Credibility and Reputation: an Application of the "External Circumstances" Model for the Real Plan*

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Summary: 1. Introduction; 2. The theoretical model; 3. Econometric procedure; 4. Credibility and reputation during the exchange rate regime; 5. Conclusion.

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This paper analyzes credibility and reputation aspects of the Brazilian economic policy between August 1994 and December 1998. It uses an "external circumstances" model, which can be applied to countries with fixed or crawling-peg exchange rate policies. The model assumes that no government can conduct its economic policy with the single objective of inflation control, thoroughly ignoring the unemployment and growth paths. Therefore, in the presence of "external circumstances" (unexpected exogenous shocks) even a strong anti-inflationary government can be forced to devalue its exchange rate. The results here show that the government followed a consistent policy with inflation control while allowing for a gradual recovery of the competitiveness level.

Este artigo analisa a credibilidade e a reputação na política econômica brasileira no período de agosto de 1994 a dezembro de 1998. O marco teórico empregado tem como base o modelo de "circunstâncias externas", que permite analisar os fatores de credibilidade e reputação durante o funcionamento de um regime de taxa de câmbio fixa ou de *crawling peg*. O modelo parte do pressuposto de que, em geral, nenhum governo pode preocupar-se única e exclusivamente com o objetivo de controlar a inflação, ignorando por com-

pleto objetivos de crescimento e emprego. Portanto, e em particular, diante de circunstâncias adversas, um governo, ainda que do tipo antiinflação, pode ser levado a desvalorizar a taxa de câmbio. Os resultados aqui apresentados permitem concluir que o governo estava seguindo uma política consistente com a manutenção da estabilidade de preços, enquanto permitia uma recuperação gradual da competitividade.

1. Introduction

After several unsuccessful attempts to stabilize the Brazilian economy during the 1980s and early 1990s, the Real Plan has finally managed to reduce inflation systematically and consistently. Initially, economic authorities allowed the real to be considerably overvalued, since reducing inflation was a priority. Hence, between July 1994 and February 1995, there was a floating exchange rate policy that allowed for such appreciation. After the Mexican crisis, from March 1995 onwards, an exchange rate band regime was implemented, which, in fact, resembled a crawling-peg regime. During the Asian crisis in October 1997, there was a reduction in foreign reserves, which was reversed after a few months, causing reserves to accumulate again. With the Russian crisis in August 1998, extensive foreign reserve losses, and the speculation against the real, the government decided to abolish the exchange rate band regime at the beginning of January 1999.

In this paper we analyze credibility and reputation aspects of the Brazilian economic policy between August 1994 and December 1998 using an "external circumstances" model. We emphasized the period between March 1995 and January 12, 1999, in which exchange rate band regimes were in use in Brazil.

An "external circumstances" model, developed by Drazen and Masson (1994),[1] Masson (1995) and Masson and Agénor (1996), was used to analyze credibility and reputation factors in a fixed or pegged exchange rate system. The model assumes that, in general, no government can conduct its economic policy with the single objective of inflation control, thoroughly ignoring the employment and growth paths. Therefore, in the presence of "external circumstances" (unexpected exogenous shocks) even a tough, anti-inflationary government can be forced to devalue its exchange rate.

We observed that the government built up reputation and credibility for its policy during the exchange rate regime implementation. Based on this theory, the government signaled its exchange rate commitment, causing unemployment

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[1]See Drazen and Masson (1993) for a detailed working-paper version.

to increase and competitiveness to recover gradually. A general conclusion is that there is no evidence "based on this model" to affirm that flawed economic fundaments led to the exchange rate regime collapse.

The article is divided into five sections, including this introduction: Section 2 consists of a theoretical review of the external circumstances model. Section 3 discusses the econometric procedure to be used and the estimation of the model. Section 4 presents the results, taking into consideration the economic policy implemented at that time, while section 5 presents a few conclusions and remarks.

2. The Theoretical Model

Although an exchange rate band was adopted by Brazil between March 1995 and early 1999, in practice it was not so different from a fixed, managed, or pegged exchange rate system, as some analysts have pointed out.[2] Therefore, the analysis of exchange rate behavior is not based upon the extensive literature on exchange rate band originated by Krugman's model (1991).[3] The theoretical approach used in this article complies with the credibility models that use economic policy games as their cornerstone.[4]

Part of this literature, namely the one produced by Backus and Driffill (1985), has underscored the role of the "type" of policymaker (weak, tough, or innumerous types) in determining the credibility of a given economic policy. As far as this matter is concerned, a weak policymaker thinks it is nice to mimic the behavior of a tougher one in order to build his reputation. Therefore, a tough policymaker who wants to signal his type should, for instance, allow high increases in unemployment (above his desirable levels) right from the start in order to improve his reputation and raise the credibility for the implemented policy.

Later on, escape clause models were created. Those models aimed at structuring economic policy conditional on exogenous shocks or unpredicted contingencies.

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[2] See, for example, Pastore and Pinotti (1999) and Bonomo and Terra (1999b). Some papers have analyzed the credibility aspect of an exchange rate band regime, assuming that this regime has really worked out in practice — see, for example, Münch (1998), Rocha and Moreira (1998) and Fontes et al. (1999). Before that, it is advisable to analyze whether the Brazilian exchange rate regime is adherent to any of the exchange rate bands models during the period — as carried out, for instance, by Flood, Rose and Mathieson (1991) for the EMS. In the same fashion, Ferreira (1999) found that the Brazilian exchange rate system presented little adherence to the theoretical models of exchange rate. At best, there is some weak evidence in relation to the model with flawed credibility and intramarginal interventions as in Bertola and Caballero (1992) and Bertola and Svensson (1993)

[3] A review of this literature can be seen in Garber and Svensson (1995).

[4] A review of this literature can be seen in Persson and Tabellini (1994, 1997, 2000).

In Lohmann (1992), for example, a policymaker delegates monetary policy to a conservative central banker who should establish a certain inflation rate in normal circumstances, and implement a flexible escape clause in extreme situations. If he does not do that, he will be fired.[5]

Following in the same path, Drazen and Masson (1994) devised an "external circumstances" model. According to them, "Whether or not an announced policy is carried out, however, often reflects more than the policymaker's intentions. The situation in which he finds himself can be as important: even a "tough" policymaker cannot ignore the cost of very high unemployment, he may renege on an anti-inflation commitment in sufficiently adverse circumstances, that is, in times of weak activity, when pressures to restore high employment are strong. In short, the credibility the public assigns to an announced policy should therefore reflect external circumstances as well" (Drazen & Masson, 1994:736).

Masson (1995) made a multi-period generalization of Drazen and Masson (1994), in which credibility evolves over time and the updating of beliefs is explicitly modeled. Masson and Agénor (1996) developed a slightly different version from that of Masson's (1995), in which the trade-off that a policymaker is faced up with occurs between inflation and economic competitiveness. Finally, Agénor and Masson (1999) also developed a slightly different version from that of Masson's (1995), in which the tradeoff that a policymaker is faced up with occurs between domestic interest rates and exchange rate stability.

In a formal manner, in Drazen and Masson's (1994) model,[6] a stochastic shock is applied to unemployment in Barro and Gordon's (1983) model, in a way that the selection of economic policies by the government will depend on the realization of shock and also on the weight the government attributes to inflation in relation to unemployment. Furthermore, there is uncertainty about the policymaker's preferences and the shocks that impinge upon economy. We take for granted that surprise inflation reduces unemployment rate u_t in relation to the natural unemployment rate $\bar{u}$ and that u_t is affected by its lagged u_{t-1} value and subject to stochastic η_t shocks:

$$u_t = \bar{u} - \sqrt{a}[(\pi_t - \pi_t^e) - \delta(u_{t-1} - \bar{u})] + \eta_t \tag{1}$$

where π_t is the current inflation rate, π_t^e the expected inflation rate and $\delta \geq 0$ is a measure of persistence for unemployment fluctuations (thus, $\Delta = \delta\sqrt{a}$ is the autoregressive coefficient on unemployment, and if $\delta = 0$ there is no persistence).

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[5]See also Obstfeld (1991).
[6]The model is based on Obstfeld's (1991) model of escape clauses.

At the initial stage of the two-period model, we assume that $u_0 - \bar{u} = 0$ and, therefore, persistence only affects unemployment rate in period 2.[7]

The government aims at minimizing an expected two-period quadratic loss function (L_t). This L_t function in a single period depends on the unemployment deviation from a target level below the natural rate, $\bar{u} - K$ (where K captures the distortions that lead to an excessively high natural unemployment rate), and also to current inflation rate

$$L_t = (u_t - \bar{u} + K)^2 + \chi(\pi_t)^2 \tag{2}$$

where χ represents the weight attributed to inflation stability in relation to unemployment. There may be different types of government, which translates into uncertainty about the government's objective function. There are two types of government: tough government (with superscript T), which cares about inflation with the weight χ^T, and weak government (with superscript W), which assigns a lower weight (χ^W) to inflation in its objective function, therefore $\chi^T > \chi^W$. In period 1, the type of government is unknown, so the government's choice of policy in period 1 may influence the expectation of a devaluation in period 2. Analyzing only two periods, and assuming that exchange rate (in log) e_t is the political tool used to influence price level, and that the price level is equivalent to the exchange rate,[8] the i-type government's objective function conditioned on information available at $t = 1$ may be defined as

$$\Lambda^i = L_1^i + \beta E L_2^i$$

$$\Lambda^i = L_1^i + \beta E L_2^i = (u_1 - \bar{u} + K)^2 + \chi^i(\Delta e_1)^2 + \beta E_1[(u_1 - \bar{u} + K)^2 + \chi^i(\Delta e_2)^2] \tag{3}$$

where Δe_t is the exchange rate change. To simplify matters we defined $\kappa = K/\sqrt{a}$ and $\epsilon_t = \eta_t/\sqrt{a}$.

The values of the objective function in (3) depend on the government's ability to offset shocks in periods 1 and 2, and also the signaling of its type through its actions in period 1, provided that the unemployment rate in period 2 is dependent on exchange rate expectations. The timing of events is as follows: private agents

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[7]Alternatively, the persistence effects may be modeled in the equation of preferences by including the lagged unemployment rate into loss function (2). The results would be the same, if the probability of devaluation in period 2 were positively dependent on unemployment in period 1.

[8]The inflation rate should be replaced with the exchange rate in equation (1).

establish their expectations as to the exchange rates and set wages before shock $\in_t$ is carried out; the policymaker observes the shock on unemployment, and then he determines the exchange rate (devaluing it or keeping it fixed).

The question to be analyzed is how the probability of a devaluation in period 2, denoted μ_2, depends on government's action in period 1, since not only the standard signaling of an unknown type of government but also the effect of unemployment persistence are considered. Taking into consideration the uncertainty about the types, we can write μ_2 as

$$\mu_2(j) = w_2(j)\rho_2^W(j) + [1 - w_2(j)]\rho_2^T(j) \tag{4}$$

where:

$w_2 =$ probability the government is of type W;

$\rho_2^W =$ probability a government of type W will devalue (given the distribution of $\in_2$);

$\rho_2^T =$ probability a government of type T will devalue;

argument j ($= D$ or F) indicates the government's action or choice, whether it devalued the exchange rate (D) or it kept the exchange rate fixed (F) in period 1; the calculation of these probabilities depends on the information structure.

To calculate ρ_2^i, we should first solve the government's problem in period 2, for given expectations of a devaluation $\mu_2(j)$. After that, substituting ρ_2^i in equation (4), we obtain $\mu_2(j)$. It is assumed that private agents know the values χ^T and χ^W, but do not know about the type of government in addition to not observing shock $\in_t$.[9] Denoting by $L_{2D}^i(j)$ (where j was the action in period 1) the single period loss function of an i-type government if it devalues in period 2, then the government will devalue in period 2 if $L_{2D}^i(j) - L_{2F}^i(j) < 0$, that is, if the expected loss with devaluation for period 2 is less than the expected loss resulting from the maintenance of a fixed exchange rate in period 2. This defines a critical value for shock $\widehat{\in}_2^i(j)$:

$$\widehat{\in}_2^i(j) = \frac{(a + \chi^i)s}{2} - \kappa - \mu_2(j)s - \delta(u_1 - \bar{u}) \tag{5}$$

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[9]Drazen and Masson (1993) also analyze the case in which the shock is observable or may be inferred.

where s is the fixed devaluation size. Therefore, critical value $\widehat{\in}_2^i(j)$ depends on the type of government (via χ^i) and on the previously observed policy. If the realization of $\in_2$ is below this critical value, the policy of maintaining the exchange rate fixed is optimal; if it is above it due to external shock, a devaluation is optimal. Assuming that the distribution of $\in_t$ is uniform between $-v$ and $+v$, and symmetric around 0 (for an interior solution), we have:

$$\rho_2^i(j) = \text{prob}(\in_2 > \widehat{\in}_2^i(j)) = [v - \widehat{\in}_2^i(j)]/2v \tag{6}$$

To calculate the probability of government type, we assume that private agents use the Bayesian approach to assess the type of government, starting with uniform priors over the two types. Expectations are conditioned on whether or not the government will devalue in period 1, but not on the realization of shock $\in_1$, since it is assumed that private agents do not observe it. The probability that the government is weak conditional on its actions in period 1 may then be written as

$$w_2(D) = \frac{\rho_1^W}{\rho_1^W + \rho_1^T} \qquad\qquad w_2(F) = \frac{1 - \rho_1^W}{2 - \rho_1^W - \rho_1^T} \tag{7}$$

when uniform priors are used as a start. Observe that $w_2(D) > w_2(F)$ as long as $\rho_1^W > \rho_1^T$, that is, as long as the probability that a weak government devalues in period 1 is greater than the probability that a tough government devalues in period 1.

The probability that a given type would devalue in period 1, ρ_1^i, is derived in an analogous way to the previous calculation for ρ_2^i. We calculate a critical value of the shock in period 1, that is, $\widehat{\in}_1^i$, in a way that $\Lambda^i(D) = \Lambda^i(F)$.[10] Consequently, the probability that $\in_1 > \widehat{\in}_1^i$, may be calculated assuming the same uniform distribution.

The last step is to establish the relationship between the credibility of the no-devaluation commitment in period 2 and the policy action observed in period 1. This allows us to show that no-devaluation in period 1 may raise instead of reducing private agents' expectations of a devaluation in period 2. For that reason, we have to derive the difference in the probabilities of a devaluation in period 2 as a function of the policy action taken in period 1, that is, $\mu_2(D) - \mu_2(F)$. To calculate $\mu_2(D) - \mu_2(F)$, we have to combine equations (5), (6) and (7) so that, after some algebraic manipulation, we obtain:

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[10]See the Appendix in Drazen and Masson (1994) for detailed information on this calculation.

$$\mu_2(D) - \mu_2(F) = \frac{1}{1 - s/2v}\left[-\frac{\sqrt{a}\delta s}{2v} + \frac{(\rho_1^w - \rho_1^T)(\chi^T - \chi^W)(s/4v)}{(\rho_1^W + \rho_1^T)(2 - \rho_1^W - \rho_1^T)}\right] \quad (8)$$

where we used $\mu_1(D) - \mu_1(F) = -\sqrt{a}s$. Note the sign in expression (8). The first part on the right-hand side is always positive, as we assume that $1 - s/2v > 0$, because the sole objective of devaluation is to offset the shock; thus, devaluation size should not exceed twice the maximum size of the shock.

The unemployment persistence parameter δ will affect both terms inside the brackets. The effect on $\rho_1^i (i = T, W)$ arises because critical level $\widehat{\epsilon}_1^i$ of the shock in period 1 depends on the welfare in both periods and, as a consequence, on δ. There are two possibilities. First, in the case of no persistence of the effects of unemployment between periods ($\delta = 0$), as only one signaling effect exists, the first term disappears from within the brackets, and the expression in (8) is certainly positive. The standard result on the signaling of types will then be in effect: if a tough policy was observed (no-devaluation) in period 1, the probability for no-devaluation will increase in period 2. Using equation (8), we observe that $\mu_2(D) > \mu_2(F)$ as long as $\rho_1^W > \rho_1^T$, that is, as long as the probability that a weak government would devalue in period 1 is greater than that of a tough government, which is true from the moment we assumed that $\chi^T > \chi^W$. This way, the absence of persistence and the existence of different preferences over inflation imply that the signaling motive alone contributes to the credibility for fixed exchange rate, which shows improvement in period 2, if no devaluation is observed in period 1.

The second possibility considers there exists persistence in unemployment, thus $\delta > 0$. The dependence of $\mu_2(D) - \mu_2(F)$ on δ is quite complex, reflecting the contribution of both terms. Drazen and Masson (1994), solving equation (8) through numeric methods, showed that for sufficiently high δ values, the persistence effect tends to dominate the signaling effect and (8) will become negative. Therefore, the probability for devaluation in period 2 will be increased, which implies that the government's credibility will be reduced. Based on this Drazen & Masson (1994:742-3) concluded as follows: "To summarize, positive persistence of unemployment implies that no devaluation in the first period may raise rather than lower the public's expectation of a devaluation in the second period. Shocks that are not offset through a devaluation in period 1 have further unfavorable effects in period 2, increasing the probability that a government of either type will devalue. If these persistence effects are sufficiently strong (δ large), not devaluating in the first period will raise the probability of a devaluation in the second. Thus, credibility will not necessarily be enhanced by 'playing tough' in period 1."

As previously mentioned, this is just a two-period model, and signaling is carried out in period 1. Masson (1995) made a multiperiod generalization of Drazen and Masson's model (1994), in which credibility evolves over time and the updating of beliefs is explicitly modeled. In a formal manner, for simplicity, the model is written in terms of ur_t, the deviation from the natural unemployment rate (that is, using the previous notation, $ur_t = u_t - \bar{u}$):

$$ur_t = \sqrt{a}[-(e_t - E_{t-1}e_t) + \eta_t + \delta ur_{t-1}] \tag{9}$$

where e is the log of exchange rate; $E_{t-1}e_t$, the expected exchange rate, and η_t an exogenous shock on unemployment.

It is believed that the government minimizes a loss function of a single period dependent on the quadratic deviations of unemployment from natural rates and on the (squared) change in the exchange rate:[11]

$$L_t = (ur_t)^2 + \chi(\Delta e_t)^2 \tag{10}$$

There are two types of government: a tough government (with weight χ^T), which attributes a higher weight to exchange rate stability than a weak government (weight χ^W), thus $\chi^T > \chi^W$. Private agents know about these values but they do not know which of them is used by the government, and, as a consequence, they create probability assessments of the type of government. They specifically update their assessments of the probability that a government is of a weak type, w_t, based on previously presented behavior.

Again, the government devalues the exchange rate when shock η_t is so strong that the costs of keeping the exchange rate at a fixed level are higher than the costs of an increased inflation. If L^F is the value for the loss function when the exchange rate is kept at a fixed level, and L^D when it is devalued by a given s size, then the government devalues when $L^D < L^F$. This implies that the government will devalue if and only if

$$\eta_t > \frac{(a + \chi)s}{2a} - E_{t-1}e_t + e_{t-1} - \delta ur_{t-1} \tag{11}$$

ρ_t^W is defined as the probability that a weak government will devalue in period t and ρ_t^T as the probability that a tough government will devalue. As w_t is the assessment by the private sector of the probability that a government would be weak, we can write the expected devaluation rate as

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[11]Note that, in this case, there is no devaluation bias, since an expression (the parameter K, in the previous model) that captures distortions in the job market is not inserted into the model.

$$E_{t-1}c_t - c_{t-1} = \rho_t s = [w_t \rho_t^W + (1 - w_t)\rho_t^T]s \qquad (12)$$

where ρ_t is the expected devaluation probability and

$$\rho_t^i = \mathrm{prob}[\eta_t > y_t - w_t \rho_t^W s - (1 - w_t)\rho_t^T s + \frac{\chi^i s}{2a}|i - \text{type government}] \qquad (13)$$

where $y_t \equiv \frac{s}{2} - \delta\ ur_{t-1}$

Assuming that η_t has a uniform distribution within $[-v, v]$ and that there is an interior solution, we have

$$\mathrm{prob}(\eta_t > \eta_t^*) = \frac{v - \eta_t^*}{2v} \qquad (14)$$

We can then solve equation (13) for ρ_t^W and ρ_t^T, and calculate in equation (12):

$$\rho_t \equiv w_t \rho_t^W + (1 - w_t)\rho_t^T = \frac{(v - y_t)}{2v - d} - \frac{\chi^T s/2a}{2v - d} + \frac{w_t(\chi^W - \chi^T)s/2a}{2v - d} \qquad (15)$$

In equation (15), we can separate the time-varying part from the time-independent part, and also decompose the second term into steady-state devaluation probabilities, $\bar{\rho}^W$ and $\bar{\rho}^T$. Assuming that private agents know about the type of government, we can write a realignment probability in period t just as[12]

$$\rho_t = \bar{\rho}^T + w_t(\bar{\rho}^W - \bar{\rho}^T) + \frac{\delta ur_{t-1}}{2v - s} \qquad (16)$$

Note that, for a given assessment of type (weak or tough), higher unemployment rates increase the expected devaluation in the next period, since they enhance the probability that a positive shock on unemployment will push it into the zone where devaluing is more interesting than keeping the exchange rate fixed.

The probability estimates that the government is of type W or T are initially calculated through a prior estimate w_{t-1}, supposing that the government has not devalued in period $t - 1$.

Therefore, Bayesian updating implies that

$$w_t = \frac{1 - \rho_{t-1}^W}{(1 - \rho_{t-1}^W)w_{t-1} + (1 - \rho_{t-1}^T)(1 - w_{t-1})}w_{t-1} \qquad (17)$$

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[12]Calculations can be seen in Masson (1995:575).

Substituting the values in equation (3) into W and T, aligning and adding an error term ξ_t, we obtain:[13]

$$w_t = \alpha w_{t-1} + \beta \ ur_{t-2} + \xi_t \qquad (18)$$

where α and β are parameters to be estimated. It is expected that $\beta \leq 0$, that is, higher unemployment rates will reduce the assessment of the probability that a government is of the weak type. In other words, the disposition to accept increases in unemployment without resorting to devaluation enhances the government's reputation for toughness.

In econometric terms, the model is estimated using the Kalman filter, which consists of a transition equation given by equation (18) and of a measurement equation given by equation (16), which, under some assumptions, is simplified as

$$\rho_t = a_0 + a_1 w_t + \gamma ur_{t-1} + \zeta_t \qquad (19)$$

where a ζ_t error term is added. It is expected that $a_1 > 0$ and $\gamma > 0$. The unobservable and time-varying parameter is the probability that the government is of the weak type, w_t. It is expected that the lower the value for the parameter is, the lower its reputation for weakness will be, and, therefore, the higher the fixed exchange rate policy credibility will be. This way, higher unemployment reduces the probability that the government is of the weak type through the transition equation (signaling effect); thus, a future devaluation probability increases through the measurement equation, in the event of sufficiently strong exogenous shocks (external circumstances effect). Masson (1995) applied this model to analyze the credibility of Great Britain's exchange rate system during the exchange rate mechanism (ERM) period.

In Drazen and Masson (1994) and Masson (1995) unemployment is used to signal the policymaker's toughness or weakness, and the shocks increase the probability that the fixed exchange rate system will be discontinued. Masson and Agénor (1996) present a version that is similar to Masson's (1995) model, with the main difference that in those models there is a tradeoff between inflation control on the one hand, and the maintenance of a reasonable level of competitiveness on the other hand, in order to maintain the economic activity, avoiding the deterioration of foreign accounts.[14] Therefore, the concerns are not related to unemployment,

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[13]See the appendix in Masson (1995)

[14]Bonomo and Terra (1999b,a) present a model in which there is a tradeoff between inflation and the balance of payments. The objective of their article, however, is to investigate the role of political economy factors over the exchange rate policy used in Brazil.

but to the loss of foreign competitiveness and its effect on foreign reserves. Shocks on domestic prices also tend to increase inflation and reduce competitiveness.

Formally, in Masson and Agénor's (1996) model, it is assumed that there is a loss function guiding the policymaker's actions in the face of external or domestic shocks. The policymaker has two choices: no devaluation (or previous announcement of a path for exchange rate devaluation) or devaluation (relatively to the previous announcement of a path for exchange rate devaluation). The policymaker specifically attempts to minimize the following loss function of a single L_t period:

$$L_t = (c_t)^2 + \chi\pi_t \tag{20}$$

where π_t is the inflation rate[15] (in terms of consumer price index, and defined as $\pi_t = p_t - p_{t-1}$, where p_t is the price level log); c_t is the level of competitiveness (defined as $c_t = e_t + p_t^* - p_t^d$,[16] where e_t is the nominal exchange rate, p_t^* is the level of foreign prices, and p_t^d is the domestic product price log), and χ is the weight attributed to inflation by the policymaker. There are two types of policymakers: χ^T, if the policymaker is of the tough type, and χ^W, if the policymaker is of the weak type, therefore $\chi^T > \chi^W$.

Once again devaluation expectations depend on the probabilities that the policymaker will be weak or tough, as well as the *ex ante* probabilities that a type of policymaker will decide to devalue in the event of a shock on domestic inflation. Following a process that is identical to Masson's (1995), Masson & Agénor (1996:8-11) show that the expected devaluation rate can be written as

$$\rho_t = a_0 + a_1 w_t + a_2 \Delta p_t^* + a_3 c_{t-1} + u_t \tag{21}$$

where $a_1 > 0$, $a_2 < 0$, $a_3 < 0$ and u_t is a white noise error term. Therefore, devaluation expectations depend directly on the probability that the policymaker will be weak, (w_t), and, inversely on foreign inflation (Δp_t^*), and also on the level of competitiveness (c_t).

Similarly, Masson & Agénor (1996:11) derive the following updating equation:[17]

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[15]Note that the inflation rate enters the loss function in a linear fashion; therefore, the model assumes there is no deflation, or if there are deflation periods, these reduce the losses. We may argue that deflation also produces losses; however, this matter is not discussed in the model.

[16]The consumer price index, p_t, is defined as the weighted average between foreign prices (converted into domestic currency) and domestic prices.

[17]Masson and Agénor (1996) studied the role of reputation and credibility factors during the exchange rate system used in Mexico before the crisis that began in December 1994, and the abandonment of that exchange rate system.

$$w_t = b_1 w_{t-1} + b_2 \Delta p^*_{t-1} + b_3 c_{t-2} + v_t \tag{22}$$

where $0 < b_1 < 1$, $b_2 > 0$, $b_3 > 0$ and v_t is a process of white noise error. Observe that, although foreign inflation and competitiveness have negative signs in equation (21), the opposite occurs with their lagged values in equation (22). This happens because the disposition to accept a competitiveness loss and lower foreign inflation without devaluation means that policymakers are less likely to be weak; consequently leading to a lower w_t value (via equation (21)), that, in its turn, implies an increase in credibility. However, greater competitiveness losses in the face of external shocks increase the probability of devaluation (via equation (22)). Thus, the signaling and external circumstances effects reappear. The model is estimated by means of a Kalman filter, in which equation (21) represents the measurement equation and equation (22) is the transition equation.

In short, these external circumstances models point out two aspects of credibility: first, the signaling of policymaker's type and, second, the probability for any type (weak or tough) that devaluation will occur if circumstances are sufficiently adverse, since no devaluation would be inconsistent with the government's goals. Thus, high unemployment or competitiveness loss signal a tough government, but also increase the probability that even a tough policymaker will devalue.

3.   Econometric Procedure

The model implies that the correlation between the changes in unemployment rates and the devaluation expectation will be very different, depending on the dominant factor: the signaling factor or the "external circumstances" factor. If, initially, there is much uncertainty about the type of government, then, high unemployment rates may convincingly signal that the government is tough and determined to carry out its announced policy; consequently, policy credibility would be improved. On the other hand, if the type of government is known (due to its historical record or because it has convincingly signaled its type) or if the types are very much alike, and there are negative external shocks, high unemployment rates reduce credibility, since one or other type is more likely to relinquish the policy commitment. The situation of competitiveness loss is quite similar.

Although Masson's (1995) and Masson and Agénor's (1996) models are theoretically more appropriate once the evolution of credibility is explicitly modeled and estimated through the Kalman filter, they are not directly used on account of their econometric limitations. The authors themselves admit there are two major limitations: firstly, for estimating the models, a linear approximation is used for

the updating equation (which, indeed, is highly nonlinear); secondly, the measurement equation may produce w_t values for the estimation that are not found within the [0, 1] interval, or the equation's right-hand-side variables take extreme values or the realizations of ξ_t (which are assumed to have a Gaussian distribution) are extremely large.[18] In addition, it is necessary that excessive restrictions be imposed on the model so that consistent estimates can be obtained. Even so, it is hard to obtain significant parameters with the estimations.

This way, the procedure used is more similar to that of Drazen and Masson's (1994), who adopted two procedures to analyze the changes in the relationship between unemployment and devaluation expectations: first, they used dummy variables that correspond to the historical periods in which the change supposedly occurred, and then they tested its significance;[19] second, and more econometrically appropriate, they did not take the breakpoints in the relationship for granted and performed tests of structural stability, splitting the whole sample into two subperiods, by successively trying different breakpoints. If breaks are significant at several dates, the one that gives the maximum likelihood ratio value is chosen; after that, each of the subsamples is further tested for breakpoints in a similar way. In both cases, the coefficients of the unemployment rate and the constant term are expected to vary between the subsamples.

Although dummy variables or tests of structural stability may be used to analyze the changes in a relationship, this is not the best alternative. As we expect the parameter that measures the relationship to vary over time, the adequate strategy is to use techniques with time-varying parameters. Thus, we will use the Kalman filter for the estimation.[20]

Differently from Drazen and Masson (1994), the competitiveness variable is explicitly included in the model's estimation. An interest matter here is to check whether competitiveness, measured through the real exchange rate, has effects on the trade balance. Pastore et al. (1998) showed the sensitivity of the trade balance to real exchange rate by using equations that explain the behavior of imports and exports. Consequently, the model to be estimated is

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[18]The same would happen if the general Kalman filter were used to estimate the nonlinear form (Masson, 1995:577).

[19]This was the method used by Arbex and Fontes (1999) in their application of Drazen e Masson's (1994) model to analyze the monetary policy credibility between 1991 and 1998. They concluded that Brazilian monetary policy was not credible from January 1991 to December 1992 and from July 1996 to July 1998 and was credible for the period June 1994 to June 1996. The rest of the sample period it was not possible to get a clear cut answer.

[20]See Portugal (1993) for the analysis of Kalman filter superiority. See Harvey (1989), Cuthberson et al. (1992) and Hamilton (1994) for the presentation of Kalman filter.

$$dif_t = \alpha_0 + \alpha_1 dif_{t-1} + \beta_t u_t + \lambda_t c_t + \xi_t \tag{23}$$

$$\beta_t = \beta_{t-1} + \mu_t \text{ and } \lambda_t = \lambda_{t-1} + \upsilon_t \tag{23'}$$

where dif_t is the expectation of exchange rate devaluation for the period; u_t, is the current unemployment rate in terms of natural unemployment rate deviation; c_t, is the measurement of economic competitiveness in terms of deviations from a competitiveness target level, and ξ_t is a white noise error term. Equation (23) is the measurement equation and equations in (23') are the transition equations, which show that parameters β_t and λ_t are time-varying.

Considering a situation in which there is uncertainty about the actual type of government, if the government wants to show it is tough, thus increasing its credibility, we expect the coefficient on unemployment to be negative, as the government will be signaling its commitment to a fixed exchange rate (and, consequently, to low inflation). Therefore, the expectation of exchange rate devaluation should decrease, disregarding any shocks, and, as a result, policy credibility should increase. If the government possesses or has built a reputation for toughness and, therefore, has created relatively firm credibility for its policy, in a context in which strong exogenous shocks take place, higher unemployment rates may increase devaluation expectations. This way, a positive relationship is expected, indicating reduced credibility to exchange rate commitment.

A similar relationship is expected in the case of competitiveness. At the beginning, the policymaker tries to signal his commitment to inflation control by maintaining the exchange rate at a fixed level, accepting competitiveness loss, and thus showing how tough he is. However, after some time, and in the event of external shocks, greater competitiveness losses lead to reduced credibility to fixed exchange rate commitment. Although competitiveness losses may be associated with an increase in unemployment, the major concern is the deficit infringed upon the trade balance and the reduction of foreign reserves.

Note that this separation is important due to the fact that the government may continue to signal its anti-inflation commitment in the face of external shocks, disregarding unemployment but showing concern with competitiveness, for instance, slowly devaluing the real exchange rate. The next step is to estimate the variables that will be inserted into the model. Interest variables are devaluation expectations, deviation of unemployment rate from the natural rate, and deviation of competitiveness from a competitiveness target level. These estimations are shown next.

3.1   Estimation of devaluation expectations

Devaluation expectations are measured through the difference between the overnight Selic interest rates applied by the Brazilian Central Bank and the prime interest rates, even though this is a flawed measurement of exchange rate expectations since it does not take into account the risk premium and other factors that may influence exchange rate expectations.[21]

The time path for the interest rate differential is shown in figure 1. We can see there is a tendency towards a reduction of such differential over time, interrupted by the Mexican crisis (December 1994), the Asian crisis (October 1997), and the Russian moratorium (August 1998). In other words, external shocks that reversed the capital flow and forced economic authorities to increase the internal interest rate. After a high increase following the crises, there was again a gradual reduction in the interest rate differential.

Figure 1
Interest rate differential (1994-98)
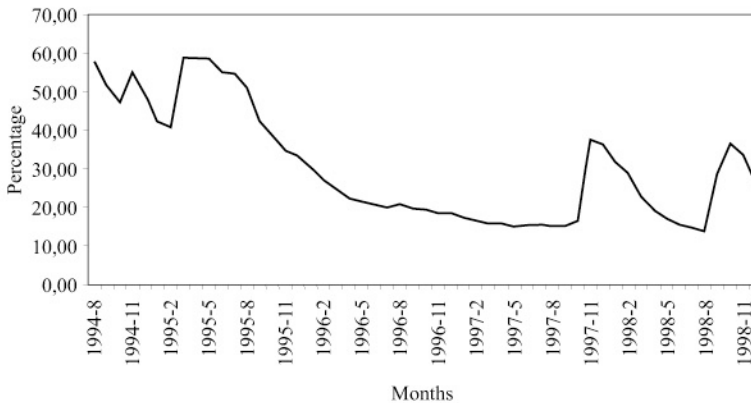
Source: Central Bank of Brazil.

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[21]This method for measuring exchange rate expectations is criticized as it calls for the application of uncovered interest rate parity. One of the criticisms is that there is a *peso problem* when testing the hypothesis (for example, Sachsida et al. (1999)). However, this problem does not imply the rejection of the hypothesis (see a discussion on this topic in Agénor and Masson (1999), chapter 6; in addition, there is no general agreement on the proposed alternatives, which have their own limitations. Another way of measuring exchange rate expectations may be seen, for instance, in Münch (1998).

3.2 Estimation of the deviation of unemployment rate from the natural rate or NAIRU

The concept of natural rate of unemployment or the Non-Accelerating Inflation Rate of Unemployment (NAIRU) is part of the monetary policy structure in theory and in practice as well. It is essential that we know whether the current unemployment rate is below or above the natural rate or NAIRU to conduct monetary policy. The problem is that they are not directly observable, and thus need to be estimated. Frequently, the natural rate of unemployment is simply approximated through the unemployment series mean during the study period, or by calculating its tendency without considering its relationship with inflation. The NAIRU is an interesting concept due to the fact that its estimation explicitly takes into account its relationship with inflation. In this case, a Phillips curve or some of its versions is estimated.

Although Phillips' original article suggested that the Phillips curve was actually a curve, it has been usually estimated as if it were linear (or only presenting little discreet changes). Even though some other studies regard the Phillips curve as linear, they have allowed the NAIRU to vary over time.[22]

However, some authors have confronted this viewpoint. For example, Clark and Laxton (1997), Debelle and Laxton (1997) and Debelle and Laxton (1997) have estimated nonlinear and convex Phillips curves in which the NAIRUs vary over time.[23] Clark and Laxton (1997) derive an equation for the nonlinear and convex Phillips curve using a price and wage determination model.

Usually, in the case of a linear Phillips curve, the estimated models are presented as follows:

$$\pi_t = \pi_t^e + \gamma(NAIRU_t - u_t) + \epsilon_t \qquad (24)$$

where π_t is the inflation rate; π_t^e is the expected inflation rate; u_t is the current unemployment rate; $NAIRU_t$, in this case, the time-varying non-accelerating inflation rate of unemployment, and ϵ_t, a white noise disturbance term. In the linear case, although the NAIRU varies over time, there is no difference between the NAIRU and the natural rate of unemployment, therefore, if u_t^* is the natural rate of unemployment, then $u_t^* = NAIRU_t$.

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[22]For instance, Gordon (1997) estimated a time-varying NAIRU for the US. In the case of Brazil, see Portugal and Madalozzo (2000) and Portugal et al. (1999).

[23]The emphasis on convexity is due to the postulation of a nonlinear, concave Phillips curve by authors such as Stiglitz (1997). This curve type has very different implications.

In the case of the nonlinear and convex Phillips curve, the model to be estimated is presented as follows:

$$\pi_t = \pi_t^e + \gamma \frac{NAIRU_t - u_t}{u_t} + \epsilon_t \tag{25}$$

This functional form does not impose a very steep convexity since we assume the lower unemployment limit to be zero. This formulation, however, allows us to perceive the differences between the linear and nonlinear forms. A convex Philips curve implies that a certain reduction in current unemployment below the natural rate triggers a bigger increase in inflation than the reduction of inflation that would be caused by an increase in unemployment above the natural rate. In other words, as excess demands are more inflationary than excess supply are deflationary, allowing the economy to enter an excess demand zone implies that the economy will have to operate for a longer time period in the excess supply and high unemployment zone in order to prevent inflation from accelerating.[24]

Another implication of this specification is the difference between the natural rate of unemployment and the NAIRU. As previously shown, when the model is linear, the natural rate of unemployment equals the NAIRU, but when the model is nonlinear, the rates are different. Debelle and Laxton (1997) have shown that, in the nonlinear and convex model,[25] the natural rate of unemployment (u_t^*) equals the $NAIRU_t + \lambda var(u_t)/2$. Consequently, aggregate demand or labor policies that reduce (increase) unemployment variance, reduce (increase) the natural rate of unemployment.

In terms of economic policy, nonlinearity has several implications:

- stabilization policies that do not succeed in reducing the variability of the business cycle may have undesirable effects not only on unemployment variance but also on the natural rate of unemployment;

- it highlights the necessity for forward-looking policies that act preventively towards offsetting inflationary pressures;

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[24] For a numeric example, take two periods, and suppose the inflation rate intended by economic authorities is 3% and that, at this rate of inflation, unemployment is within the NAIRU. Therefore, for instance, in period 1, a given reduction in unemployment may increase the inflation rate by 4%; if economic authorities intend the average inflation to be equal to 3%, inflation in period should be reduced to 2%; however, to obtain such a reduction in inflation, the increase in unemployment must be higher (in terms of absolute value) than the reduction obtained in period 1. The graphic examples can be seen in Debelle and Laxton (1997:254-6) and Clark and Laxton (1997:17).

[25] Assuming that, for simplicity, the nonlinear, convex Phillips curve is $\pi_t = \pi_t^e + \exp[\gamma NAIRU_t - u_t)] - 1 + \epsilon_t$.

- it suggests that strong recessions may only have an anti-inflation impact that is narrowly higher than weaker recessions;

- it emphasizes that policymakers need to act cautiously, especially if the economy is close to its potential (Debelle and Laxton, 1997:256), and (Debelle and Vickrey, 1997:24-6).

In the case of Brazil, recent estimates of the linear, time-varying NAIRU based upon the estimation of a Phillips curve have been carried out by Portugal et al. (1999) and Portugal and Madalozzo (2000), having produced consistent results. However, their estimates of the NAIRU using only the unemployment rate and estimating its structural component (which is identified as the NAIRU) have not shown good results. This shows the need to estimate a NAIRU in relation to the inflation rate.

Following Clark and Laxton (1997), Debelle and Laxton (1997), and Debelle and Vickery (1997), we estimate equation (25), allowing the NAIRU to vary over time. To estimate this equation, it is necessary to estimate the $NAIRU_t$ that is not directly observable. With this objective, we use the Kalman filter, which estimates the models as presented next:

$$y_t = X_t^{'}\beta_t + \epsilon_t \qquad \qquad \epsilon_t \sim N(0, \sigma 2H) \qquad \qquad (26)$$

$$\beta_t = T\beta_{t-1} + \eta_t \qquad \qquad \eta_t \sim N(0, \sigma^2 Q) \qquad \qquad (26')$$

where vector β_t is variable over time and determined by the transition equation (26'). To estimate equation (25), we define $y_t = \pi_t$, $X_t = (\pi_{t-1}, 1/u_t, 1)$ and $\beta_t = (\delta, \gamma NAIRU_t, -\gamma)$. We assume that δ and γ are constant and that only the $\gamma NAIRU_t$ varies over time. The NAIRU estimates at each time period are calculated through the negative value of the ratio between the second and third element of β_t.

The model was estimated by means of monthly seasonally adjusted data on the current unemployment rate obtained from Ipeadata and the inflation rate measured by IGP-DI (general price index), obtained from FGVDados. As the NAIRU is expected to vary in the long run, estimation encompassed the period between January 1982 and December 1998. To estimate the model, the seasonally adjusted inflation rate was used, with the same filter applied to the unemployment series.[26]

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[26]Equation (24) was also estimated by means of the Kalman filter, in order to calculate a linear time-varying NAIRU. However, the nonlinear model expectedly showed better results.

The use of the Kalman filter produces two NAIRU time series. The first, called filtered time series, originates from the model's recursive estimation, which uses data that are only available until the current period. At each time period, the filter uses the new information to review its estimates of the model's parameters and of the NAIRU. This exercise mimics, to some extent, the process that a policymaker would carry out when using this approach to determine inflationary pressures. The second time series, called smoothed, uses the data from the whole (full) sample to estimate the NAIRU time series. This way, we are able to assess, in a retrospective manner, whether recursive estimates produce a different path for inflationary pressure level when full-sample estimates, which incorporate more information, are used (Debelle and Laxton, 1997:268-9).

Figure 2
Unemployment rates (1982-98)
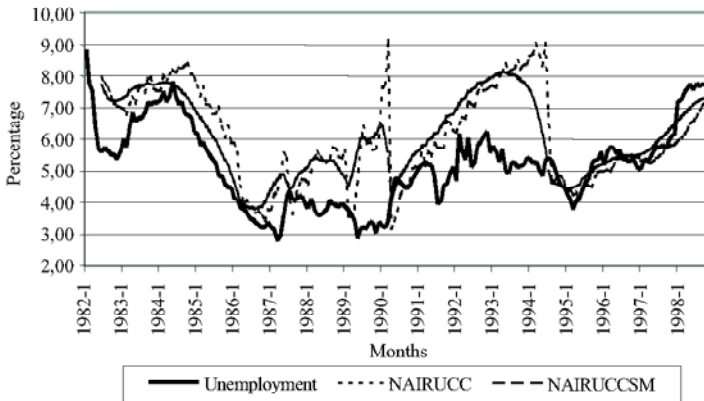
Source: Ipeadata (non-weighted unemployment rate).

The time paths for the unemployment rate and filtered NAIRU estimated time series (denoted NAIRUCC) and smoothed NAIRU (denoted NAIRUCCSM) are shown in figure 2. The results are consistent with historical evidence. In the 1980s and mid-1990s, a period with high and growing inflation, the unemployment rate was almost always below filtered and smoothed NAIRU. After the Real Plan, in comparison with the filtered NAIRU, the unemployment rate was almost always below it. Using the smoothed estimation, the unemployment rate was initially above the NAIRU and below it in part of 1995 and early 1996. Later, the unemployment rate was always above the NAIRU. This is consistent with the price

stabilization occurring at that period. We can also observe that, after the opening of the economy in 1990, the unemployment and NAIRU rates increased at first and then declined. After the Real Plan, there was a reduction in the unemployment rate; however, some time after that, this rate, as well as the NAIRU, climbed remarkably.

Even though it is not possible to directly compare the NAIRU estimated in this section with the linear time-varying NAIRU estimated by Portugal and Madalozzo (2000), because these authors used quarterly and seasonally unadjusted data, both estimations are consistent with historical experience, and estimated paths usually followed a similar pattern. However, an interesting difference is that the NAIRU estimated by these authors was overly variable, which is not very consistent with the concept of NAIRU as a long-run variable, expected to vary, but not so fast. The smoothed NAIRU estimated in this section had a very smooth behavior, as the name itself suggests.

As the estimation period of the external circumstances model goes from August 1994 to December 1998, only the data that correspond to this period are used for later analysis. The deviations of the current seasonally adjusted unemployment rate are used in relation to the filtered NAIRU, which mimics the behavior of a policymaker whose aim is to reduce inflation.

3.3 Estimation of the deviation of competitiveness from a target level

There has been a lot of debate on the best way to measure competitiveness. Even if we decide that we should use a real exchange rate, there will be discussion on which the best rate should be.[27] Since the model assumes that the policymaker is concerned with the external sector, we opted for a general indicator, which includes not only the US but also the most important partners. Therefore, in this article, the competitiveness level is measured by the real effective exchange rate of exports calculated by Ipeadata. Again, what matters is the behavior related to a path for or a target level of competitiveness, which may be identified with a real equilibrium exchange rate (calculated by several methods).

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[27]See a discussion about this topic in Turner and Golub (1997).

In this subsection, two methods were initially used. The first method was developed by Goldfajn and Valdés (1999), who calculate a series of overestimation or underestimation as deviations of the exchange rate from a filtered series using a Hodrick and Prescott filter (Hodrick and Prescott, 1997), where the filtered series captures the series' stochastic tendency, which is identified as the predicted real equilibrium exchange rate. Nonalignments are identified as the series' cyclic component, since they are expected to occasionally correct themselves. The second and simplest method supposes that the real equilibrium exchange rate is given by the base-year or by the index mean of the real exchange rate during the study period.[28]Since the estimates made with the Hodrick-Prescott filter[29] produced less consistent results, the results are presented through the deviations of the log real exchange rate in relation to the series mean during that time period.

The inspection of figure 3, which presents the time path for the real exchange rate, shows that it is hard to define a single level for the real equilibrium exchange rate. We can observe that there is a strong appreciation of the real exchange rate, which is in accordance with the economic openness that occurred in the 1990s and, also, a strong appreciation after the implementation of the Real Plan, especially in the period of free floating exchange rate, in which the real exchange rate achieved a remarkable appreciation between July and November 1994, remaining constant nearly up to February 1995. After the Mexican crisis and the implementation of the exchange rate band regime in March 1995, there was a tendency towards the recovery of the real exchange rate, which accumulated a depreciation of nearly 10% until June 1996, although reversed to some extent during 1997. After January 1998, there was again a gradual recovery of the real exchange rate.

Considering that the estimation period in this article started in August 1994, we can observe that the real exchange rate was much appreciated at that moment. Most analysts agree with that, despite using several methods to measure the real exchange rate.[30] Depending on the method used, after this strong, initial appreciation, there was a depreciation of the real exchange rate or the level of appreciation was maintained. The discussion at the time dwelt upon whether and how much the appreciation implied a overvaluation in relation to a certain equilibrium value. Nevertheless, we can affirm that most economic agents expected no additional appreciation, but in fact a recovery of competitiveness. This fact, which will be discussed later on, is important for analyzing the results of the model's estimation.

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[28]This second alternative was originally used in Masson and Agénor's working paper (1996).

[29]Different smoothing coefficients were used for the estimation of the real exchange rate.

[30]For example, Portugal and Galvão (1996), Dornbusch (1997), Bonomo and Terra (1999b,a), and Pastore and Pinotti (1999).

Figure 3
Real exchange rate(1982-98)

3.4   The model's estimation

As previously observed, these models were developed to analyze fixed or pegged exchange rate regimes. Although the exchange rate regime band formally began in March 1995, the model was estimated through monthly data on the variables estimated in the previous subsection for the period between August 1994 and December 1998 (exactly one month before the exchange rate regime was abolished). The inclusion of information about the previous months aims at determining the type of government before the implementation of the new regime. The estimation results of model (23), by means of the Kalman filter, were the following (t-statistics is found within parentheses):

$$\hat{\sigma}_{\mu}^2 = 74.46857; \qquad \hat{\sigma}_{v}^2 = 3.86E - 66$$

$$(3.5938) \qquad\qquad (2.32E - 127)$$

$$R^2 = 0.94; \qquad \bar{R}^2 = 0.94; \qquad \sigma = 3.26; \qquad DW = 2.29$$

As we can observe in the t-statistics, the coefficient on the unemployment variable is time-varying, while the coefficient on the competitiveness variable is almost constant. Figure 4 shows the time paths for the estimated filtered coefficient ($Beta$) and the smoothed coefficient ($BetaSM$) on the unemployment rate, observing that this is a time-varying coefficient, almost always negative throughout the period. There is sign reversion in part of 1997, period that coincides with the

reduction in the unemployment rate, signaling, according to the model, a weaker exchange rate commitment. In addition, in this period, unemployment was below the filtered NAIRU, indicating inflationary pressure and reduced credibility.[31] Later, the unemployment rate became negative again, a tendency only reversed during the external shock periods, Asian and Russian crises. In these two cases, sign reversion was due to the increase in interest rate differential, which originated from the increase in the internal interest rate as a response to reversed capital inflows, and not because of unemployment rate negative deviations, as they had always been positive from early 1997 onwards.

Figure 4
Unemployment variable coefficient(1994-98)
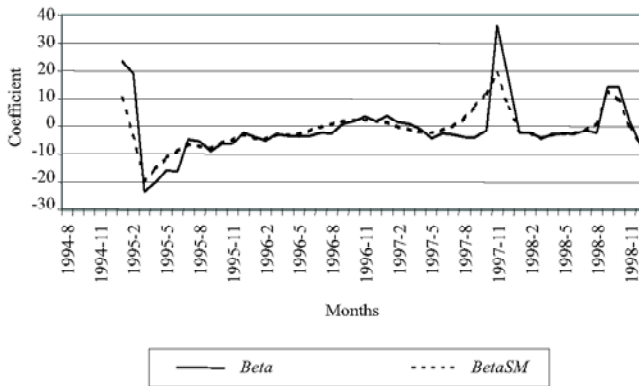
The time paths for the estimated filtered ($Lambda$) and smoothed ($Lambda$ SM) coefficient on competitiveness are shown in figure 5, which is practically constant (it has a final estimated value of -4.34). The filtered estimates are consistently negative throughout the estimation period. In addition, the smoothed parameter estimates are practically constant. This indicates that the slow recovery of competitiveness reduced the interest rate differential, conferring higher credibility to the government. As mentioned, in August 1994 there was a common agreement that the real exchange rate was overvalued and that such overvaluation

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[31]Note that if the smoothed NAIRU, which considers all the information about the period, were used, unemployment would actually be below the NAIRU for a longer time period. This fact is important because it shows that, *a posteriori*, the policymaker would have underestimated the NAIRU. As mentioned in the part concerned with the implications of nonlinear, convex NAIRU economic policy, this reinforces the idea that the policymaker should act cautiously not to lead the economy into a situation of inflationary pressure.

should be reversed. Therefore, the agents did not expect higher competitiveness losses to get to know the government level of commitment, as these losses would reduce the government's reputation and its policy credibility. Consequently, the gradual recovery of competitiveness would reduce the interest rate differential and was consistent with the economic policy adopted.

Figure 5
Competitiveness variable coefficient (1994-98)
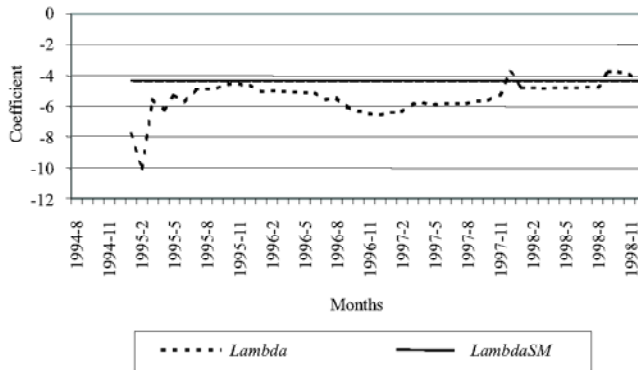
4.   Credibility and reputation during the exchange rate regime

The objective of this section is to analyze whether the abandonment of the exchange rate regime can be explained by economic fundamentals, or, more specifically, to analyze whether the government has lost its reputation and whether the policy lost its credibility before the exchange rate regime was lifted. It is important to stress that the interest is not on the timing of speculative attacks or on the exchange rate crisis. Therefore, the literature on speculative attacks and exchange rate crises is not the main topic here.[32]

The external circumstances model presented in the theoretical section aims at explaining the reputation and credibility of a fixed or pegged exchange rate regime. The basic idea is that by allowing for an increase in unemployment and competitiveness losses, the government's reputation and its policy credibility are enhanced. However, after external shocks, further increases in unemployment and

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[32]This literature is reviewed by Garber and Svensson (1995), and Agénor and Masson (1999), chapter 16.

greater competitiveness losses reduce the government's reputation and its policy credibility.

After several unsuccessful attempts to stabilize the economy during the 1980s and early 1990s, the Real Plan has finally managed to reduce inflation systematically and consistently. At the beginning, a monetary anchor was announced, but the idea was soon cast aside, and an exchange rate anchor was then adopted.

Initially, economic authorities allowed the real to be considerably overvalued, as reducing inflation was a priority. Hence, between July 1994 and February 1995, there was a floating exchange rate policy that allowed for such appreciation. After the Mexican crisis, from March 1995 onwards, an exchange rate band regime was implemented, which, as previously mentioned, resembled a crawling peg regime. After the Asian crisis in October 1997, there was a reduction in foreign reserves, which was reversed after some months, causing reserves to accumulate again. After the Russian crisis in August 1998, extensive foreign reserve losses, and the speculation against the real, the government decided to abolish the exchange rate band regime at the beginning of January 1999.

As previously mentioned, in the second half of 1994, there was a general agreement that the real exchange rate was very much appreciated. Economic authorities had already shown their commitment to price reduction by accepting the strong exchange rate appreciation in the period between July and November 1994, when the Central Bank decided to intervene in the exchange market in order to prevent an increased appreciation, although there was no fixed exchange rate regime yet. After the Mexican crisis, in March 1995, an exchange rate band regime was implemented, and the exchange rate began to recover, especially through gradual increases in the nominal exchange rate. Therefore, it is hard to believe that economic agents were waiting for greater competitiveness losses to show the government's commitment to inflation control. It would be more coherent with the model to await a gradual recovery of the real exchange rate, thus allowing economic competitiveness to be restored and, consequently, not jeopardizing the reduction in the inflation rate. As expected, the results show that such situation was really taking place. The recovery of competitiveness, or at least the unchanging level of competitiveness, was followed by the reduction in the interest rate differential, conferring higher policy credibility and increased reputation to the government.

In the case of unemployment, there was initially a strong economic expansion and a reduction in the unemployment rate, which may be explained by consumption boom models in stabilization plans with an exchange rate anchor.[33] This is consistent with the positive value found at the beginning for the model's coeffi-

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[33]See, for example, Agénor and Masson (1999), chapter 12.

cient on unemployment. Thus, we cannot affirm that the positive sign indicates lack of policy credibility. Later on, the unemployment rate, however, began to gradually increase, rising above the filtered NAIRU from April 1995 to mid-1996, thus signaling a commitment to the exchange rate regime and better reputation to the government. After that, unemployment declined and, in the period between September 1996 and April 1997, a positive value was obtained again. This was caused by the reduction in unemployment itself and also by the unemployment rate below the NAIRU in mid-1996 and early 1997. We have, therefore, a period in which the reputation and credibility of the exchange rate regime were reduced. After mid-1997, the unemployment rate increased continually, rising above the filtered NAIRU from the beginning of 1997, and growing even more at the end of 1997, signaling, again, the commitment to the exchange rate regime, and thus enhancing the government's reputation and its policy credibility. This was precisely the period in which monthly inflation rates fell below 1%. However, after the Russian crisis, the strong speculation against the real and the quick reduction in foreign reserves caused the exchange rate regime to collapse at the beginning of 1999, making the exchange rate oscillate, and forcing the government to implement inflation rate targets.

How can we therefore explain the abandonment of the exchange rate policy at the beginning of 1999? As previously observed, the interest rate differential, despite the reversions on its reduction path due to external shocks, continued to slowly decrease until some time before the exchange regime was discontinued. Apparently, the adopted policy was consistent with the prescriptions for the model, with the goal of gaining or maintaining credibility. Based on the estimated model, we cannot affirm that fundamental factors (unemployment and competitiveness) signaled the onset of an unbearable situation. Unemployment was consistently above the NAIRU and competitiveness was gradually recovering, conferring credibility to the adopted policy. On top of the fundaments analyzed by the model, there were some other worrying factors, especially fiscal vulnerability and the consequent increase in the internal public debt/GDP ratio, whose major part consisted of short-term financing. However, these factors are not fully blamable for the exchange rate collapse. At least, there is no econometric evidence showing that.

Therefore, it is believed that, in great part, the abandonment of the Brazilian exchange rate regime was neither explained by flawed economic fundaments[34] nor

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[34] A similar conclusion was obtained by Masson and Agénor (1996) and Agénor and Masson (1999) for the Mexican crisis in December 1994.

predicted by economic agents.[35]   It might be better explained through second-generation speculation models, which have nothing to do with fundaments.[36] For example, Baig and Goldfajn (2000) have shown that speculative attacks were triggered by a contagious effect from the Russian crisis. However, this kind of explanation is beyond the scope of this article.

Also, we can always affirm that, *a posteriori*, the initially strong appreciation of the real was an error or that the recovery of competitiveness was too slow and should have been accelerated. Based on the results obtained, it seems that the government acted correctly. Although it is possible to affirm that the economy found itself in a stable situation, a strong devaluation or a faster devaluation would not bring inflation back to an explosive behavior.[37] In that moment, it was risky to make a decision in that direction due to Brazil's inflationary history.[38] We should also bear in mind that, due to the uncertainty over the NAIRU value, slackening the monetary policy and expecting not to have heavily inflationary effects was too risky. Maybe these facts help to explain why economic authorities preferred to be cautious and delay as much as possible the devaluation of the exchange rate or the regime malleability.

5.   Conclusion

In this article, some basic credibility and reputation models were analyzed so as to understand the behavior of exchange rate expectations during the exchange rate band regime implemented in Brazil. For that reason, an "external circumstances" model was presented. This model assumes that, in general, no government should worry only about inflation control, totally ignoring the path for growth and job market. Therefore, in the presence of external circumstances, even an anti-inflationary government can be forced to devalue the exchange rate. Hence, a government can signal its commitment to a fixed exchange rate regime, by causing increases in unemployment and competitiveness losses, enhancing its reputation as well as the credibility of the exchange rate regime. Thus, in the event of external shocks, further increases in unemployment or greater competitiveness

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[35] For example, Goldfajn and Valdés (1998) and Berg and Pattillo (1999) have shown that exchange crises are not predictable.

[36] See some references in footnote 31 of this article.

[37] See, for example, Fiorencio and Moreira (1999a,b).

[38] The fear of an inflation backlash was so strong that, even after the exchange rate was lifted, the possibility for fixing the exchange rate was cogitated, considering that many observers forecasted very high inflation rates. See Fraga (2000) for the opinion of an economic authority.

losses reduce the government's reputation and the credibility of the regime, possibly resulting in the abandonment of the exchange rate regime.

We observed that the government built up reputation and credibility for its policy during the exchange rate regime implementation. Based on this theory, the government signaled its exchange rate commitment, causing unemployment to increase and competitiveness to recover gradually. A general conclusion is that there is no evidence based on this model to affirm that flawed economic fundaments led to the exchange rate regime collapse.

This way, the first contribution of this article was analyzing the credibility and reputation factors throughout the implementation of the exchange rate band regime. As previously shown, the economic policy was being conducted in a way that was consistent with the model. The government took on the risk of gradually recovering competitiveness, especially after the Mexican and Asian crises. However, after the Russian crisis, which caused a strong and fast capital outflow and successive attacks against the real, the government had to discontinue the exchange rate regime and adopt a free floating rate of exchange.

A second contribution, yet only a by-product, was estimating a nonlinear, convex Phillips curve. An additional line of research may intensify the discussion about this Phillips curve type and, especially, insert credibility into a nonlinear, convex Phillips curve model, and finally allow the model to be estimated.[39] However, this is still an area open for theoretical and empirical studies.

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[39]An attempt to insert a convex Phillips curve into the credibility models can be seen in Tambakis (1998) and in a discussion by Clark and Laxton (1997).

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