Learning to Forget? Contagion and Political Risk in Brazil[*]

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Abstract

We examine whether Brazilian sovereign spreads of over 20 percent in 2002 could be due to contagion from Argentina or to domestic politics, or both. Treating unilateral debt restructuring as a policy variable gives rise to the possibility of *self-fulfilling* crisis, which can be triggered by contagion. We explore an alternative *political-economy* explanation of panic in financial markets inspired by Alesina (1987), which stresses exaggerated market fears of an untried Left-wing candidate. To account for the fall of sovereign spreads since the election, we employ a model of Bayesian learning and analyse the effects of contagion and IMF commitments.

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"Neither (of the two principal opposition candidates for the presidency) would be likely to choose a policy of deliberately reneging on Brazil's debts. That being so, the recent market turbulence has to be interpreted as a panic." Williamson (2002).

1. Introduction

To the dismay of those who believed that, by now, emerging market lenders could 'quarantine' individual countries in crisis, the collapse of the Argentine currency board in late 2001 has been followed by a sharp rise in sovereign spreads throughout Latin America as capital flows to the region have come to a Sudden Stop, Calvo et al. (2002), Wolf (2003). As Figure 1 makes clear, however, Brazil - the dominant economy of the region, operating with a floating exchange rate, inflation targets and an internationally respected governor - suffered more than the average. Following a substantial reduction in its external debt during the past four years, Brazil's public debt appears to be sustainable[1] but interest rate pressures may nevertheless expose it to self-fulfilling crisis. In the view of the ex-governor of the Central Bank and his deputy, the debt to GDP ratio will decline if real interest rates move toward single figures[2]; but if interest rates stay high - or growth falters - debt service could become an unsustainable burden, Fraga and Goldfajn (2002)

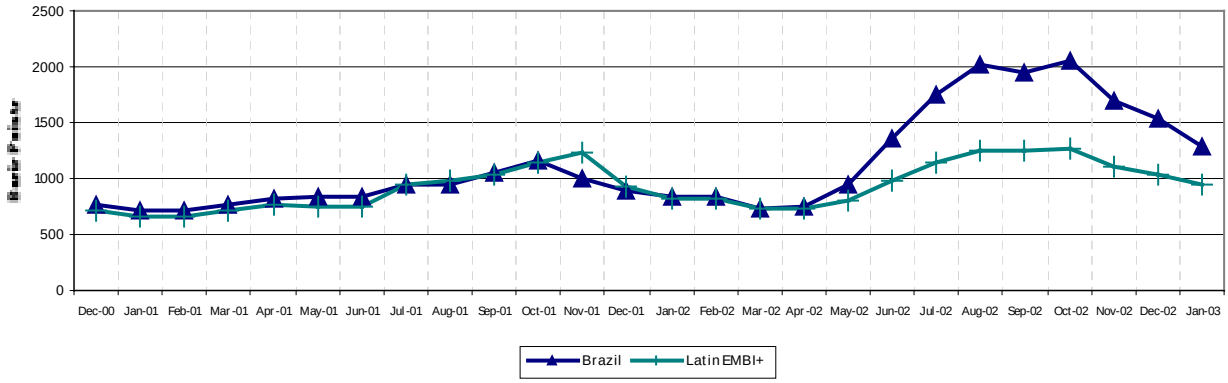
Regional contagion is clearly one factor to be considered in explaining the high sovereign spreads for Brazil: but what appeared to 'spook' financial markets in the summer of 2002 was domestic politics, in particular the upcoming October election in which the Left-wing candidate was expected to do well. With Lula da Silva, the charismatic leader of the Left-wing Workers' Party (PT), as the front-running candidate, markets feared a resort to unilateral debt restructuring to deal with the problems facing Brazil. Foreign banks carry substantial exposure to Brazil, so it is perhaps not surprising that, as the polls swung in his favour, sovereign spreads increased sharply: from around 7

[1] According to Sebastian Edwards, Brazil's debt ratio will decline as long as the primary surplus is maintained; see " Brazil's only hope of avoiding collapse," The Financial Times, August 5, 2002

[2] The current primary surplus of 3.75 per cent of gross domestic product guarantees a declining debt to GDP ratio as long as the inflation-adjusted interest rate paid by the government on its publicly traded debt does not exceed GDP growth by more than 7 percentage points. This is quoted from Fraga and Goldfajn (2002).

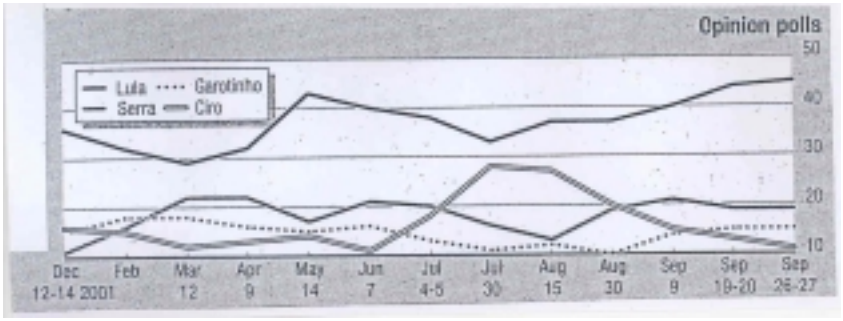
percent in March, the country's spread widened to around 20 percent in September, as Lula moved from less than 30 percent to over 40 percent in the public opinion polls, see Figures 1 and 2.

Figure 1: Sovereign Spreads for Latin America and Brazil



Source: Monthly average sovereign spreads obtained from Central Bank of Peru

Figure 2: Opinion polls prior to the presidential election in October 6, 2002.



Source: Financial Times, page10, Wednesday, October 2, 2002

In the months following the election of Lula as president, however, sovereign spreads on the country's bonds declined from a peak of 23 percent to around 13 percent by January 2003. They must fall further if Brazil is to be able to honour its debts in the medium term: but there is evidence that markets are getting over their initial panic at the prospect of a Left-wing administration.

We analyse these issues as follows. First, we outline a model where a "Sudden Stop" in capital flows leads to the prospect of default and debt restructuring in a

discretionary equilibrium with high sovereign spreads. The approach follows that of Sachs, Tornell, and Velasco (1996) in their analysis of the Mexican crisis of 1994/5, except that the policy choice is the rate of default on debt rather than how fast debt is inflated away. Multiple equilibria emerge when there are lump-sum costs of default, such as sanctions, litigation and other transaction costs (as in Rodrik and Velasco, 1999). Econometric studies of contagion in East Asian crisis have found evidence of jumps between regimes: could contagion from Argentina have shifted expectations enough to trigger a shift of equilibrium in Brazil?

The macroeconomic implications of domestic politics in the run-up to an election are analysed in Section 3. Along the lines proposed by Alesina (1987), we distinguish between the political preferences of Right and Left (where the latter are more prone to default on debt) and calculate sovereign spreads endogenously, using election probabilities. To analyse events after the election, in Section 4, we appeal to a model of learning. Formally, market expectations are a weighted average of two rates of default (high, ρ_H, and low, ρ_L), and the weights are revised by Bayesian updating. Where markets initially expect default with high probability, but revise this down if no default takes place, sovereign spreads will continue to subside much as has been observed. The Bayesian model also contains channels for contagion effects: events in Argentina could help determine ρ_H and/or the initial Bayesian prior attached to this prospect.

Could these contagion effects be mitigated through the good offices of the IMF? When a Left-wing candidate signs a Letter of Declaration to implement sound fiscal policy and eschew default, could this not reduce ρ_H and/or the priors that the markets attach to this prospect? While the simple learning model we outline can be used to incorporate these features, it could surely be extended to allow for strategic behaviour on the part of the incoming government if, as The Economist (2003, pp. 39-40) suggests, Lula in Brazil, like New Labour in Britain, realises that managing market expectations is an important element of macroeconomic policy.

2. Sovereign Spreads with Multiple Equilibria

Consider a small open economy with substantial government held debt in private hands, where inflation is checked by inflation targets operated by an independent Central Bank. To service the debt, the government can choose either to tax or to default – using involuntary debt restructuring to lengthen the term of the debt for example, or possibly to write it down. Where τ is the tax rate, and δ the default rate -- a measure of how costly the debt restructuring will be to creditors[3]-- the government minimises the following loss function:

$$\min_{\delta} \{\lambda_i y^2 + \tau^2 + I_{\delta} C_i(\delta)\} \qquad (1)$$

where y is a percentage deviation from full employment (natural rate), λ indicates the importance of welfare losses associated with output to the government. (Here, we index the parameters λ and C by i, indicating different possible political parties.) In addition to welfare losses associated with output and taxes, we assume there are extra costs related to debt default, $I_\delta C(\delta)$, where I_δ is an indicator function which is equal to 1 if there is a default and zero otherwise. The cost of default may reflect the direct sanctions imposed by the creditor countries, the temporary suspension of the borrowing country from the world capital markets, or other transaction costs associated with restructuring and repudiation. In particular, we specify the cost of default as

$$C_i(\delta) = Z_i + \alpha_i \delta^2 \qquad (2)$$

where both Z_i and α_i are positive. The costs imposed reflect 'punishment' for the act of default itself (breaking the terms of the debt contract) and for the degree of debt restructuring (value loss to creditors).

Let all debts be short term (one period), the government would face the following budget constraint

$$\tau + \delta b + R = (1 + \delta^e) b \qquad (3)$$

where b is the quantity of debt as a fraction of GDP, R is the amount of debt that is rolled over, and δ^e is the expected default rate. We assume that, in normal

[3] A low value of δ could involve debt rollover, while a high level could indicate outright default.

circumstances, when R=b, the government raises taxes to pay the interest charges, and default is not really an option. But what if creditors panic and refuse to rollover[4]? In this case, when there is a Sudden Stop, to use Calvo's phrase[5], we set R = 0 and find that default and restructuring are real possibilities. (The latter could, for example, amount to imposing an involuntary rollover.) Given the Sudden Stop, we assume that creditors move first to determine the interest rate for debt contracts before the government chooses its policy.

Actual default is beneficial to the government since it reduces taxes. But increase in default rate will increase expected default rate in the equilibrium.

Given the foreign interest rate r^*, we assume that the following interest parity condition holds for this small open economy

$$r = r^* + \delta^e \qquad (4)$$

where r is the domestic interest rate. We assume, for simplicity, that there will be no expected depreciation or appreciation of the domestic currency: so sovereign spreads reflect the expected default rate. (We discuss implications of adding a risk premium later.)

Aggregate demand is simply given by

$$y = -r$$

where y measure the percentage deviation from full employment level of output and for simplicity we ignore the effect of taxes on output . Normalising the foreign interest rate to zero, we arrive at

$$y = -\delta^e \qquad (5)$$

The government's decision is specified as a one period problem. The chronology in this single period is as follows: (1) after signalling a Sudden Stop, creditors form the expectation of the default rate and use it to determine the sovereign spread for the given borrowing, (2) conditional on this, the government decides whether to default. The set-up here clearly indicates that the government faces a time-consistency problem along the line of Sachs et al (1996) and Obstfeld (1996).

[4] As in Mexico the signal is the failure of the government to place its debt in the current auction.

Minimising the loss function in (1), subject to the given expected default rate of δ^{e}, gives rise to the following best response function for the government

$$\delta = \frac{b^2}{\alpha_i + b^2}(1+\delta^{e}) = \frac{b}{\alpha_i}\tau \qquad (6)$$

Substituting (2), (5) and (6) into (1) yields minimum losses under given expected default rate

$$L^{D}(\delta^{e}) = \frac{\alpha_i b^2}{\alpha_i + b^2}(1+\delta^{e})^2 + \lambda_i(\delta^{e})^2 + Z_i \qquad (7)$$

The rational expectations on the part of creditors imply

$$\delta^{e} = \delta \qquad (8)$$

Therefore, we obtain the time consistent equilibrium as

$$\begin{cases} \delta_D^{e} = \delta_D = b^2/\alpha_i \\ \tau_D = b \end{cases} \qquad (9)$$

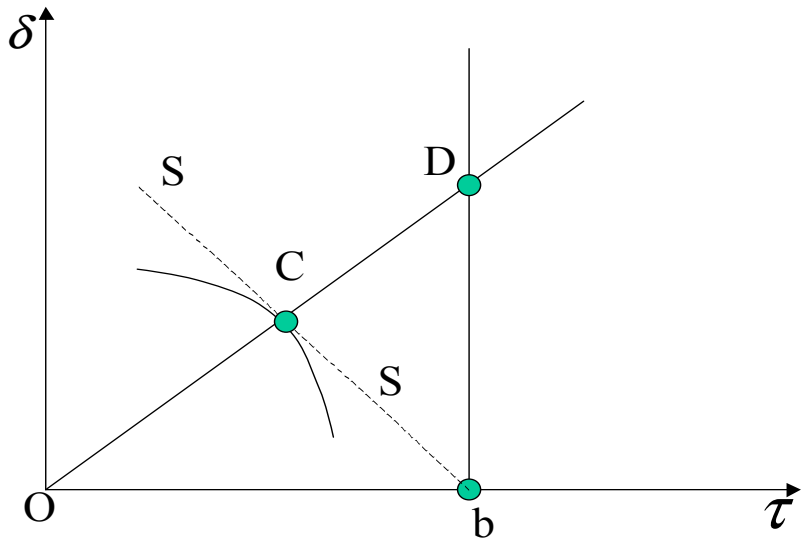


Figure 3: Time-consistent and pre-commitment equilibria

Figure 3 illustrates graphically how this time consistent equilibrium is obtained. The horizontal and vertical axes indicate tax rate and actual default rate respectively. It can be seen from (1) that the absolute minimum (given $C(\delta)$) is at the origin. Part of an

[5] See Calvo et al (2002).

ellipse sketched in Figure 3 indicates one iso-loss function. The budget constraint for $\delta^{e} = 0$ is given by a downward sloping line SS going through point b. Under this budget constraint, the government's optimal default rate would be at point C (which gives a strictly positive default rate). This clearly shows that, *in the absence of lump sum costs of default* government promises of no default are not credible. Varying δ^{e} traces all "short run" optimal choices made by the government on line OD, the government best response function described by (6). Substituting the rational expectations requirement (8) into (2) gives the best response function of the creditors' (indicated by vertical line Db in the figure). The intersection between OD and bD gives the time-consistent (Nash) equilibrium at D.

It is clear from the figure that with rational expectations on the part of creditors, equilibrium must satisfy the restriction that $\tau = b$ after a Sudden Stop. (In normal times, however, the budget constraint would be much closer to the origin. Technically, with r* set to zero, it would be at the origin if R = 1; and one interpret the tax rate as the extra taxes needed to finance the Sudden Stop.) If the government can credibly pre-commit, the best outcome is where

$$\begin{cases} \delta_{P}^{e} = \delta_{P} = 0 \\ \tau_{P} = b \end{cases} \tag{10}$$

This is illustrated in Figure 1 by point b and it is clear that the welfare losses to the government are less than that at point D.

Suppose that the government can pre-commit to no default ($\delta = 0$). The losses to the government when the default is nevertheless expected must be

$$L^{P}(\delta^{e}) = (1+\delta^{e})^{2} b^{2} + \lambda_{i}(\delta^{e})^{2} \tag{11}$$

What happens if the government can choose whether to commit or not? Pre-commitment is not always and everywhere preferable as it rules out the option of cheating. But as long as $L^{P}(\delta^{e}) \le L^{D}(\delta^{e})$, the pre-commitment equilibrium would be chosen. Define the critical level of expected default rate as

$$\delta_c^e = \{\delta^e : L^P(\delta^e) = L^D(\delta^e)\}$$

or

$$\delta_c^e = \frac{\sqrt{(\alpha_i + b^2)Z_i}}{b^2} - 1 \qquad (12)$$

So, if $\delta^e \le \delta_c^e$ the pre-commitment (no-default) equilibrium will be chosen, otherwise, the time-consistent (default) equilibrium will be chosen. Since δ^e is an endogenous variable, the conditions for selecting equilibrium are summarised below.

Proposition 1 *Equilibrium Separation*

(i) If $Z_i \le b^4/(\alpha_i + b^2)$, the government would choose to default and the equilibrium is given by (9).

(ii) If $Z_i \ge b^4(\alpha_i + b^2)/\alpha_i^2$, the government would not choose default and the equilibrium is given by (10).

(iii) If $b^4/(\alpha_i + b^2) < Z_i < b^4(\alpha_i + b^2)/\alpha_i^2$, both equilibria are possible.

Proof: For default to be the equilibrium, we only require $\delta_c^e \le 0$; and for no-default to be the only equilibrium, we require $\delta_c^e \ge \delta_P^e$. Rearranging in terms of Z_i, we obtain the above conditions.

It is clear from Proposition 1 that, when the fixed cost of default is low, the government would choose to default; if the cost is high it would choose not to; and the medium range of fixed costs generate multiple equilibria. This is very much in line with Obstfeld (1996) and Sachs et al (1996).

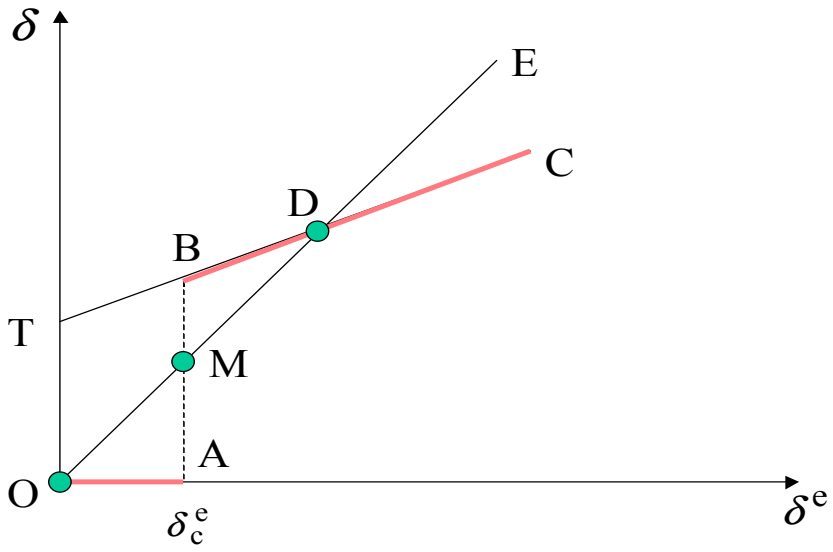


Figure 4: Endogenous choice of default: multiple equilibria

The multiple equilibria case is drawn in Figure 4, where horizontal axis represents expected rate of default and the vertical the actual default rate. The 45-degree line OE indicates rational expectations. With moderate fixed cost of default, the critical level of the expected rate of default, δ_c^e, lies in between point O and D. To the right of δ_c^e, default would be chosen, so the effective government response function is given by BC; to the left of δ_c^e, no default would be chosen, so the effective government response function is given by OA. If creditors expect serious default, the cost for government not to default is high, so it chooses to default. If little or no default is expected the government is better off honouring its debts. This makes the selection of equilibrium entirely depend on creditors expectations, which may depend on the realisation of "sun spots" – or on contagion.

2.1 Contagion and Multiple Equilibria

The evidence from currency crises in emerging markets during the 1990s suggests an important role for contagion across countries, as well as weak fundamentals and exogenous shifts in agents' expectations. From an empirical study of Markov-switching regimes, for example, Marcel Fratzscher (2000, 2002) concludes that contagion is the core explanation. In another time-series study by Jung Yeon Kim (2001), it was found

that a latent variable measuring contagion "plays an important role in causing a series of crises in East Asian emerging markets."

According to Masson (1999), 'pure' contagion involves changes in expectations that are not related to changes in a country's macroeconomic fundamentals. In a context where financial markets are subject to self-fulfilling crisis, it may, he suggests, trigger 'jumps between multiple equilibria'.

Fraga and Goldfajn's (2002) calculation of the sustainable interest rate for Brazil[6] suggests a critical value of expected default, δ_c^e, in single figures and explicitly discusses the risk of self-fulfilling crises if sovereign spreads go significantly higher. The model specified in previous section generates multiple equilibria for Z in an intermediate range, This implies the existence of three rational expectation equilibria, as indicated in Figure 3. The origin, O, where there is no Sudden Stop, the no-default equilibrium at the point (b, 0) where, despite the Sudden Stop, taxes are high and no default is expected; and default equilibrium at D.[7]

The effects of contagion can be captured in two ways. First there is the drying up of capital flows into the Brazilian bond market which eliminates the first low tax equilibrium. Then there is the rise in sovereign spreads as the market calculates the government's response. Despite the difference in fundamentals, both might simply mimic earlier developments in Argentina.

Three arguments in favour of a role for contagion are: first that an event such as Argentine default is the type of public signal which could co-ordinate private agents'

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[6] We compare the rate of interest (r), which is the sum of the default expectation and the risk aversion, with the δ_c^e, which is the critical value of default expectation. We apply the Fraga's criteria, which is the real interest rate should not exceed GDP growth by more than 7 percentage points, in our model. Provided that the potential GDP growth is 4.5 percent, this implies that the real rate of interest should not exceed 12 percent (δ_c^e) for a guarantee of a declining debt to GDP ratio.

[7] The last two equiibria are illustrated in Figure 4, indicating that which is selected depends on private sector beliefs. Clearly when δ^e is less than δ_c^e, the net welfare gain from default must be less than the lump-sum cost of default (Z) so there is no default; and the reverse applies when δ^e exceeds the critical value.

expectations on the bad equilibrium[8]; second that sovereign spreads have risen generally throughout Latin America not just in Brazil, see Figure 1; and third the analogy from East Asia, where a fundamentals-driven crisis in Thailand in mid-1997 led to a full blown liquidity crisis in Korea the following Christmas. Is Argentina to Brazil, what Thailand was to Korea?

3. Sovereign Spreads and Political Risk

The three leading presidential candidates in the first round of presidential election were Luiz Inacio Lula da Silva, Jose Serra, and Ciro Gomes. Mr. da Silva, a charismatic former trade union leader, was the candidate of the Left-wing Workers' party (PT). Despite the verbal commitments by the PT regarding the maintenance of economic stabilisation policies (inflation control, contractual obligations, and a primary budget surplus needed to service debt obligations of 3.75 percent of GDP in 2003), uncertainty over Mr. da Silva's economic proposals has triggered a panic in the country's financial markets as the markets feared he would use the unilateral repudiation as the tool to deal with the debt problems facing Brazil. Mr. Serra was the incumbent government's presidential candidate, the leading proponent of economic continuity, and candidate financial markets preferred. Ciro Gomes was the centre-left populist Labour Front's candidate. All three candidates were prevailed upon to endorse IMF fiscal policies as part of the arrangements for official financing agreed over the summer.

The pre-election poll results led to a sell-off in the Brazilian bond and currency markets; and, from a level of around 7 percent in March, country risk (measured by yield spreads on sovereign bonds over U.S. Treasuries) rose to around to 20 percent in August and September (see figure 1). After the first round on October 6, in which Lula obtained just under half of the votes, there was a run-off between himself and Mr. Serra on October 24 in which Lula obtained a decisive 61 percent of the votes. Despite the fact he had moderated his anti-capitalist discourse and adopted many mainstream economic proposals over the preceding two years, ambiguity over his policies continued to generate uncertainty in financial markets at least till the end of the second round; and interest rate

[8] Although Morris and Shin (2000) argued in favour of *unique* equilibria in a model with private signals, Atkeson (2000) and Boonprakaikawe and Ghosal (2000) show how the existence of public signals can generate multiple equilibria

spreads in October averaged just over 20 percent. In the months that followed, spreads narrowed by around 200 basis points per month, dropping to around 13 percent in January.

3.1 A Simple political economy model with no default by the Right-wing

To analyse how political factors can determine sovereign spreads, we modify the model along the line of Alesina (1987) by introducing two political parties with different preferences: Left-wing (L) and Right-wing (R), Thampanishvong (2002). We denote by π the ex-ante probability of the Left-wing party being elected, as indicated by the pre-election polls - for example.[9] To simplify the analysis, we follow Rodrik and Velasco (1999) by assuming that *the Right-wing party always repays debt* in the face of a Sudden Stop: while the *Left-wing party always chooses to default and restructure*. Conditional on the Sudden Stop, the sequence of events is as follows: (1) creditors use the ex-ante probability for each party to be elected to form the expected rate of default δ^{e}, (2) the election is held, (3) the elected party chooses whether to default by minimising its losses subject to given default expectations.

With political uncertainty, rational expectations on the part of creditors imply that

$$\delta^{\mathrm{e}} = \mathrm{E}(\delta) = \pi\delta(\mathrm{L}) + (1-\pi)\delta(\mathrm{R}) \qquad (13)$$

where E denotes the mathematical expectation, $\delta(\mathrm{L})$ and $\delta(\mathrm{R})$ are the ex-post default rates for the Left- and Right-wing parties respectively.[10] The equilibrium results may be summarised in the following proposition:

Proposition 2 *Sovereign spreads and political uncertainty*

Let $\alpha_{\mathrm{L}} = \alpha_{\mathrm{R}} = \alpha$, $Z_{\mathrm{L}} \le \mathrm{b}^4/(\alpha + \mathrm{b}^2)$ and $Z_{\mathrm{R}} \ge \mathrm{b}^4(\alpha + \mathrm{b}^2)/\alpha^2$, then the expected default rate is given by $\delta^{\mathrm{e}} = \pi\mathrm{b}^2/[\alpha + (1-\pi)\mathrm{b}^2]$ which is increasing in π. If the Left-wing party is elected, the post election outcomes are $\delta_{\mathrm{L}} = \mathrm{b}^2/[\alpha + (1-\pi)\mathrm{b}^2] > 0$ and

[9] Ideally, one would explain how these probabilities are determined.

[10] In a more complete model of the political process, this probability would be endogenous as the candidates selected programs to gain votes.

$\tau_L = \alpha b/[\alpha + (1-\pi)b^2] < b$. If the Right-wing party is elected, the outcomes are $\delta_R = 0$ and $\tau_L = (\alpha + b^2)b/[\alpha + (1-\pi)b^2] > b$.

Figure 5 illustrates. (The axes are as defined in Figure 4, but here we also use vertical axis to represent the mathematical expectation of the default rate). As the Left-wing government always defaults and the Right-wing always honours its debts, the corresponding reaction functions (conditional on gaining office) are LL and the horizontal axis, respectively. Prior to the election, the mathematical expectation of the default rate, $E(\delta)$, is a weighted average of these two reaction functions, as shown by SS in the figure. The mathematical expectation matches the expected rate of default δ^e at point E where SS crosses 45-degree line labelled OR, where the rational expectation constraint is satisfied. After the election, the Left will default as shown at X_L; while the Right will choose X_R.

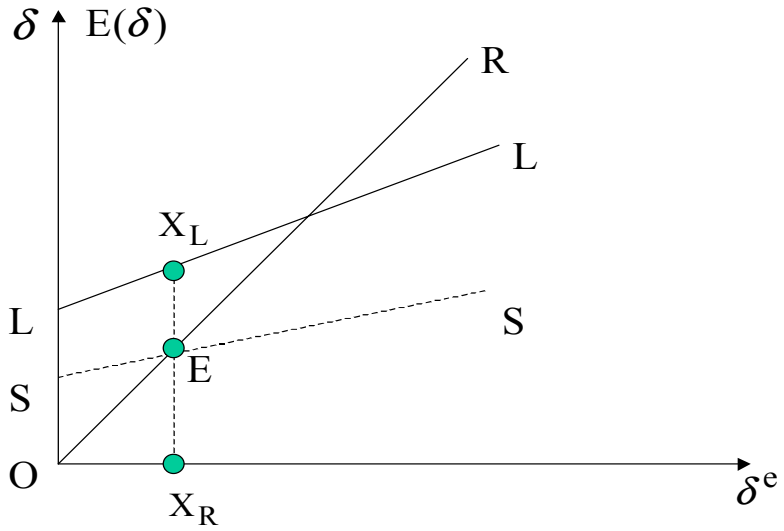

Figure 5: Sovereign spread and political uncertainty.

Consider the situation when the Right-wing party holds power, but an election looms, as in Brazil in 2002. Clearly the prospect of the Left-wing being elected will increase sovereign spreads even though the current government has no intention of defaulting. This is consistent with surges in Brazilian spreads as and when Mr da Silva's

popularity soared. Note that if Lula is almost sure to win, there will be little ex-post jump in the spread.[11]

4. Learning

4.1 Bayesian Updating

The Alesina-style model outlined above assumes that policy preferences of both parties are well known. But there was in fact considerable uncertainty about what Lula's economic policies might be. His pre-election speeches indicated substantial Left-wing sentiments: on the other hand, he was a signatory to the IMF Letter of Intent promising to deliver substantial primary fiscal surpluses and responsible monetary policy. In brief, the public had to *learn* about his policy preferences, particularly his attitude to debt default. As shown in Figure 1, there was a marked decline in average spreads in three months after the election, and there was no default. Here we employ a model of Bayesian learning to see how avoiding default could lead to restoration of confidence and a fall in post-election sovereign spreads. This involves extending the previous one period model into a multi-period setting.

To incorporate Bayesian learning in an analytically tractable way, we first assume that a Left-wing party can randomly choose one of the two different preferences (after public has formed its default expectations): either a set of preference parameters (low α_l and/or low Z_l) which generate *default* under all circumstances, or a set of preference parameters (high α_h and/or high Z_h) which generate *no default* under all circumstances. The "types" of the Left-wing government are differentiated by assigning two different probabilities to these two sets of preference parameters. The Left-wing party can be one of two possible types: either it defaults with a high probability, ρ_H, in each given period or with a low probability, ρ_L, where $0 \le \rho_L < \rho_H < 1$, cf. Driffill and Miller (1992).

[11] The predicted ex-post jump in sovereign spreads, EX_L, will shrink as the pre-election polls swing to left, shifting SS closer to LL

Here ρ_i ($i = H$ or L) is the per period probability that the Left-wing government would randomly choose a "default" set of preference parameters to determine the policy outcome, i.e., default while $1-\rho_i$ is the complimentary per period probability of its choosing a "non-default" set of parameters to determine the policy outcome. (We call a Left-wing government with ρ_L a "strong" government and that with ρ_H a "weak" government.) Ex ante (at the beginning of each period), the preferences of the Left-wing party can be thought of as the weighted average of extreme values of parameters, (e.g. sufficiently low α_l to generate default in all circumstances and sufficiently high α_h so that default is avoided), with probability weights of ρ_i and $1-\rho_i$ (where $i = H$ or L).

Just after the election, the private sector attaches a prior probability P_0 to the belief to the prospect that the Left-wing government is "strong" (and the complimentary probability of $1-P_0$ to the prospect that it is "weak"). How will these priors evolve over time? Let P_t be the private sector's prior belief at time t that the Left-wing government is strong, conditional on observing that the government has not defaulted in the previous t periods. If there is no default at period t, the prior belief of a "strong" government at period $t+1$ can be obtained using the Bayesian updating rule

$$P_{t+1} = \frac{P_t(1-\rho_L)}{P_t(1-\rho_L)+(1-P_t)(1-\rho_H)} \tag{14}$$

The complimentary probability of a "weak" government is

$$1-P_{t+1} = \frac{(1-P_t)(1-\rho_H)}{P_t(1-\rho_L)+(1-P_t)(1-\rho_H)}.$$

Dividing the above two equations yields

$$\frac{P_{t+1}}{1-P_{t+1}} = \frac{1-\rho_L}{1-\rho_H}\frac{P_t}{1-P_t}. \tag{15}$$

Let $V_t = \frac{P_t}{1-P_t}$, then (15) becomes a first-order homogenous difference equation

$$V_{t+1} = \frac{1-\rho_L}{1-\rho_H} V_t ,$$

with the solution

$$V_t = \frac{P_0}{1-P_0}\left(\frac{1-\rho_L}{1-\rho_H}\right)^t . \qquad (16)$$

Solving for P_t yields

$$P_t = \frac{\frac{P_0}{1-P_0}\left(\frac{1-\rho_L}{1-\rho_H}\right)^t}{1+\frac{P_0}{1-P_0}\left(\frac{1-\rho_L}{1-\rho_H}\right)^t} . \qquad (17)$$

Consider a simple case where $\rho_L = 0$, i.e., the "strong" Left-wing government never defaults. The probability that the government is strong (P_t) increases monotonically over time. Taking limit to (17), one can show that

$\lim_{t\to\infty} P_t = 1$.

As long as the government has not defaulted, the learning will asymptotically reveal the true type of the government.

Given that the strong Left-wing government never defaults and that there has been no default up to period t, what would be the default expectation at period t? Under the previous assumptions, "strong" and "weak" Left-wing governments, respectively, have the following response functions (see (10) and (6))

$\delta_S = 0$

and

$$\delta_W = \frac{b^2}{\alpha_l + b^2}(1+\delta_t^e) ,$$

where δ_S and δ_W denote the appropriate default rates. The assumption of rational expectations requires

$$\begin{aligned}\delta_t^e &= E_t(\delta_t) = P_t[\rho_L \delta_W + (1-\rho_L)\delta_S] + (1-P_t)[\rho_H \delta_W + (1-\rho_H)\delta_S] \\ &= (1-P_t)\rho_H \delta_W \\ &= (1-P_t)\rho_H \frac{b^2}{\alpha_l + b^2}(1+\delta_t^e)\end{aligned} \tag{18}$$

Solving for the expected default rate yields

$$\delta_t^e = \frac{(1-P_t)\rho_H \dfrac{b^2}{\alpha_l + b^2}}{1-(1-P_t)\rho_H \dfrac{b^2}{\alpha_l + b^2}} \tag{19}$$

Since P_t is increasing over time, δ_t^e declines monotonically.

How does post-election learning affect sovereign spreads? Note that the expected default rate just after the election of the Left-wing party is given by δ_0^e. Incorporating politics introduced in the previous section, the pre-election expected default rate is given by (see (13))

$$\delta^e = \pi\delta_0^e + (1-\pi)\delta(R). \tag{20}$$

Assume the Right-wing party never defaults, then the rise in sovereign spreads due to the Left-wing party being elected is given by

$$\delta_0^e - \delta^e = (1-\pi)\delta_0^e$$

If the Left-wing party is almost surely to be elected (so π is close to 1), the sovereign spreads would be more or less continuous over the election period.

The qualitative nature of the sovereign spread dynamics is sketched in Figure 6, with time measured on the horizontal axis, and 0 indicating the date of the election. Before then, growing spreads reflect increasing probability that the left-wing party will be elected. Post election, the spreads increase momentarily and then decline over time because of learning (conditional on observing no defaults).

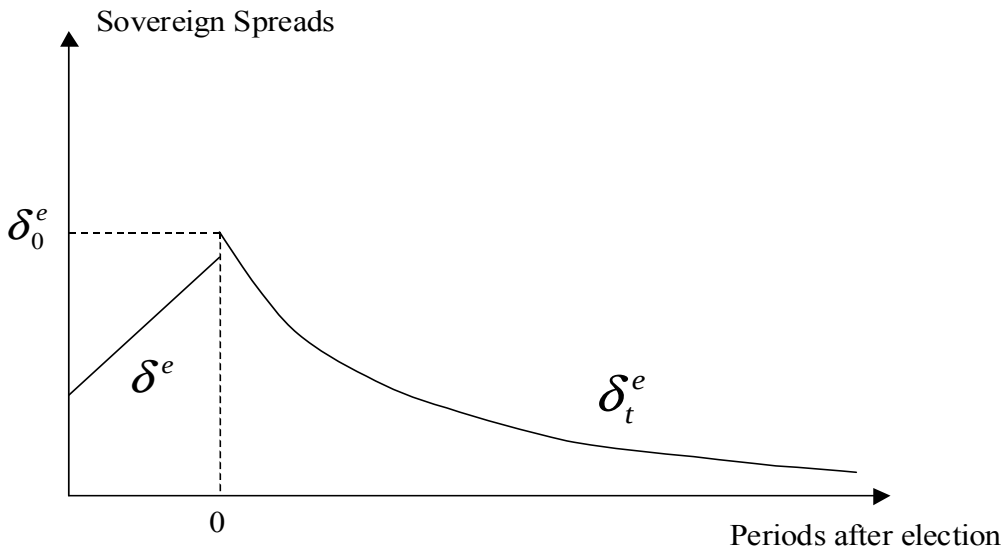

Figure 6: Sovereign spreads: political uncertainty and learning.

To illustrate the quantitative effect of learning on Brazilian sovereign spreads, we use the following numerical example. As the Brazilian external debt to GDP ratio prior to the election stood at 40%, we choose $b = 0.4$. We assume that the "strong" Left-wing government never defaults, $\rho_L = 0$, and the "weak" Left-wing government has a high probability of default in each month, $\rho_H = 0.4$; and that the Lula government had very little reputation of being a "strong" type just after the election, $P_0 = 0.2$. If we choose $\alpha_l = 3$, using (17) and (19), the annualised spread just after election will be 21.7%, and the annualised spreads for the next three months are given by 18.9%, 15.5% and 12.0%, respectively. The time pattern of the spreads so generated is similar to monthly average sovereign spreads for Brazil after the election (given in Figure 1). Of course, there may be other factors affecting sovereign spreads in Brazil after the election: this example is only for purposes of illustration.

5. Contagion - and 'learning to forget'

In Section 2.1, we discussed how contagion might lead to jumps between equilibria; but political-economy approach with learning provides an alternative channel

for contagion. Where should the market get its ideas of what a new government in Brazil might do? Why not look at what happened in its southern neighbour less than a year before the Brazilian election, where the departure of Argentine President de la Rua led to debt repudiation? The Economist (2003, pp. 39) takes such a view: "Over the past year, fears of default, stoked by Argentina's insolvency and the past radicalism of Lula and his Workers' Party (PT), helped push up interest rates and the value of the dollar."

How can this be captured in the model of learning? In the first place, the "high repudiation prospect" (ρ_H in the previous section) could be subject to contagion as it reflects developments outside Brazil. Thus, instead of causing a shift between multiple equilibria, contagion can raise default expectation by shifting prior beliefs about the nature of an incoming Left-wing government. In the second place, with no change in ρ_H, contagion might reduce the Bayesian prior (P_0) attach to the prospect that the Left-wing government is strong.

Formally, substituting for δ_0^e in (20), we find that devaluation expectations in the political-economy model with learning are determined as:

$$\delta^e = \pi\delta_0^e + (1-\pi)\delta(R) = \pi(P_0\rho_H + (1-P_0)\rho_L)) + (1-\pi)\delta(R) \qquad (21)$$

i.e. default expectations are increasing in either of the parameters ρ_H or P_0 subject to contagious infection.

Things may, in practice, be more complicated. As The Economist (January, 2003) went on to remark: "Since the final weeks of the election campaign, Lula has worked hard to turn investor panic into mere wariness. He has stressed that Brazil means to pay its debt and has chosen ministers who seem ready to carry that promise through." (The Economist page 39, January 4, 2003). This suggests how the learning model used above could be improved: namely by incorporating strategic behaviour on the part of the new president to reassure the market that he is not as radical as they might have feared. So, instead of Bayesian updating, beliefs could be subject to manipulation by the new government. [12]

[12] Models of strategic learning that may be useful in this context include Cripps (1991), Ellison and Valla (2001) and Rosal and Spagat (2003)

If President de Silva wanted to reassure the markets, dismissing the incumbent Central Bank Governor, Arminio Fraga, was surely a risky thing to do.[13] Should one also model the learning-curve of the incoming government as it develops the skill of managing market sentiment?

5. Can the IMF counter contagion?

When the IMF approved Brazil's request for a 15-month stand-by credit of approximately US$ 30 billion to support the country's economic and financial program until December 2003, it sought a written commitment from the leading presidential candidates on the policies their administrations would follow if they won the election.[14] To help stabilise public debt dynamics, and lower the debt ratio over the medium term, the commitment included a target for a public sector primary surplus of 3.75 percent of GDP in 2003, and no less than this for 2004-2005.

Just as bad news from Argentina could increase sovereign spreads in the political-economy model discussed above, so arrangements with the IMF might have the opposite effect. By supplying funds before the election in exchange for these commitments, the IMF could help counter contagion. By signing a Letter of Declaration, for example, an incoming Left-wing party might effectively reduce extreme views of its potential behaviour (so increasing P_0 and reducing ρ_H).

Note that, alternatively, such declarations might have the effect of significantly increasing the perceived *lump-sum* cost of default for the Left-wing government, i.e. increasing Z_l in equation (2). This could lead to multiple equilibrium outcomes in the political-economy model as a zero-default equilibrium might exist even for the Left-wing government. In principle, therefore, the two approaches to modelling contagion could be combined.

[13] It should be added that the new appointee as governor who is likely to retain many of Fraga advisers; and the new Finance Minister is reputed to have plans to make the central bank more independent of the government, as did the British Chancellor when the Labour Party first took office under Tony Blair.
[14] "IMF Approves US$30.4 Billion Stand-By Credit for Brazil," International Monetary Fund, Press Release No. 02/40, September 6, 2002.

6. Discussion and Conclusion

Williamson (2002) has examined Brazilian fundamentals and politics and concluded that markets had panicked. Like the bank panic in Korea, this might represent a shift of equilibrium triggered by contagion from a neighbouring crisis. It may, on the other hand, reflect the political equilibrium in a context where, for the first time, a charismatic Left-wing leader is running strongly for office. For reasons suggested by Alesina, sovereign spreads will then tend to move in line with opinion polls, rising with the popularity of Left-wing president as shown in Figure 1 and 2. In the context where the behaviour of the potential Left-wing president is very uncertain, contagion may arise as markets and masses unthinkingly transpose events from neighbouring Argentina to Brazil. As models of Bayesian learning suggest, prior probabilities of a radical repudiation will be revised over time if debts are honoured and repudiation resisted. This is, we believe, taking place in Brazil; and if it continues it offers the prospect of interest rate falling sufficiently to allow for continued growth without default.

Allowing for strategic learning, where the incoming government actively tries to manage public perceptions and allay market fears, would doubtless provide a more comprehensive and realistic understanding of events.

Even before the election takes place, the IMF may help offset the effect of contagion. Perceptions of radical repudiation may fade as candidates of all parties publicly promise to control fiscal deficits and abide by existing debt contracts and sign a Letter of Declaration to the IMF as a form of pre-commitment.

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