratio of GDP), using these variables gives therefore substantial gains of significance in the econometric model.

The debt-export ratio depends directly on a country's budgetary policies, while the reserves over imports ratio depends directly on a country´s monetary policies. Moreover, both policies have an indirect impact on the variables as well. Thus, changes in institutional structure and laws that alter the degree of discretion in favor of the use of rules in both fiscal and monetary policymaking will have a favorable impact on these variables, which in turn has a favorable impact on the risk premium. Assuming desired steady state values for these variables (say, a perceived "risk free" threshold level, denoted b_t, and λ_t), a deviation of the expected value Eb_t and $E\lambda_t$ from this (actual) rate will increase with adverse shocks in government expenditure (for example, an unexpected bail out of a major state's debt by the federal government), resp. with speculative runs on the currency, exhausting the

[**] Foreign Assets are defined as a country´s Foreign Reserves. The terminology is used interchangeably in the literature, and therefore will be used as such in this paper. The data is readily available from the Brazilian Central Bank and also published in the *International Financial Statistics* (IFS), by the IMF. It should be observed that IFS data is not manipulated in any way by IMF Staff, but is an integral publication of data provided by sovereign country´s officials. The dataset also uses IMF Staff estimates for various data observations, but not with respect to reserves. Estimates are used when country data is missing for various monthly observations, mainly due to measurement problems. Using those estimates is the methodology chosen to deal with missing observations, rather than treating those data points as "not available".

foreign assets (for example if a government tries to stick to a currency peg while the pressure to devaluate is getting substantial).

In general, countries have decided to default on outstanding international debt when the costs of not repaying the debt did no longer outweigh the domestic economic costs of repaying the debt, such as loss of economic growth and the increasing domestic unemployment. This can be modeled by describing the relevant effects on unemployment, modeled as the deviation from its natural rate at time t (ur_t). This variable will increase when the expected debt-export ratio exceeds the desired rate, and/or when the expected foreign assets-imports ratio is less than the desired rate. Equation (1.3) describes this relationship, where (ur_t) also will increase if an unemployment shock (u_t) occurs, and by part (ur_t) is explained by the deviation of the natural rate of unemployment one period ago (ur_{t-1}). The model developed here is a simple credibility model, in line with similar models presented by for example Obstfeld (1991), Drazen and Masson (1991) and Masson (1994). However, none of these models have been specifically designed for fiscal policy credibility, or for modeling the risk premium on sovereign bonds of LDCs. Starting point in the model is thus the tradeoff between unemployment (as most obvious policy objective, signalling recession, etcetera) and the government´s determinedness to repay outstanding international debt.

$$\mathrm{ur_t} = \left\{ a\left[\left(Eb_t - b_t \right), \left(-E\lambda_t + \lambda_t + u_t + \delta u_{t-1} \right) \right] \right\}^{1/2} \qquad (1.3)$$

Equation (1.4) gives the loss function, showing the tradeoff between the costs of having excessively high debt-export ratio and/or low foreign assets over imports ratio, in terms of its impact on unemployment, and the costs of actual default (denoted d_t). The type of government enters in this equation in the form of the variable θ, which will be higher for a tough government (such government puts more weight on the costs of defaulting) than for a weak government ($\theta^T > \theta^W$).

$$L_t = \left\{ ur_t = f\left(\left(Eb_t - b_t \right), \left(-E\lambda_t + \lambda_t \right) \right) \right\}^2 + \vartheta \left(d_t \right)^2 \tag{1.4}$$

From substituting the square root of (1.3) into (1.4) and solving for (u_t), it follows that each government will default if:

$$u_t > \left\{ \frac{\left(a + \vartheta \right) d}{2a} \right\} + \left(Eb_t - b_{t-1} \right) - \left(E\lambda_t + \lambda_{t-1} \right) - \delta ur_{t-1} \tag{1.5}$$

The private sector's expectations on a country's default are formed by a weighted average of the probability that a tough or weak government will default, where the weights are the private sector's assessment that the government is strong (1-w_t), resp. weak (w_t). Let ($p^W{}_t$) be the probability that a weak government will default in period *t*, and ($p^T{}_t$) the probability that a tough government will default in period *t*. This can be expressed in the following two equations, (1.6) and (1.7):

$$\left(Eb_t - b_{t-1} \right) = \left[w_t p_t^W + \left(1 - w_t \right) p_t^T \right] d \tag{1.6}$$

and/or

$$\left(l_{t-1} - El_t \right) = \left[w_t p_t^W + \left(1 - w_t \right) p_t^T \right] d \tag{1.7}$$

Substituting (1.6) and (1.7) into (1.5), the probability of default that either a tough or a weak government will actually default can now be written as equation (1.8):

$$p_t^i = prob\left(u_t > \left[\frac{\left(\vartheta^i d \right)}{2a} \right] - w_t p_t^W d - \left(1 - w_t \right) p_t^T d + \frac{d}{2} - \delta ur_{t-1} | \text{gov. is of type i} \right) \tag{1.8}$$

For simplicity (u_t) is assumed to be uniformly distributed in the interval [-v,v], assuming an interior solution:

$$prob\left(u_t > u_t^*\right) = \frac{\left(v - u_t^*\right)}{2v} \tag{1.9}$$

Solving (7) for ($p^W{}_t$) and ($p^T{}_t$), by substituting (1.8) in (1.9) and specifying the type of government then gives equations (1.10) for a weak government, and (1.11) for a tough government:

$$p_t^W = \frac{-\left(\frac{\vartheta^W d}{2a}\right)}{\left(2v-d\right)} + \frac{\left(\frac{\left(1-w_t\right)\left(\vartheta^W - \vartheta^T\right)d^2}{2a}\right)}{2v\left(2v-d\right)} + \frac{\left\{v - \left(\frac{d}{2} - \delta ur_{t-1}\right)\right\}}{\left(2v-d\right)} \tag{1.10}$$

$$p_t^T = \frac{-\left(\frac{\vartheta^T d}{2a}\right)}{2v-d} + \frac{\left(\frac{w_t\left(\vartheta^W - \vartheta^T\right)d^2}{2a}\right)}{2v\left(2v-d\right)} + \frac{\left\{v - \left(\frac{d}{2} - \delta ur_{t-1}\right)\right\}}{\left(2v-d\right)} \tag{1.11}$$

and by definition:

$$p_t^T \equiv w_t p_t^W + \left(1-w_t\right) p_t^T = \frac{-\left(\frac{\vartheta^T d}{2a}\right)}{\left(2v-d\right)} + \frac{\left(\frac{\left[w_t\left(\vartheta^T - \vartheta^W\right)d\right]}{2a}\right)}{2v\left(2v-d\right)} + \frac{\left\{v - \left(\frac{d}{2} - \delta ur_{t-1}\right)\right\}}{\left(2v-d\right)} \tag{1.12}$$

If the private sector knows the type of government, i.e. w=1 in (1.10) and w=0 in (1.11), and if the deviation of the natural rate of unemployment at time (*t-1*) is zero ($ur_{t-1}=0$), then (1.10) and (1.11) can be rewritten as:

$$p_t^{W^*} = \frac{1}{2} \frac{-\left(\frac{\vartheta^W d}{2a}\right)}{(2v-d)} \tag{1.13}$$

$$p_t^{T^*} = \frac{1}{2} \frac{-\left(\frac{\vartheta^T d}{2a}\right)}{(2v-d)} \tag{1.14}$$

Where ($p^{W*}{}_t$) and ($p^{T*}{}_t$) can be interpreted as the "steady state" probabilities of defaulting, assuming the type if government to be known.

Substituting (1.13) and (1.14) into (1.12) then gives the probability of default in period *t* as:

$$p_t = p_t^{W^*} + w_t\left(p_t^{W^*} + p_t^{T^*}\right) + \left(\frac{\delta ur_{t-1}}{2v-d}\right) \tag{1.15}$$

Estimation of the probability that the government is weak (w_t) is now formulated by starting from a prior estimate (w_{t-1}) and by supposing that there is no default in period (*t-1*). Then Bayesian updating implies that:

$$w_t = \left(\frac{\left(1-p_t^W\right)}{\left(\left(1-p_t^W\right)w_{t-1} + \left(1-p_t^T\right)\left(1-w_{t-1}\right)\right)}\right) w_{t-1} \tag{1.16}$$

Now, substituting in (1.16) of the results obtained in (1.13, 1.14) and (1.10, 1.11), substituting in for (ur_{t-1}) its tradeoff counterpart in terms of the proxy variables for a country's solvency and/or liquidity, and linearizing around ($w_{t-1}= w_0$) and ($[Eb_{t-1}-b_{t-1}]=\Delta b_{t-1} = \Delta b_0$), and ([-E$\lambda_t+\lambda_t$] =-$\Delta\lambda_{t-1}$ = -$\Delta\lambda_0$), which are defined as the initial values of these variables in the transition equation using Kalman filter estimation. Also, adding an error term (η_t), the transition equation can be written as:

$$w_t = \beta_t w_{t-1} + \beta_2 \Delta b_{t-2} - \beta_3 \Delta\lambda_{t-2} + \eta_t \tag{1.17}$$

where (β_1, β_2, *and* β_3) are parameters to be estimated. The parameter (β_2) should have a positive sign and the parameter (β_3) should have a negative sign. The probability that a government is of the weak type therefore increases if one period before it signalled a weak type, decreases if two periods before the government allowed a deviation of the debt-export ratio of the desired rate without defaulting, and decreases if the government saw a drop in foreign assets (as percentage of imports) two periods before without defaulting.

Now, recalling equation (1.2) that shows the relationship between the spread and the probability to default, and assuming it has the following logistical form:

$$p = \frac{e^{\sum \alpha_i y_i}}{\left(1 + e^{\sum \alpha_i y_i}\right)} \tag{1.18}$$

where (p) is a concave function of the country-specific variables (y_i), that are considered to affect a country's creditworthyness. Combining equation (1.2) and (1.18) and taking the logarithm, gives the following equation for the yield spread:

$$\log s = \alpha_0 + \sum \alpha_i y_i + \log \gamma \tag{1.19}$$

Defining the variables (y_1, y_2 and y_3) as the country's debt-export ratio, its foreign assets over imports, and the probability of a weak government (w_t) as measure of political risk, which follows the updating process of the transition equation (14) and thus takes into account the probability that a weak or tough government will default as modeled in equations (3) to (14), the model can be rewritten as follows:

$$\log s = \alpha_0 + \alpha_1 b_t - \alpha_2 \lambda_t + \alpha_3 w_t + \alpha_4 r_t^* + \varepsilon_t \tag{1.20}$$

$$w_t = \beta_1 w_{t-1} + \beta_2 \Delta b_{t-2} - \beta_3 \Delta \lambda_{t-2} + \eta_t \tag{1.21}$$

This system can be directly estimated, if the initial value, the prior ($w_{t-1}=w_0$) is given. (See for example Hamilton (1990), or Harvey (1989)).

III. EMPIRICAL ESTIMATES: THE CASE OF BRAZIL

For Brazil, data was obtained on spreads for Brady bonds as well as Eurobonds, for a limited period, 1990-1996, using an extended dataset of (Ygosse (1997). See for a detailed description of the dataset used the appendix. Longer series were not yet constructed due to the difficulties in comparing newly obtained dataseries with the properties of the existing series, especially for the eurobond series. The obtained results were used to calculate the "steady state" probabilities of default of either a tough government or a weak government. The results are in line with the expectations, showing a slightly higher steady state probability for a weak government to default on outstanding debt. The Table on the next page shows the outcomes for both Bradies and Eurobonds for Brazil. Various initial values for the prior have been tried, and reported here are only the results of assuming *ex ante* a fifty-fifty chance of the government to be weak or tough. The rationale for this choice is that even at the announcement of a reform plan, the government initially has a fifty-fifty credibility and will show its "toughness" as time passes if in the past

reform plans have both been successfully as well as have failed. Especially in the case of Brazil the reality showed more plans that eventually failed, than succeeded in achieving the proposed goals of economic stability. Therefore using a fifty-fifty chance of the government to be of the tough or weak type seems justified. It would be interesting however to re-estimate the model, leaving the initial value also be as an unknown parameter, and a procedure should be formulated to estimate its starting value from maximum likelihood estimates.

Kalman Filter Estimation for Brazilian Brady and Eurobonds (t-values in brackets)

	Brady bonds	Eurobonds
α_1	0.052 (2.21)	0.214 (1.33)
α_2	-0.013 (-0.54)	-0.034 (-1.97)
α_3	-0.003 (-1.74)	-0.014 (-1.52)
α_4	-0.542 (-0.61)	-0.189 (-0.52)
β_1	0.51 (imposed)	0.51 (imposed)
β_2	0.014 (1.98)	0.136 (1.17)
β_3	-0.007 (-0.44)	-0.008 (-1.80)

The results are in line with the earlier results, as published in Ygosse (1997). Only since here no cross-section data is used, but only Brazilian data, the parameter estmates are somewhat less precise and efficient. Although the t-values are only significant at a 10 percent level, the results from using the Kalman filtering

technique are promising, as they do show a similar picture in terms of which factor is more important, the proxy for a country's solvency (debt-export ratio), or the proxy for a country's liquidity (foreign assets over imports). All variables show the expected sign.

IV. CONCLUSIONS

The goal of this paper was to model credibility of a government both to signal its type of budgetary policymaker into a model for the risk premium on sovereign bonds as well as the credibility of the government, independently of its type, of not defaulting, given the economic costs. As from earlier empirical research a country's debt-export ratio, a proxy for its solvency, as well as its foreign assets over imports, a proxy for its liquidity, were shown to be the key economic variables determining the risk premium paid on international bonds of LDCs, This paper contributes to the existing research by explicitly modeling the underlying fiscal policymaking framework as driving force behind the economic key variables of debt-export ratio and foreign assets over imports. A so called "tough" government, can be interpreted as a government with a higher degree of institutionalization of its budgetary system, for example in Brazil after the implementation of the so called "fiscal responsibility law". A "weak" government would typically be a government with a lower degree of institutionalization (or "rules") and a higher degree of discretion among the policymakers. In the latter, the occurrence of elections are making the credibility of a country not to default on its debt, in the absence of clear social consensus on desired policy vis-à-vis the outstanding international debt, much more volatile. Investors anticipating on such information would reflect this in demanding a higher risk premium for the country involved.

The preliminary empirical results for Brazil show that the new model specification, with the probability that a government is weak or tough, and whether a weak or tough government would decide to default on its outstanding debt explicitly driving

the variables that thusfar have always been significant in assessing a country's risk premium, shows results that are in line with earlier empirical findings. Moreover, the estimated parameters in the transition equation also show the expected signs. This is an encouraging result continue in this line of research of modeling the risk premium, as it takes into account the critique to the earlier models that no institutional framework is taking into account. Applied to a panel of countries, this model could help explain the perceived differences in risk premium for countries with similar debt-export performance but different degrees of institutionalization of their fiscal policies, and therefore a different degree of vulnerability and government's credibility.

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VI. DATA APPENDIX

Brady bonds: Par bonds, based on daily data from Salamon Brothers. These Brady bonds are collateralized. In order to investigate the default risk of such bonds, the bond yields need to be stripped from their collateral. The data obtained included stripped yields, as calculated and provided by Salamon Brothers. These stripped yields were used and daily data were transformed into monthly, quarterly and semi-annual data for estimation purposes.

Eurobonds: Yield spreads were constructed from various Brazilian Eurobonds, issued by government owned enterprises, by taking the difference between a Eurobond yield and a US Treasury Bond yield of comparable maturity. Daily data of US Treasury bond yields and Brazilian Eurobonds were obtained from Reuter´s, and transformed into monthly, quarterly and semi-annual data for estimation.

Country-Specific Variables:

Debt-Export Ratio:

World Bank *World Debt Tables*, IMF *International Financial Statistics* (IFS), and IMF Staff Estimates. This ratio can be seen as an indicator of the degree of solvency of a country. The higher the ratio, the less solvent is the country, thus the higher is the risk of such a bond. (Expected sign positive.)

Ratio of Foreign Assets (International Reserves) over Import:

IMF *International Financial Statistics* (IFS), IMF Staff Estimates. This ratio gives a scaled measure of the

international reserves position, of a country and thus shows a degree of international liquidity. Reserves/Imports has shown to be a more sensitive variable than for example Reserves/GDP, and therefore the former is preferred. (Expected sign negative.)

Inflation Rate: IMF *International Financial Statistics* (IFS), IMF Staff Estimates. As argued by McDonald (1982), a higher inflation rate could indicate an increased probability of a balance of payments crises, and consequently a higher probability of default. (Expected sign positive.) The inflation rate dropped out of the estimated equations.

Political Risk Indicator:

It is difficult to find an appropriate measure of pure "political risk", since this is a highly subjective variable. I took the same indicator that was used in Ygosse (1997), the "Institutional Investor Credit Rating", published twce a year by the *International Investor*. This is a measure based on a survey mainly among bankers throughout the world, how they view the risk of investing in Brazil. The higher the rating, the more creditworthy they think the country is. The indicator captures a broad measure of country risk, including the market´s perceptoiion of expected government turnovers, expected changes of economic policies that could affect the riskiness of a country´s financial assets, changes in taxation policies, and all possible othe factors influencing the risk of investing in a specific country as perceived by market participants. (Expected sign negative.)