Canaries and Vultures: A Quantitative History of Monetary Mismanagement in Brazil

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JEL Classification: O23, O54, N16
Keywords: Money Demand, Money Supply, Monetary Policy, Inflation, Stabilization, Brazil

Abstract

During the last two decades of the twentieth century, Brazil went through a sequence of failed stabilization plans that tried to cope with an enduring hyperinflation. This paper uses a money demand model to evaluate monetary policies during those episodes. The consistency between the money supply and the expected conditional money demand growth rates is considered for each plan. It is shown that the unsuccessful programs were marked by excessive liquidity. The results not only suggest that the mismanagement of the monetary aggregates led to the failure of the plans, but also that the excessive liquidity could have been predicted.

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> "A politician meets ten economists. Nine of them paint a dark scenario that implies painful adjustments. Those are the vultures. The tenth economist is sure, however, that everything is fine, that no adjustment is necessary. This is the canary. The politician always follows the canary."
> – L. P. Rosenberg in *Os Pais do Cruzado Contam por Que Não Deu Certo* (1987).

1 Introduction

Part of the recent monetary history of Brazil was marked by hyperinflation and a sequence of unsuccessful macroeconomic stabilization plans based on the so-called "economic heterodoxy." The plans were devised mostly by structuralist, Keynesian, Post-Keynesian, and Marxist economists, who dominated the academic discussion in Brazil and occupied the most important government positions during that period.

The basic tenets of economic heterodoxy were that inflation in Brazil was an inertial phenomenon, microeconomically justified by distributive conflicts, and that the fiscal problem was not the cause but the result of inflation, following the argument developed by Tanzi (1977). The government deficit was supposedly aggravated by "excessive" public debt interest payments, which were rejected by some even on moral grounds. Money supply growth rates played no role in their analysis, since money was considered passive – a purely endogenous variable, determined by the needs of the economic agents and not by Central Bank policies.[1]

According to those economists – the *canaries*, the sudden reduction of the inflation rate and the elimination of the inertial factors (generalized indexation, for example) would lead to a nearly self-fulfilling low-inflation equilibrium. The automatic reduction of the budget deficit and of the distributive conflict that would follow an intervention would lead to additional inflation reduction, creating a virtuous circle. After remonetization, money growth rates would passively decrease at par with inflation, such that there would be no need to restrict monetary growth. Unrestricted remonetization was welcome, since it would contribute to the reduction of the outstanding public debt, and consequently to the reduction of the budget deficit.

On the other hand, "economic orthodoxy," which represented the view that hyperinflation in Brazil was a monetary phenomenon, driven mainly by the government dependency on inflationary revenue sources, was defended by a smaller group of economists – the *vultures*. The orthodox view was largely rejected at the political level given its proposal that a stabilization program would only succeed if preceded by unpopular fiscal and monetary adjustments.[2]

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[1] See for example Pereira (1987) and Baer (1987).
[2] See for example Simonsen (1989) and Barbosa et al. (1989).

These economists were also associated, correctly or not, with previous military governments, and with the painful macroeconomic adjustment policies that took place after the oil shocks in the seventies and the debt crisis in the eighties. This reputation transformed their proposals into an even harder sell.

From 1986 to 1991 Brazil went through five heterodox stabilization programs: Cruzado (1986), Bresser (1987), Verão (1989), Collor (1990) and Collor II (1991). These five plans proved to be flagrant failures. The sixth stabilization program, the Real plan (1994), was the only to succeed at containing hyperinflation. This paper will show that, despite using a concept borrowed from the heterodox agenda – the "indexed currency," the Real plan succeeded, among other reasons, because it was the sole stabilization plan that presented a post stabilization monetary growth rate expansion consistent with the expected nominal money demand growth rate under a feasible low-inflation trajectory.

To achieve this result, the paper will employ a money demand growth rate model to check the consistency of monetary policies during each stabilization episode. Actual $M1$ supply growth rates will be compared with money demand growth rate forecasts based on scenarios representing different policymaker choices and expectations. The money demand growth rate model will be shown to be sufficiently stable in order to generate forecast confidence intervals.

Notice that an adequate money supply growth during stabilization is *a necessary but not a sufficient condition for the success of a plan.* Other macroeconomic conditions have to be met – for example, aggregate demand needs to be compatible with aggregate supply during stabilization, and, for that, the real interest rate may play an essential role, which will not be considered here. Yet, an adequate remonetization of the economy after stabilization is one of the trickiest tasks to be performed by a central bank, and therefore the importance of evaluating the level of monetary growth during transition with the best forecasting tools available to the policymaker.

The Brazilian recent history of monetary policy mismanagement will be studied therefore with the help of a capable money demand growth rate forecast model. To construct such a model for the Brazilian economy, tests for the presence of unit roots will be performed. Johansen's cointegration tests will lead to the nonrejection of the null of noncointegration. A growth rate model for $M1$ will be chosen, considering the interventions that happened during the sample period of choice (1983-1999). A variable seasonal pattern, defined as a function of the nominal interest rate, an original contribution of this paper, will substantially improve its predictive power.

Note that aggregates broader than $M1$ cannot be used to evaluate monetary policies in Brazil, since those aggregates, due to hyperinflation, carry a very large share of floating rate assets, presenting therefore a strong positive correlation with the abnormally high nominal interest rates.

Consequently, $M1$, which in Brazil does not include interest-earning accounts, is the only monetary aggregate that clearly reflects systematic monetary expansions and contractions due to nominal interest rate changes, and as such will be the only aggregate considered.

Finally, it will be shown that unsuccessful macroeconomic stabilization programs were marked by excessive liquidity, with money supply exceeding expected conditional money demand during intervention periods.

2 The Conditional Demand for Money

Consider as a benchmark the baseline inflation-targeting model presented in Clarida, Galí and Gertler (1999). It has two equations, an IS curve and a Phillips curve:

$$x_t = -\phi\left[i_t - E_t\pi_{t+1}\right] + E_t x_{t+1} + g_t \qquad \text{(IS)}$$

$$\pi_t = \lambda\, x_t + \beta\, E_t\pi_{t+1} + u_t\,, \qquad \text{(Phillips)}$$

where x_t is the output gap, i_t is the nominal interest rate, π_t is the inflation rate, g_t is the possibly autocorrelated demand innovation and u_t is the possibly autocorrelated supply innovation. Note that no concept of money enters this system: the monetary side of the economy is entirely represented by the nominal interest rate – the policy instrument.

In the same paper, Clarida, Galí and Gertler justify the choice of the interest rate as the policy instrument, in place of a monetary aggregate: "Large unobservable shocks to money demand produce high volatility of interest rates when a monetary aggregate is used as the policy instrument. It is largely for this reason that an interest rate instrument may be preferable."

Yet, monitoring one or more definitions of money could be a useful monetary policy tool, even when the interest rate is the policy instrument. Consider for example the money demand equation used in Clarida, Galí and Gertler (1999):

$$m_t = p_t + \kappa y_t - \eta i_t + \upsilon_t \tag{2.1}$$

Given projections for y_t, i_t and p_t, the conditional behavior of m_t can be forecasted using the model above. Econometric analysis would lead to probability intervals for m_t, which would depend on the statistical process driving υ_t. Forecasted values could be compared to the actual money measurement. Any substantial or systematic departure between those values would indicate a possible inconsistency between the scenarios and reality (or, maybe, a significant money demand structural change). It would anyway give the policymaker early alert regarding the economic conditions, since money measures tend to be available earlier to central bankers, and tend to be more reliable than inflation measures.

As an example, suppose that the policymaker has defined its interest rate target, which would be consistent with a certain projection for output and inflation. If she observes later that the actual monetary aggregate growth is above the projection coming from equation (2.1), she would know that maybe output is increasing faster than expected, or that perhaps price expectations are higher than previously thought. In a case like this, the money demand model would be able to give early warning to the policymaker, helping her to take preventive measures.

Note that the European Central Bank uses a similar kind of approach as one of the pillars of its stability strategy.[3] It studies the demand trends for a broad aggregate (*M*3) and defines reference growth rates based on the policy goals. The Bank of England and the Central Bank of Chile, on the other hand, use the information from the aggregate growth rates as an economic indicator, but do not set aggregate growth targets as the ECB does.[4]

3 Modeling the Brazilian Money Demand

A money demand forecast model has to be found before the concept presented in the previous section can be applied to the Brazilian monetary history. For that, a sample of 240 monthly observations, covering January of 1980 to December of 1999 is employed. Data are not seasonally adjusted.

As monetary variable, the Brazilian narrow money concept (*M*1), measured as monthly average daily balances, is employed. The general price index (*P*) from Fundação Getúlio Vargas, known as IGP-DI, is used to deflate

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[3] European Central Bank (1999).

[4] The Bank of England (2000) states that "the money supply… could be a target of policy, but it need not be so. In the United Kingdom it is not, as we have an inflation target, and so monetary aggregates are indicators only." The Central Bank of Chile (2000) states that "developments regarding monetary aggregates are relevant when evaluating the economy's overall progress and the impact of monetary policy on it, even though the Central Bank has no explicit or implicit goals regarding these aggregates."

$M1$, leading to the real money stock variable (M). The interest rate (I) is the SELIC, the Central Bank nominal base interest rate, measured as the annualized monthly rate of return. The proxy for real output (CE) is the monthly national consumption of electricity. The logarithmic transformation is applied to all variables, with the exception of the interest rate, which is transformed into an instantaneous interest rate.[5]

Although energy consumption may not be a perfect proxy for output, it was chosen not only because it is available monthly but also because it is able to capture the growth of the underground economy in Brazil. Other activity variables have been considered, with less success.

Tests for the presence of unit roots in the series are performed. Appendix 1, Table 1, presents the results of the ADF unit root tests. The tests employ critical values from MacKinnon (1991) and two criteria to select the number of lags: Akaike information criterion and Schwert (1989) lag-selection rule. The results indicate that the unit root hypothesis cannot be rejected in any case. The variables henceforth are assumed as being integrated of order one.

To confirm the results above, the null hypothesis of presence of unit root is tested against the alternative hypothesis of stationarity along a breaking or shifting trend. This test is well suited to the Brazilian case, where interventions have happened. The chosen approach is described in

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[5] An instantaneous rate is given by the equation $I = \ln(1 + i)$.

Banerjee et al. (1992). The results are presented in Appendix 1, Table 2. The hypothesis of unit root cannot be rejected, and, in two cases, the hypothesis of integration of order two cannot be rejected too. It is assumed however that the order of integration is one for every variable.

Given that series are assumed to have a unit root, a cointegration test is in order. If the null hypothesis of noncointegration is rejected, then an error-correction mechanism model will be used. On the other hand, if there is no cointegration among the series, then the choice will be for a growth rate model (a model of first differences of logs).

Appendix 2 presents the results of the cointegration tests. The Johansen procedure is employed, with critical values given by Osterwald-Lenum (1992) and corrected according to Cheung and Lai (1993).[6] The null hypothesis of noncointegration is not rejected, therefore, a growth rate model is chosen.

The unrestricted model for $M1$ is therefore

$$\Delta \ln M_t = \alpha_0 + \sum_{i=1}^{n} \beta_i \Delta \ln M_{t-i} + \sum_{j=0}^{p} \chi_j \Delta I_{t-j} + \sum_{k=0}^{q} \phi_k \Delta \ln CE_{t-k} + \sum_{m=0}^{s} \Lambda'_m \mathbf{D}_{t-m} + \mu_t , \quad (3.1)$$

where Λ_m is a vector of parameters, $\mathbf{D}$ is a vector of dummy variables, and μ represents the model innovations, which can be interpreted as being related to unobserved and independent changes in the velocity of circulation of

[6] See Johansen and Juselius (1990) and Johansen (1991).

money. The sample regression was restricted to 204 observations, ranging from January of 1983 to December of 1999.[7]

The dummy vector **D** is composed of four different sets of interventions. One set is made by step and impulse dummies for stabilization plans in Brazil. An impulse dummy is defined as the first difference of a step dummy. Dummies are considered for the following plans: Cruzado (step and impulse on March 1986), Cruzado II (step and impulse on December 1986), Bresser (step and impulse on July 1987), Collor (step and impulse on March 1990) and Real (step and impulse on July 1994, and impulse on August 1994).

The second set of dummies is used to treat the effect of the Brazilian bank account debits tax known as CPMF. The third set takes care of deterministic seasonal components. The fourth set deals with a variable seasonal component, which is a linear function of the nominal interest rate.

The dummies for the stabilization plans may be interpreted as controls for periods of chronic or temporary mismanagement of the money supply. To avoid preselection of the mismanagement periods, the models for all stabilization plan subsamples are treated with dummies in the unrestricted model, and later the statistically insignificant dummies are excluded. Notice that dummies will not be used in the subsamples to be forecasted. Only preexisting information will be used for forecasting, as it would be done by policymakers under real operational conditions.

[7] Financial innovations related to changes in financial indexation between 1980 and 1982 apparently generated unstable interest rate coefficients during this subperiod.

The variable seasonal dummies are essential to totally remove seasonal patterns from the innovations, which are a major source of monthly forecast errors. These interest rate dependent dummies are defined as

$$I_{m,t} = \begin{cases} 0 \text{ if month } \neq m \\ I_t \text{ if month } = m, \end{cases}$$

being proxies for changes in the seasonal behavior of the agent when the opportunity cost of holding money changes. In Brazil, it is clear that the money demand seasonal pattern is accentuated by increases in the nominal interest rate.

A few explanations can be given to this phenomenon, among them the existence in Brazil of a 13^{th} wage month, which coincides with the holiday season and represents a higher proportion of the real yearly income when nominal interest rates are high. Another explanation is related to the asymmetric use of cash during work and vacation periods. In Brazil, the latter usually coincides with the last and first months of the year, due to the academic calendar. Money demand during vacation months tends to be less sensitive to nominal interest rates than during other periods. Families hold more money due to traveling and holiday expenses, not caring as much about the opportunity costs as they would do during work periods.

The unrestricted model shown in (3.1) is estimated using OLS for the whole sample and for every subsample starting on 1983:01 and ending immediately before a stabilization plan. Variables and dummies with statistically insignificant coefficients are discarded (with the exception of the constant term, which is kept in order to avoid long-run forecast trend biases), leading to the restricted models presented in Table 4, Appendix 3. Table 5 shows the values of the long-run coefficients for the interest rate (*I*) and for the output proxy (*CE*)

Notice from those statistics that the forecast models are able to satisfactorily explain money demand growth rates for every subsample. The estimated coefficients follow well-established money demand theoretical principles, showing a positive relation with the proxy for output and a negative relation with the nominal interest rate. Seasonal effects are significant both statistically and economically.[8]

The coefficients are reasonably stable among subsamples, with the exception of the subsample ending before the Cruzado plan. This subsample has a small number of observations, what could explain the departures in coefficient values. Yet, observe that the model for this subsample performs well, and is consistent in quality with the rest of the group.

The stability of the model and its forecast performance are statistically evaluated using an *N*-step ahead forecast test. The results are presented in Appendix 4, Figure 1. The test confirms that the model is acceptably stable, presenting good forecasting performance, particularly for subsamples ending after the Cruzado plan.

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[8] The coefficients for inflation rate variables were not statistically significant. The nominal interest rate was always the best proxy for the opportunity cost of holding money. This could be a result of the widespread indexation of financial instruments in Brazil, and consequently of the population awareness of nominal interest rate levels.

4 Evaluating the Stabilization Plans

In this section, the money demand models are used to evaluate the stabilization plans. Figure 2 in Appendix 4 presents the monthly inflation rate and the nominal interest rate along the hyperinflationary period. The implementation dates of the stabilization plans are highlighted with dotted lines.

Note from the graph that, even though the inflation rate never surpassed 100% per month, the process is clearly hyperinflationary. The inflation rate rises continuously, except during intervention periods.[9] The Real plan was the only one that clearly succeeded at eliminating the hyperinflationary process.

The procedure to be used is simple: the models for real $M1$ developed in the previous section are used to produce N-step-ahead forecasts, starting from the first month of implementation of each stabilization plan. These out-of-sample forecasts take the actual values of the output proxy (CE) and of the nominal interest rate (I) as if they were the policymaker path choices. The expected nominal money growth rates are then obtained by combining the forecasted growth rates of real $M1$ with three different scenarios for the expected inflation rate trajectories, which represent hypothetical policymaker expected inflation rate path choices.

[9] This kind of inflationary process is alternatively defined in Garcia (1996) as a "megainflation," in contrast with Cagan's more stringent definition of hyperinflation, which did not account for interventions like those adopted in Brazil.

Scenario 1, the most stringent, is based on a zero expected inflation rate path. This scenario may look artificial or unfeasible to the reader, given the zero inflation assumption. It is, however, the one that most adequately describes the expectations of the policymaker during all stabilization plans in Brazil, with the exception of the Real plan. This is because the latter was the only stabilization plan that was not based on generalized price controls. In all other plans, price increases were deemed illegal during a predetermined period following the intervention, such that zero inflation was essential for success.[10]

Scenario 2 is based on the downward trajectory of inflation of the Real plan, which is taken as a proxy for the expected inflation rate. It is used as a forgiving yet feasible scenario for all plans. It is forgiving because the residual inflation rates of the first few months that followed the implementation of the Real plan are arguably too high for plans based on price controls.[11] Unsuccessful plans have therefore the benefit of doubt under this scenario.

Scenario 3 combines the Real plan inflation rate trajectory of the scenario 2 with the upper 95% (2 S.E.) interval of the forecasted money demand growth rate paths. Those forecast error intervals take in

[10] For example, one of the main operational elements of the Cruzado plan was a massive propaganda blitz exalting the new "zero inflation" economy, and requesting the help of all concerned citizens, which were turned into price control agents during a presidential address to the nation. As a result, significant episodes of revolt and vandalism took place once the government decided to give up price controls months later.
[11] The accumulated inflation rate of the first five months after the implementation of the Real plan was 37.5%.

consideration residual and coefficient uncertainty. Under these conditions, there is only a 2.5% chance that actual money demand growth rates can be higher than the forecasted rates. This is an extremely forgiving scenario. Actual monetary growth rates above these trajectories, if remaining uncorrected, would almost surely doom a stabilization program.

An adjustment was made when preparing scenarios 2 and 3. In the expected inflation rate trajectory, the inflation rate of the first month of the Real plan was replaced with the actual inflation rate of the first month of the stabilization plan under evaluation. This adjustment is necessary because the inflation of the first month after plan implementation is always contaminated with an idiosyncratic statistical carry-over effect resulting from the price index calculation procedure. This inflation residue needs to be taken in consideration when evaluating remonetization during the month following intervention.[12]

After feeding the model with paths for every variable, remonetization trajectories were forecasted for the ten months that followed the adoption of each stabilization plan. The forecasted values were then compared with the actual $M1$ nominal growth rates. The results are presented in Appendix 5, Figures 3 to 8. Each plan will be discussed in detail in the following subsections.

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[12] Some economists in Brazil have argued that this carry-over effect should be deducted from the inflation rate of the first month after plan implementation when calculating remonetization levels. According to this view, the adjustment used here would be forgiving of policymakers, erring on the loose side.

4.1 Cruzado Plan

Following Barbosa et al. (1989), the four main elements of the Cruzado plan were: (a) mandatory price controls; (b) deindexation of the economy; (c) monetary reform with the introduction of a new currency; and (d) conversion of wages, rents and other contractual incomes to the new currency, based on prestabilization average real values. The plan was implemented as a surprise measure on February 28, 1986, through Presidential Decrees that were later confirmed by the Congress.[13]

According to Simonsen (1989), the Cruzado plan did not succeed at stabilizing the Brazilian economy due to a plethora of theoretical and implementation errors. While prices were frozen, wages were increased by governmental decree. The popular price control legislation was extended beyond reasonable limits. The fixed exchange rate became rapidly overvalued. The government deficit did not fall, frustrating heterodox hopes. On the contrary, the government lost the inflation tax, and the remonetization did not significantly reduce government interest spending. Real interest rates were negative, since nominal rates were not high enough to cope with residual inflationary expectations. Finally, all monetary aggregates expanded substantially during the months that followed the plan implementation. For example, $M4$ expanded 20% from March to July.

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[13] For additional discussion on the Cruzado plan, see, for example, Cardoso and Dornbusch (1987), Baer (1987), Pereira (1987), Welch et al. (1987), Cardoso (1992), and Agénor and Taylor (1993).

Due to price controls, shortages and black markets increasingly became the economic norm. The black market exchange rate spread, for example, rose from 26% to 48% during the three months following the plan.

Figure 3 shows that, according to scenarios 1 and 2, there was substantial monetary mismanagement during the ten months that followed the Cruzado plan, particularly during the first and second months. Notice that the remonetization of almost 50% that happened in the first month of the plan was excessive even according to the extremely forgiving scenario 3. Data indicate therefore that the Cruzado plan was victimized by monetary mismanagement.

4.2 Bresser Plan

According to Simonsen (1989), the Bresser plan was a reheated and short-lived version of the Cruzado plan, marked by unfulfilled promises of fiscal austerity. Figure 4 shows that the plan was followed by significant monetary mismanagement, even under the most forgiving scenario. The period reveals a total absence of monetary discipline.

4.3 Verão Plan

As it can be seen in Figure 5, the Verão plan, another version of the Cruzado plan redressed with renewed but unfulfilled promises of fiscal and monetary discipline, repeated almost the same pattern of mismanagement of the Bresser plan.

4.4 Collor Plan

Cardoso (1992), Tanner (1994), and Mèrette (2000) discuss the Collor plan. It combined some of the heterodox elements of the Cruzado plan, like price controls and another monetary reform, with an even more radical type of heterodoxy: the temporary confiscation of any kind of bank account balance above twelve hundred dollars – a form of debt moratorium. The confiscated resources were deposited in inflation-indexed accounts paying 6% yearly interest rates, which would be unblocked in twelve installments after an eighteen-month waiting period.

Due to the confiscation, available $M4$ was immediately reduced by 68%. No need to say, such a traumatic and unpopular measure created enduring negative credibility effects for the Brazilian public and private financial institutions, and surely did not help the acting President when he was impeached by the Congress, less than three years after the plan's adoption.

It should be noted on the other hand that the Collor plan represented the first serious attempt to implement important orthodox reforms, such as government spending cuts, tax increases, reduction of trade barriers, privatization, and deregulation. Those measures paved the way for the success of the Real plan, a little more than four years later.

The plan failed for many different reasons. It could never bring inflation below 9% per month. The public had become worn and cynical towards heavy-handed government interventions, after so many failed plans based on coercive measures. The confiscation did not hold for long: leakage of potentially destabilizing blocked funds into an unreputable financial and monetary system became a routine. Credibility of policies where at the lowest, limiting the power of fiscal and monetary authorities.

Figure 6 shows that the remonetization during the first three months of the Collor plan was compatible with scenario 2, even if excessive in the first month according to scenario 1 (zero inflation). The situation changes for worse however after the third month. Monetary mismanagement became the norm once more, as the confiscated funds were reinjected in the economy in an unplanned fashion, and $M1$ growth rates settled between 10% and 20% per month – excessive even when judged by the extremely forgiving standards of scenario 3.

4.5 Collor II Plan

The Collor II plan was another failed attempt at recycling Cruzado plan tenets, leading once more to the same type of mismanagement pattern observed during the Bresser and Verão plans, as shown in Figure 7.

4.6 Real Plan

Sachs and Zini (1996), Dornbusch and Cline (1997), and Franco (2000) discuss the Real plan. Silva and Andrade (1996) argue that the plan borrowed the heterodox "indexed currency" idea from the so-called "Larida's plan," and corrected it with the arguably orthodox "Simonsen's criticism."[14]

The Real plan was in fact a very orthodox stabilization plan. It did not depend on surprise or coercive measures, like price controls. It was based on: (a) preaccumulation of international reserves; (b) incentives to foreign capital inflows; (c) fiscal budget tightening and privatizations; (d) realignment of prices before currency change, through the creation of an "indexed currency" called the URV;[15] (e) monetary reform after price realignments, with the introduction of a new currency, the Real; (f) deindexation; and (g) establishment of a hidden exchange rate band and remonetization targets as nominal anchors.[16]

The Real plan succeeded at eliminating hyperinflation. Notice however that Brazil was only able to do it after twenty years of painful learning, and

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[14] As stated by Silva and Andrade, "in fact the Real Plan is basically the Larida's proposal corrected by Simonsen. Simonsen (1984) raised a fundamental point. He argued that the "equilibrium values" of prices and wages should be done before the introduction of the new currency otherwise the inflation would accelerate, and the new money unit would be born already corrupted. He suggested, therefore, that the first step to be taken should be the correction of the fundamentals; the second step, the conversion of incomes and contracts; and the third the introduction of the new currency. As we will see, these were exactly the steps followed by the stabilization program."

[15] The URV was a unit of reference but not a means of transaction, a role similar to the ECU in Europe.

[16] The exchange rate band later became the main intermediate target, with the nominal interest rate acting as the main instrument target.

that the plan's success depended on the previous development of better analytical tools and skills by the government agencies.

Brazil has been cited once, regarding the successful implementation of its inflation targeting regime in 1999, as an example of how policymaking based on advanced theoretical and econometric tools can be put in place in a developing country, even in a short period of time.[17] This statement can be misleading however if not considered from a wider perspective. The fast implementation of those measures could not have taken place without the development of government staff analytical skills that happened during the nineties.

Until the end of the eighties, the Central Bank of Brazil was, overall, an institution with low quantitative analytical capabilities. For example, its very first money demand model was developed in 1988, as described in Alvim (1988). The model had limited functionality however, and, as such, it was rarely used as a policymaking tool.

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[17] According to Mishkin and Savastano (2001), the Brazilian new monetary regime adopted in 1999 had "all the 'bells and whistles' of an inflation targeting regime, and was clearly the first comprehensive attempt to establish a regime of this type in Latin America... Many central bankers in the Latin American region have been concerned that it might take them a long time to acquire the technical capability to issue an inflation report of this type. Brazil has shown the way, indicating that an inflation targeting regime, with a high degree of transparency and accountability can indeed be implemented quickly." The inflation targeting experience, which is described in detail in Bogdanski et al. (2000), Mishkin and Savastano (2002), and Averbug (2002), has been mostly successful at maintaining low inflation rates, while protecting the country against external shocks, as discussed in Amann and Baer (2003).

Alvim's model was the result of new staff development policies adopted by the Central Bank during the eighties.[18] The policies were intensified in the beginning of the nineties, leading to remarkable increases in staff qualification. The implementation of the inflation targeting regime in 1999 would possibly not have succeeded without the technical expertise accumulated by the staff during the nineties.

For this new generation of quantitatively oriented economists, the Real plan was the first ordeal and learning ground. Albuquerque (1994), for example, describes a functional money demand forecast model that helped to determine the remonetization growth rate targets used in the Real plan.

Even if not considered as the main foundation of the plan, the remonetization targets were carefully observed – a result of the active management of the monetary aggregates by the Central Bank during the remonetization period, as described in Franco (1995).

Figure 8 shows that $M1$ growth rates during the implementation of the Real plan were consistent with a scenario of lowering inflation. The excessive remonetization of the first month was apparently corrected with a low rate of monetary growth in the second month. Monetary growth rates after the third month were highly consistent with a trajectory of decreasing inflation, a

[18] Those policies included incentives for staff to engage in master and doctoral programs in economics, improved recruitment efforts, and better allocation of new employees.

feature of the data that closely matches the description of the remonetization process presented in Franco (1995).[19]

It is not just coincidence, therefore, that the Real plan was the only stabilization plan that successfully disinflated the economy. The out-of-sample predictions of the money demand models confirm that it was the sole intervention episode presenting correctly managed monetary growth rates.

Conclusions

The paper gives an example of how a money demand model can be used to evaluate a country's monetary policy. The idea is to check the consistency between the money supply growth rates and the expected money demand growth rates conditional on the policymaker choices for interest rate, output, and inflation rate paths.

The concept was applied to the Brazilian case by modeling real $M1$. Based on unit root and cointegration tests, a growth rate model was chosen, taking in consideration the many interventions that happened during the sample period (1983-1999). The forecast model is shown to be acceptably stable.

As an original feature of the model presented in this paper, a variable seasonal pattern, which was defined as a linear function of the nominal

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[19] It is stated in that paper that the effects of the restrictive monetary measures on prices were impressive, particularly after the new restrictive measures adopted in October.

interest rate, increased the model ability to explain seasonal changes in the money demand. Despite the economic instability that marked the Brazilian economic history during the last two and a half decades, the model showed good fit and predictive performance.

Finally, using the model as a forecasting tool, it was shown that unsuccessful macroeconomic stabilization programs in Brazil were marked by excessive monetary growth rates during low inflation intervention periods. The results not only suggest that the mismanagement of the monetary aggregates were among the main causes of the failure of the stabilization plans, but also that the excessive liquidity could have been predicted during the implementation periods.

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Appendix 1

Table 1 – Unit Root Test [a]

Series	Schwert Criterion [b]			Akaike Criterion (AIC) [c]		
	t	ϕ	p	t	ϕ	p
			Level			
$\ln M$	-1.67	0.974	14	-1.67	0.974	14
I	-1.93	0.930	14	-3.36	0.907	1
$\ln CE$	-1.50	0.954	14	-2.89	0.906	25
			First Difference			
$\ln M$	-4.30**	0.150	14	-4.38**	0.175	13
I	-4.91**	-0.88	14	-14.8**	0.033	1
$\ln CE$	-4.40**	-1.50	14	-3.77*	-1.30	17

* null hypothesis of presence of unit root rejected at 5%;
** null hypothesis of presence of unit root rejected at 1%;
(a) augmented Dickey-Fuller (ADF):
$y_t = \alpha + \beta t + \phi y_{t-1} + \sum_{j=1}^{p-1} \psi_j \Delta y_{t-j} + \varepsilon_t$, critical values from MacKinnon (1991);
(b) $p = \text{int}\left[12(T/100)^{1/4}\right]$;
(c) maximum number of lags bound to 10% of the sample size.

Table 2 – Sequential Unit Root Test [a]

Series	Trend Shift [b]			Mean Shift [c]		
	$\tilde{t}_{DF}(\tilde{\delta})$	$\tilde{t}_{DF}^{min*}$	p	$\tilde{t}_{DF}(\tilde{\delta})$	$\tilde{t}_{DF}^{min*}$	p
			Level			
$\ln M$	-2.00	-2.67	14	-1.66	-2.26	14
I	-3.30	-3.30	14	-0.50	-2.78	14
$\ln CE$	1.413	-2.61	14	-1.59	-1.70	14
			First Difference			
$\ln M$	-4.74**	-4.75**	14	-4.32	-4.45	14
I	-5.40**	-5.40**	14	-3.24	-5.70**	14
$\ln CE$	-5.17**	-5.17**	14	-4.33	-4.45	14

* null hypothesis of presence of unit root rejected at 5%;
** null hypothesis of presence of unit root rejected at 2.5%;
(a) According to Banerjee et al. (1992):
$y_t = \alpha + \beta_1 \tau(k) + \beta_2 t + \phi y_{t-1} + \sum_{j=1}^{p-1} \psi_j \Delta y_{t-j} + \varepsilon_t$,
$p = \text{int}\left[12(T/100)^{1/4}\right]$;
(b) $\tau(k) = (t-k)\cdot 1(t>k)$, where $1(\cdot)$ is the indicator function;
(c) $\tau(k) = 1(t>k)$.

Appendix 2

Table 3 – Cointegration Test [(a)]

Series	Schwert Criterion [(b)]			
	1st LR	2nd LR	3rd LR	p
$\ln M, I, \ln CE$	40.56	12.77	4.57	14

* significant at 5% - critical values corrected following Cheung and Lai (1993);

** significant at 1% - critical values corrected following Cheung and Lai (1993);

(a) Johansen likelihood ratio (LR) cointegration rank test, trace statistic, intercept and trend in cointegration equation, intercept and trend in VAR;
a significant 1st LR statistic indicates rejection of the null hypothesis of cointegration rank equal to zero (rejection of noncointegration);
a significant 2nd LR statistic indicates rejection of the null hypothesis of cointegration rank lower than or equal to one (rejection of noncointegration and of cointegration with one cointegrating vector);
a significant 3rd LR statistic indicates rejection of the null hypothesis of cointegration rank lower than or equal to two (rejection of noncointegration, cointegration with one cointegrating vector, and cointegration with two cointegrating vectors);
critical values come from Osterwald-Lenum (1992) and Cheung and Lai (1993);
p represents the number of lags as in Johansen and Juselius (1990);

(b) $p = \text{int}\left[12(T/100)^{1/4}\right]$;

Appendix 3

Table 4 – Estimated Coefficients

Dependent Variable: $\Delta(\ln M_t)$ – Method: Least Squares

Sample	83:01 – 99:12		83:01 – 86.02		83:01 – 87:06		83:01 – 89:01		83:01 – 90:02		83:01 – 91:02		83:01 – 94:06	
Before plan			Cruzado		Bresser		Verão		Collor		Collor II		Real	
Included observations	204		38		54		73		86		98		138	
Variable	Coeff.	t-Stat.	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
Constant	-0.010	-1.40	-0.007	-1.28	-0.013	-1.89	-0.008	-1.16	-0.012	-1.54	-0.012	-1.51	-0.011	-1.45
$\Delta(\ln M_{t-2})$	0.159	5.40	0.590	5.30	0.299	4.49	0.197	3.32	0.123	2.23	0.084	2.04	0.116	3.05
$\Delta(I_t)$	-0.069	-9.81	-0.122	-3.51	-0.125	-7.11	-0.087	-6.40	-0.075	-6.99	-0.079	-12.41	-0.064	-8.02
$\Delta(I_{t-1})$	-0.086	-15.64	-0.057	-1.78	-0.093	-5.38	-0.105	-8.41	-0.093	-8.48	-0.079	-12.98	-0.086	-13.75
$\Delta(\ln CE_{t-1})$	0.453	4.35	0.424	2.63	0.305	2.05	0.451	3.38	0.372	2.62	0.327	2.38	0.336	2.71
Cruzado_t	0.059	3.65			0.038	2.19	0.046	2.63	0.063	3.39	0.072	3.92	0.065	3.53
$\Delta(\text{Cruzado})_t$	0.311	7.03			0.254	5.53	0.297	6.64	0.292	5.92	0.270	5.57	0.307	6.18
Cruzado2_t	-0.147	-6.63			-0.107	-3.85	-0.121	-4.45	-0.155	-5.68	-0.171	-6.72	-0.162	-6.38
Bresser_t	0.095	6.01					0.071	3.96	0.100	5.48	0.103	5.54	0.098	5.45
$\Delta(\text{Collor}_t)$	0.128	2.32											0.143	2.28
$\Delta(\text{Real}_t)$	0.227	4.53												
$\Delta(\text{Real}_{t-1})$	-0.180	-3.89												
$\Delta(\text{CPMF}_{t-1})$	0.240	5.75												
Seasonal(February)	-0.102	-6.82					-0.071	-3.94	-0.077	-3.26	-0.080	-3.44	-0.091	-4.08
Seasonal(April)			0.051	2.73	0.046	2.31								
Seasonal(May)	-0.027	-2.52												
Seasonal(August)	-0.032	-3.08	-0.044	-2.39	-0.042	-2.27	-0.038	-2.37	-0.047	-2.79	-0.047	-2.86	-0.041	-2.86
Seasonal(December)	0.144	10.79			0.059	1.83	0.083	3.88	0.133	5.78	0.137	5.85	0.138	6.20
$\Delta(I_{\text{January},t})$	-0.024	-5.05	0.087	7.17	0.044	3.52			-0.017	-2.44	-0.020	-2.79	-0.023	-3.51
$\Delta(I_{\text{December},t})$	0.025	5.41	0.137	11.84	0.093	4.49	0.051	6.11	0.024	3.57	0.025	3.58	0.027	4.04
R-squared	0.910		0.872		0.940		0.913		0.894		0.908		0.889	
Adjusted R-squared	0.899		0.837		0.922		0.895		0.875		0.893		0.877	
S.E. of regression	0.037		0.027		0.033		0.036		0.042		0.044		0.044	
Sum squared resid	0.249		0.022		0.044		0.077		0.124		0.161		0.241	
Log likelihood	395.0		87.82		115.4		146.5		159.2		175.1		242.3	
Durbin-Watson stat	2.189		2.289		1.934		1.915		1.339		1.504		1.990	
Mean dependent var	-0.0004		-0.016		-0.011		-0.014		-0.018		-0.008		-0.013	
S.D. dependent var	0.117		0.068		0.117		0.111		0.117		0.134		0.126	
Akaike info criterion	-3.647		-4.149		-3.792		-3.659		-3.377		-3.288		-3.294	
Schwarz criterion	-3.273		-3.761		-3.313		-3.251		-2.977		-2.918		-2.976	
F-statistic	83.32		24.74		53.17		52.17		46.59		63.55		70.48	
Prob(F-statistic)	0.000		0.000		0.000		0.000		0.000		0.000		0.000	

Table 5 – Estimated Long-Run Coefficients

Variable	Sample (before plan)						
	83:01 – 99:12	83:01 – 86.02 (Cruzado)	83:01 – 87:06 (Bresser)	83:01 – 89:01 (Verão)	83:01 – 90:02 (Collor)	83:01 – 91:02 (Collor II)	83:01 – 94:06 (Real)
I	-0.184	-0.437	-0.311	-0.239	-0.192	-0.172	-0.170
$\ln CE$	0.539	1.034	0.435	0.562	0.424	0.357	0.380

Appendix 4

Figure 1 – *N*-Step Ahead Forecast Test

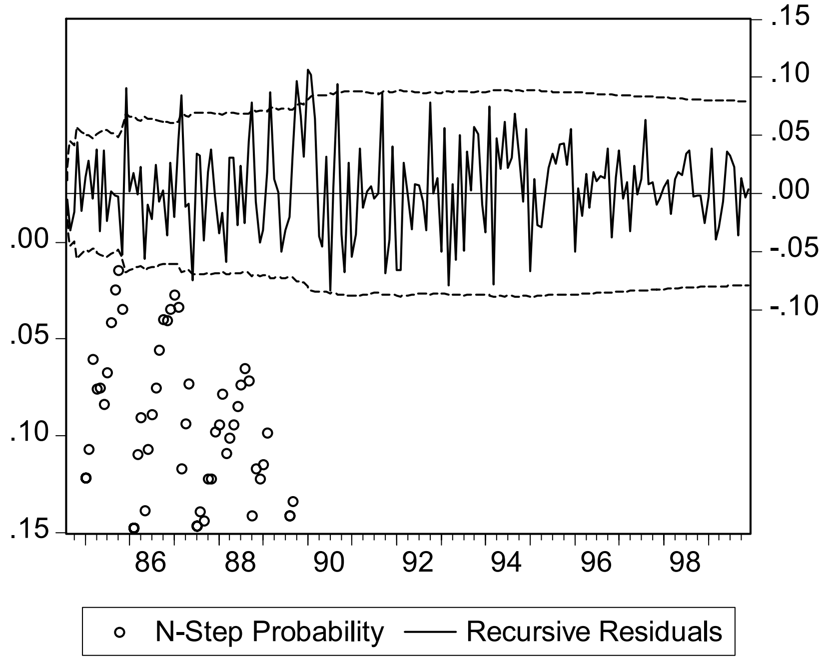
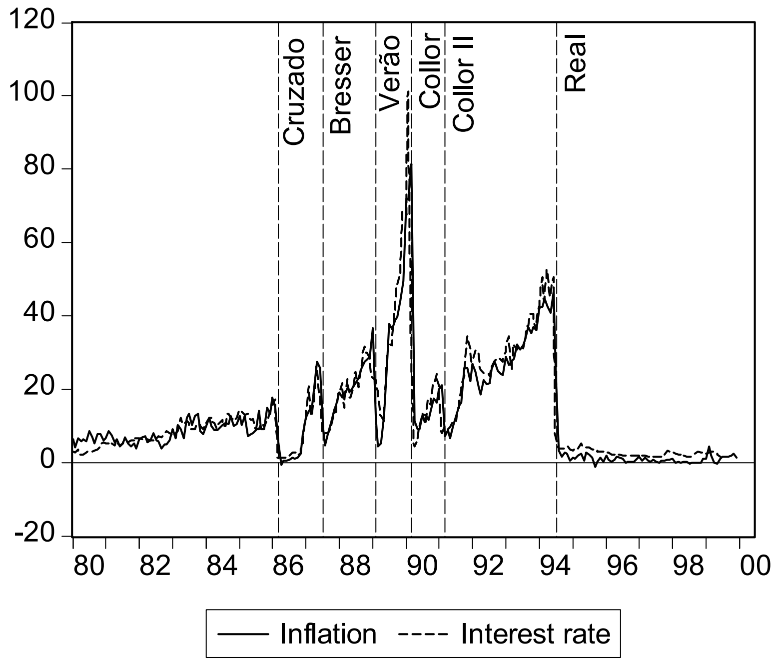


Figure 2 – Stabilization Plans



Appendix 5

Figure 3 – $M1$ Growth Forecast, Cruzado

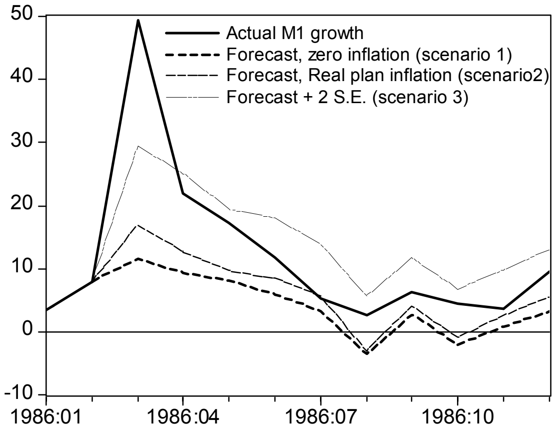


Figure 6 – $M1$ Growth Forecast, Collor

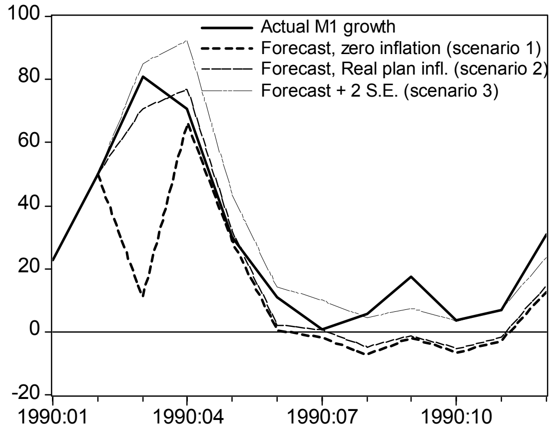


Figure 4 – $M1$ Growth Forecast, Bresser

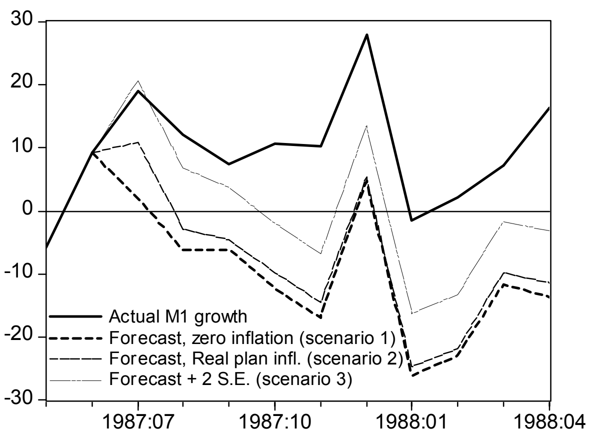


Figure 7 – $M1$ Growth Forecast, Collor II

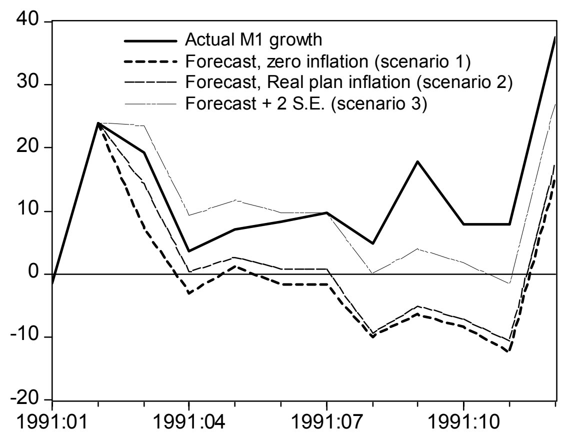


Figure 5 – $M1$ Growth Forecast, Verão

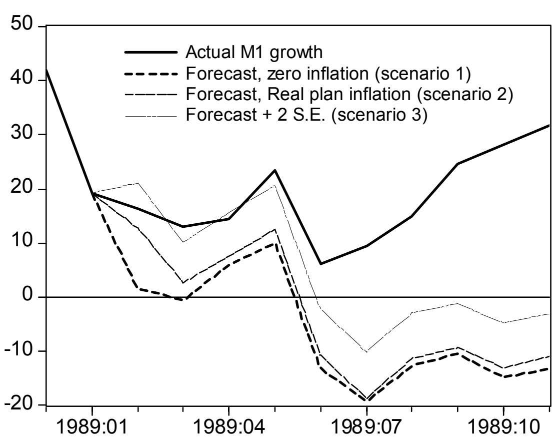


Figure 8 – $M1$ Growth Forecast, Real