

Antecedents of the Real Plan:

Spending contraction, interest-bearing money, and lagged indexation

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Highlights

- This study models three characteristics of the Brazilian economy that were important to define the country's 1994 inflation-stabilization plan.
- Inflation was more important to compress government spending than to generate the inflation tax.
- Government debt was monetized by the Central Bank, which generated interest-bearing money.
- Generalized lagged-indexation mechanisms constrained inflation expectations to be backward-looking.
- The plan started with a constitutional amendment to reduce mandatory spending and balance the budget.
- Next, an inflation-protected unit of value, worth one dollar, unified and synchronized the indexation system.
- Through a monetary reform, the unit of value became the new dollar-anchored Brazilian currency, the Real.

Summary

This paper models three antecedents of the Real Plan. First, inflation was more important in compressing government spending than generating the inflation tax. Second, the Central Bank largely monetized the public debt, which led to money that paid interest depending on inflation expectations. Third, expectations were tied to past inflation due to widespread mechanisms of lagged indexation of wages and prices. These antecedents influenced the design and implementation of the 1994 Real Plan, which ended hyperinflation in Brazil.

Keywords: Brazil, Guardia effect, hyperinflation, lagged indexation, interest-bearing money, Real Plan

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1. Introduction²

The Real Plan of 1994 eliminated hyperinflation in Brazil with a monetary reform—the replacement of the cruzeiro real by the Real—preceded by two legal measures. The first was a constitutional reform to untie federal revenues and reduce spending to eliminate the operational deficit in the government budget for 1994. The second was the unification of the multiple mechanisms for adjusting wages and prices to past inflation through a stable unit of account, equal in value to one dollar, in which wages (according to predetermined rules) and the prices of goods and services (mostly voluntarily) were redenominated. Transactions continued to be settled in cruzeiros reais, but their values were updated daily by the unit of account.

The price in cruzeiros reais of this unit of account—called the Unit of Real Value (URV)—was adjusted daily by the Central Bank according to an estimate of current inflation. After four months, during which prices and wages were redenominated into URVs, on July 1st, 1994, the monetary reform was carried out, replacing the old currency, the cruzeiro real, with the new one, the Real. The Real initially had the same value in cruzeiros reais as the US dollar and the URV, which was extinguished. Bacha (2003) details these procedures.

On July 29, 1993, having already assumed the position of senior advisor to Finance Minister Fernando Henrique Cardoso, I gave a lecture in the exams for full professor at the Federal University of Rio de Janeiro, later published in Bacha (1994). This paper contained simple macroeconomic models, reworked here, that influenced the procedures adopted in the monetary reform that established the Real as the new Brazilian currency.

²Forthcoming in a special issue of *The Quarterly Review of Economics and Finance* on the Brazilian economy, organized by Marcio Garcia and Marcelo C. Medeiros

Bacha (1994) builds on a finding from Eduardo Guardia's master's thesis, *Public Budget and Fiscal Policy* (1992), which illustrates the enormous difference, in real terms, between the federal government's budgeted spending approved by Congress and those carried out in the early 1990s. Guardia estimates that, measured in dollars, only about 60% of the programmed spending was implemented. Guardia attributes such extreme differences between budgeted and actual spending to the high inflation in the early 1990s.

Guardia points out that congressmen could exaggerate budgeted spending without affecting the deficit forecast in the budget because they greatly overestimated tax revenues. He estimates that actual tax revenues (in USD terms) also represented about 60% of budgeted revenues in 1990 and 1991. Franco (1995) obtained similar estimates for 1992.

The following section discusses the inflation model proposed by Bacha (1994), elaborating on the hypothesis of a negative relationship between real government spending and inflation, which we call the Guardia effect. The third section explores a contemporary paper by Don Patinkin, which provides a similar explanation for the inflationary process in Israel.

The fourth section contains a different model of the inflationary process, based on the concept of interest-bearing money and lagged indexation of prices and wages, which is in line with Bacha's (1994) appendix. The section explains how the Real Plan addressed these issues to overcome Brazil's hyperinflation.

Conclusions are drawn in the fifth section.

2. Guardia's argument and its modeling

Following Guardia (1992), Bacha's (1994) argument is that inflation mattered for the government not only because it generated revenue through the inflation tax but, more importantly, because it eroded the real value of budgeted spending. There was no significant reduction of real tax revenues

(actual revenues, not those estimated in the budget), as these were well protected against inflation by the Fiscal Reference Unit (Ufir), a daily inflation index used for tax payments.

According to Bacha (1994), this would explain the paradox of high inflation associated with a small operational deficit (the difference between primary spending plus real interest and the government's tax revenues)³. Following Guardia's lead, the paper argued that the deficit was small because of the spending contraction due to high inflation.

The paper contained a simple model, updated below, in which inflation resulted from the equalization of money demand (via the inflation tax) with the money supply—stemming from the government deficit (assumed to be fully financed by money issuance). The model's novelty was that higher inflation reduced the money supply (due to the erosion of real spending by inflation—the Guardia effect). Therefore, a deficit higher than the level financeable by the inflation tax could be budgeted without generating hyperinflation because, as inflation increased, the deficit decreased until it equaled the money demand generated by the inflation tax.

One implication of the model was that, to control inflation, it would be necessary to devise an alternative mechanism to reduce budgeted spending. In other words, approving a balanced budget in constant currency would be necessary, with realistically estimated and properly defined revenues (i.e., without accounting tricks). This was the justification for the creation in 1994, through a constitutional amendment, of the Emergency Social Fund (FSE) that allowed the federal government's operational deficit in 1994, initially budgeted at 6.6% of Gross Domestic Product (GDP), to be reduced to 1.1% of GDP in the budget resubmitted to Congress (Bacha, 2021, p. 205).

The following is an updated modeling of the Guardia effect.

³ According to Guardia and Tinoco (2023, p. 26), between 1991 and 1993 the public sector's operational deficit varied from 0.2% to 1.9% of GDP (the corresponding figures for the central government were 0.1% and 0.7%).

At current prices, the budget deficit approved by Congress is given by:

$$Db = Gb - Tb \quad (1)$$

where Db , Gb , and Tb are the budgeted deficit, authorized spending, and estimated tax revenue for the following year (the letter b stands for budget).

Assume that real GDP is constant and equal to one. Then, by hypothesis, projected spending in the budget aims to appropriate a share of GDP equal to k (with $0 < k < 1$) for a given budgeted inflation rate, π^b :

$$Gb = kP_{-1}(1 + \pi^b) \quad (2)$$

The product $P_{-1}(1 + \pi^b)$ is the nominal GDP anticipated for next year, with P_{-1} being the price level of the previous year (the year in which the budget is prepared).

By hypotheses as well, the tax revenue projected in the budget is equal to authorized spending to make the budgeted deficit equal to zero⁴:

$$Tb = Gb \Rightarrow Db = 0 \quad (3)$$

We move on to actual nominal values. The actual deficit, D , is equal to actual spending, G , minus actual revenue, T :

$$D = G - T \quad (4)$$

Suppose there are no unused funds and no cancellation of expenditures. Then, we temporarily assume that actual spending is equal to the spending forecasted in the budget:

$$G = Gb = kP_{-1}(1 + \pi^b) \quad (5)$$

However, actual spending may be greater than budgeted spending if tax revenue, driven by inflation, exceeds the budget's forecast. In this case, additional credits would be opened to absorb the excess revenue. We will address this case later.

⁴ This wasn't exactly the case before the Real Plan, since legislators tended to add capital revenues, including net debt issuance, to close the accounts. A more realistic hypothesis would be that estimated taxes were a high fraction of authorized spending. The figures in Franco (1995, p. 212) suggest that, for 1991 and 1992, estimated tax collection was around 94% of budgeted spending.

Assuming perfect inflation indexation, collected taxes are equal to a share t (with $0 < t < 1$) of nominal GDP, that is:

$$T = tP = tP_{-1}(1 + \pi) \quad (6)$$

where $\pi = (P/P_{-1}) - 1$ is the observed inflation rate.

Thus, substituting (5) and (6) into (4), the actual nominal deficit is given by:

$$D = P_{-1}[k(1 + \pi^b) - t(1 + \pi)] \quad (7)$$

We assume conflicting claims in the budget preparation, defined by the inequality $k/t > 1$, i.e., the desired spending share of GDP, k , exceeds the share collected by the government, t . We elaborate on this hypothesis in the next section.

As a proportion of GDP, that is, in real terms, the actual deficit, given by dividing (7) by P , is:

$$D/P = k(1 + \pi^b)/(1 + \pi) - t \quad (8)$$

where we use the definition: $P_{-1}/P = 1/(1 + \pi)$

Equation (8) says that if the observed inflation, π , were equal to that forecasted in the budget, π^b , the government's deficit as a proportion of GDP would be equal to $k - t > 0$. This is the expression of the potential deficit, which would exist without the adjustment produced by inflation. From (8), the actual real deficit, D/P , will be a decreasing function of the inflation rate, π .

In equilibrium, the actual real deficit is equal to the inflation tax, m^5 :

$$D/P = m \quad (9)$$

To simplify the analysis, we assume that the inflation tax is a constant fraction of GDP, equal to $m > 0^6$.

⁵ Seigniorage is assumed to be equal to the inflation tax. The deficit is fully financed by currency issuance, and there is no net issuance of public debt—a topic dealt with in the next section.

⁶ This assumption of a constant inflation tax is justified by the evidence that, regardless of the inflation rate, the monthly inflation tax estimated in the online appendix of Aires et al. (2021) varied very little, between 2.5% and 3.7% of GDP, from January 1991 to December 1993. In Bacha's (1994) model, inflation tax collection is a function of inflation, following

Then, from (8) and (9), the inflation rate, π^* , which equates the actual real deficit to the inflation tax collection, m , is given by:

$$1 + \pi^* = (1 + \pi^b) [k / (m + t)] \quad (10)$$

The greater the conflicting claims, k vs. t , the higher the equilibrium inflation rate. If $k > m + t$, the equilibrium inflation, π^* , will be greater than that forecasted in the budget, π^b .

Franco's (1995, p. 212) estimates for 1991 and 1992 suggest a ratio between k and t of 1.54, given that collected taxes amounted to around 65% ($1/0.65 = 1.54$) of authorized spending. Assuming federal tax revenues around 17% of GDP (as estimated by Giambiagi and Tinoco, 2023), it follows that authorized spending would be about 26% of GDP ($0.26 = 0.17 \times 1.54$)—a potential deficit of no less than 9% of GDP ($0.09 = 0.26 - 0.17$).

Estimates by Aires et al. (2021) suggest figures around 3% of GDP for the inflation tax, m . Thus, $k / (m + t) = 0.26 / (0.03 + 0.17) = 1.3$.

These figures mean that, in the early 1990s, inflation "resolved" the conflicting claims, which led to a potential deficit of 9% of GDP, in two ways. The first, the traditional one, was the production of an inflation tax of 3% of GDP. The second was the reduction of real spending from 26% to 20% of GDP. We conclude that, before the Real Plan, the Guardia effect was twice as important as the inflation tax to balance the government's accounts.

Another conclusion, derived from inserting our estimates for k , t , and m in (10), is that the inflation rate that balanced the budget in the pre-Real period needed to be about 30% ($0.26/0.20 - 1$) higher than the inflation forecast in the budget, to reduce government spending from 26% to 20% of GDP thus equalizing the deficit with the inflation tax collection.

the traditional Lafer curve. The only additional complication regarding the assumption of a constant revenue from the inflation tax, as adopted here, is that, for the stability of equilibrium in the money market on the descending side of the Laffer curve, the derivative of the fiscal deficit with respect to inflation must be greater in absolute value than that of the inflation tax.

Consider the case where the inflation rate forecasted in the budget is no less than that observed in the previous year, $\pi^b \geq \pi_{t-1}$, which seems reasonable during a period when, except when temporarily interrupted by the two Collor Plans, inflation tended to double each year⁷. From the tax revenue forecasted in the 1991, 1992, and 1993 budgets, we derive estimates of the inflation factors $(1 + \pi^b)$ for 1992 and 1993, respectively, equal to 1.19 and 1.49 times actual inflation in the preceding year⁸.

Entering these figures in (10), we conclude that the inflation factors $(1 + \pi^*)$ that would balance the budget in 1992 and 1993 were equal to 1.5 and 1.9 times those observed in 1991 and 1992, respectively⁹. As measured by the IGP-DI, both in 1992 and 1993, the observed inflation factors were 2.2 times higher than those of the preceding year (i.e., $(1 + \pi)/(1 + \pi_{t-1}) = 2.17$ in 1992 and $(1 + \pi)/(1 + \pi_{t-1}) = 2.23$ in 1993)—therefore higher than those needed to balance the budget.

A higher inflation than necessary to match the government's deficit with the inflation tax revenue would imply that the deficit would have been smaller than the inflation tax, which does not seem to have occurred. This is because higher inflations, which eroded real budgeted spending beyond necessary, created room for additional spending through supplementary credits using the "excess revenue." If we include the inflation tax in this

⁷ Measured by the IGP-DI, inflation from December to December in 1987 was 416%; in 1988, 1,038%; and in 1989, 1,793%. There was a break in this trend in 1990 and 1991 with the two Collor plans. In 1991, inflation was 480%; in 1992, 1,158%; and in 1993, 2,708%.

⁸ In 1991, from December to December, inflation measured by the IGP-DI was 480%. Meanwhile, the forecast for government current revenues, which is a reasonable estimator of the inflation embedded in the budget, increased by 593% between the 1991 budget (approved on 01/31/1991) and the 1992 budget (approved on 02/28/1992). Throughout 1992, inflation, according to the IGP-DI, was 1,158%, and the tax revenue forecast grew by 1,774% from the 1992 to the 1993 budget (the latter approved on 04/30/1993). In other words, in these two years, the inflationary factors predicted in the budget, $(1 + \pi^b)$, were respectively 19% $(= (1 + 5.93)/(1 + 4.80) - 1)$ and 49% $(= (1 + 17.74)/(1 + 11.58) - 1)$ higher than those observed in the year of their preparation. The IGP-DI data are from the Getúlio Vargas Foundation, and the budget data are sourced from:

<https://www.congressonacional.leg.br/materias/materias-orcamentarias#1993>.

⁹ Dividing both terms of (11) by $1 + \pi_{t-1}$ results in $(1 + \pi^*)/(1 + \pi_{t-1}) = [(1 + \pi^b)/(1 + \pi_{t-1})] \cdot [k/(m+t)] = 1.19 \times 1.3 = 1.5$ in 1992 and $1.49 \times 1.3 = 1.9$ in 1993.

revenue¹⁰, an implication is that actual spending will be equal to budgeted spending, as presumed in equation (5), only if the latter is higher than total tax revenue (regular taxes plus the inflation tax). However, if budgeted spending turns out to be lower than total tax revenue, actual spending will be higher than budgeted spending (and equal to total tax revenue). That is, instead of (5), in real terms we'll have:

$$G/P = \max[Gb/P, t+m] \quad (11)$$

Dividing (2) by $P=P_0(1+\pi)$ and inserting the resulting value for Gb/P in (11), we arrive at the following general expression for actual real spending¹¹:

$$G/P = \max[k(1+\pi^b)/(1+\pi), t+m] \quad (12)$$

In other words, for inflation rates that generate a G/P higher than $t+m$, the Guardia effect holds—the higher the inflation, the lower the real spending. However, starting from the inflation rate π^* , for which $G/P(\pi^*)=t+m$, subsequent increases in inflation do not reduce real spending. Excess revenue is generated in this situation, allowing nominal spending, through supplementary credits, to grow *pari passu* with total tax revenues.

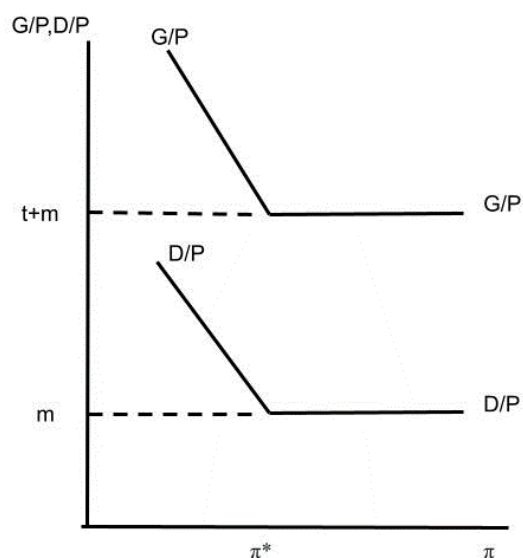
This reinterpretation of the Guardia effect is illustrated in Graph 1, where the inflation rate π is on the horizontal axis, and both real spending G/P and real deficit D/P are on the vertical axis. For simplicity, we assume linear relationships between government spending and deficit with inflation. We mark the observed values for m and $t+m$ on the vertical axis. Thus, for inflation rates lower than π^* , the Guardia effect applies: increases in the inflation rate reduce the government's real spending and deficit. The effect is no longer valid for inflation rates higher than π^* because all excess revenue generated by inflation is spent. This may have occurred in the years immediately preceding the Real Plan: inflation accelerated to such an extent that it allowed more spending than was budgeted. This model's simplified

¹⁰ The Central Bank's profits transferred to the National Treasury are included in the budget as a source of funding for government spending.

¹¹ I am indebted to Marco Bonomo for improving the derivation of equation (12).

scheme does not explain why inflation was higher than necessary to balance the budget.

Fig.1: Guardia's effect reinterpreted



3. Patinkin and the Guardia effect

In 1993, the dominant conception regarding the effect of inflation on the government deficit was that the higher the inflation, the larger the government's operational deficit. This conception was expressed in the so-called Olivera-Tanzi effect—the references being Olivera (1967) and Tanzi (1977). According to these authors, the higher the inflation, the lower the real revenue due to the lag between the generating event (sale of the product or income appropriation) and the collection of taxes. In Brazil, however, since 1964, taxes have been collected according to a reference unit indexed to inflation. In 1993, this unit was the Ufir, which varied daily according to the estimated inflation rate. Therefore, the Olivera-Tanzi effect tended to be small.

The literature also assumed that government spending was well protected from inflation in the context of realistic and reasonably balanced budgets. Thus, with invariant real spending and poorly indexed taxes, the literature presumed that higher inflation would result in larger deficits.

When I presented my 1993 lecture, I had not yet read Don Patinkin's paper published that same year (Patinkin, 1993), in which—based on many years of observing the situation in Israel—he asserts that inflation could be seen as the finance minister imposing a tax on other government ministers:

Specifically, in a situation where—because of coalition considerations—the finance minister does not have the power to force individual ministries to make adequate reductions in their respective budgetary demands and is thus confronted with an overall budget whose planned expenditures far exceed its expected revenues, he may seemingly accept these demands, and then finance the deficit by printing money and letting the resulting inflation enforce the necessary reduction in real government expenditures. (Patinkin, 1993, p. 115)

The model in Bacha (1994) postulated the existence of a negative relationship between real spending and the inflation rate. The same was true in Patinkin's version, so much so that this author carefully observed that the phenomenon did not imply that those losing out due to inflation suffered from money illusion. In his words:

This does not mean that ministers suffer from money illusion. Instead, they are best regarded as being caught up in the 'prisoners' dilemma,' in which out of fear that his or her position relative to that of other ministers may be worsened, each one insists on an increased nominal budget, the aggregate of which over all ministers then generates an inflation that endangers the survival of the coalition government, and thus makes all of them worse off. And a corollary of this 'coalition

theory of inflation' is that the weaker the coalition, the higher the rate of inflation. (Patinkin, 1993, p. 216)

Ultimately, it was a game in which inflation was generated by conflicting claims not between profits and wages over income shares but between government spending units over budget allocations.

I have not found any prior academic references to my paper and Patinkin's regarding the importance of inflation in reducing the government deficit. Therefore, it seems fair, at least from a Brazilian perspective, that this phenomenon is called the Guardia effect, as Franco (2024) does.

4. Interest-bearing money and lagged indexation

The argument in Bacha (1994) was useful for the sequencing of the Real Plan, the first stage of which was the approval of a constitutional amendment that allowed the submission to Congress of a balanced budget in its operational concept for 1994. However, the model in the paper was flawed in assuming that non-interest-bearing money financed the government deficit.

In practice, the bulk of the deficit was financed by short-term debt, with a peculiar Brazilian characteristic. A significant portion of the government's debt was held by commercial banks, which funded their holdings by interest-bearing deposits retained by the public. These deposits constituted the bulk of the country's money supply, as paper currency and non-interest-bearing demand deposits were gradually reduced to very small amounts. This was the domestic money substitute analyzed by Garcia (1996).

On this topic, it is worth reproducing an excerpt from my assessment of the Real Plan (Bacha, 2003, p. 193):

At the time of the introduction of the Real, Brazil's monetary base stood at only 0.6 percent of GDP, and M1 was an equally meager 1.1 percent of Brazil's GDP. The money that mattered was held in the form of overnight funds, on which checks could be written because

commercial banks provided automatic free-of-charge conversion of such funds into checking deposits. The backing of such funds was typically provided by one-month Central Bank bills, which could be automatically rediscounted with the Central Bank at the daily overnight interest rate. In principle, the Central Bank stood ready to provide immediate and costless liquidity to the whole of the federal public debt (Treasury bills plus Central Bank bills in the hands of the public), which was mostly carried within the banking system itself, not by final non-financial holders. This debt amounted to some 6.8 percent of GDP and served as a domestic money substitute. This allowed Brazil, in spite of very high inflation rates, to avoid the dollarization of its domestic monetary system.

An appendix in Bacha (1994) contained a model in which the government was financed primarily through interest-bearing money (i.e., government debt monetized by banks through interest-bearing accounts)¹². In addition to its real component, the interest rate on money included the expected inflation rate. In the limit when all money was interest-bearing, it did not generate an inflation tax.

In abbreviated form, the model is as follows. Suppose that the demand for partially interest-bearing money that finances the government's deficit, B , is proportional to the price level, P (real output is constant and equal to one):

$$B = bP, \quad b > 0 \quad (13)$$

In terms of rates of change, it follows:

$$\Delta B/B = \pi \quad (14)$$

where: $\pi = \Delta P/P$ is the inflation rate.

The government's budget constraint satisfies:

$$\Delta B = D + ibB \quad (15)$$

¹² The appendix in Bacha (1994) builds on Calvo (1993).

where ΔB is the change in partially interest-bearing money, D is the primary deficit, and b is the portion of B that is interest-bearing at rate i ¹³.

Let:

$$i = \pi^e + r \quad (16)$$

where π^e is the expected inflation rate, and r is the real interest rate, assumed to be constant. With a positive r , D can be reinterpreted, as we do henceforth, as the operational deficit.

Dividing both sides of (15) by B , using (13) and (16), and defining $d=D/P$, we get:

$$\Delta B/B = d/b + b\pi^e \quad (17)$$

Equating (17) to (14), we obtain the equilibrium condition in the market for partially interest-bearing money:

$$\pi = d/b + b\pi^e \quad (18)$$

This equation establishes a link between observed inflation, π , and expected inflation, π^e , the strength of which varies with the portion b of interest-bearing money in B .

One implication of this dependency is that it becomes necessary to convince the holders of B that eliminating the operational deficit d will be accompanied by the end of high inflation so that inflation expectations immediately converge to values close to zero. However, inflation expectations in Brazil were tied to past inflation, perpetuated through the country's widespread price and wage indexation mechanisms, a topic elaborated in Lopes and Bacha (1983) and Arida and Resende (1985). In this case, in simplified form, we can write:

$$\pi^e = \pi_{-1} \quad (19)$$

¹³ In 1993, the monetary base was 0.6% of GDP, and public debt was 6.8% of GDP. Hence, b was about 92%.

where π_{-1} is the inflation rate of the previous period¹⁴. When the operational deficit is eliminated, $d=0$, it follows from (18) and (19) that:

$$\pi = b\pi_{-1} \quad (20)$$

Since the value of b is close to one, the convergence of observed inflation to zero will be slow. The pain of fiscal adjustment will not quickly be reflected in lower inflation, and the political support for the stabilization program may vanish in a few months.

Therefore, overcoming lagged indexation was required for a fast drop in inflation to single digits. Lopes and Bacha (1983) propose to achieve this through a political negotiation in which wages would be indexed to current inflation, maintaining real wages constant. Arida and Resende (1985) suggest introducing (alongside the existing inflated currency) an "indexed currency" in which wages (and prices) would be voluntarily converted and gradually phasing out the existing currency.

The monetary stage of the Real Plan was implemented in two steps. Initially, through a law approved by the Brazilian Congress wages were denominated in a stable unit of value, the URV, according to a formula that preserved the real value of wages in cruzeiros reais. The URV was made equal to one dollar, and its price was adjusted daily according to the Central Bank's estimate of the current inflation in cruzeiros reais¹⁵. Due to the negotiations with Congress, the same procedure adopted for wage conversion was extended to residential rents and school fees. These conversions in URVs were made on March 1, 1994. In the following four months, the denomination in URVs of other transactions was carried out by voluntary negotiations between the involved parties, with assistance from the Ministry of Finance in the case of critical value chains. Although denominated in URVs until July 1, 1994,

¹⁴ Equation (19) is not, in general, consistent with the determination of the inflation rate, π , by (18). These two equations imply that $\pi=d/b + b\pi_{-1}$; therefore, in general, $\pi \neq \pi_{-1}$. However, with d close to zero and b close to one, as in the early 1990s, (19) provides a reasonable approximation to the equilibrium inflation rate resulting from (18).

¹⁵ The URV was inspired by the Ufir, the inflation-protected unit of value used by Brazil's Internal Revenue Service for tax collection.

wages and prices continued to be settled in cruzeiros reais. On July 1, the URV was extinguished and the cruzeiro real was replaced by a new currency, the Real, with an initial value of one dollar. With the introduction of the Real as the country's legal tender, all contracts whose value had previously been set in real terms (in URV units) became fixed in nominal terms (in Reais). See Bacha (2003) for further details.

In terms of the model, by transforming lagged indexation into a contemporaneous one through the URV, the Real Plan succeeded in making inflation expectations equal to current inflation:

$$\pi^e = \pi \tag{22}$$

Substituting (22) into (19) and collecting terms, we get:

$$\pi = d/b(1-b) \tag{23}$$

Therefore, under contemporaneous indexation, inflation immediately converges to zero when the operational deficit d is eliminated. In other words, the Real plan can be understood as a credible change in the economic policy regime, which altered the expectation formation process by balancing the budget and introducing contemporaneous indexation of wages and prices¹⁶.

The model of interest-bearing money also offers an alternative reason why inflation remained high despite a small operational deficit. In the case of the Guardia effect, the reason was that the deficit was reduced by high inflation to match the small inflation tax. In the model with interest-bearing money linked to expected inflation, inflation remained high despite a small operational deficit because inflation expectations responded not to the size of the deficit but to past inflation—based on the observation that the widespread mechanisms of lagged indexation of prices and wages ensured that past inflation would persist.

In an equilibrium where $\pi^e = \pi$, equation (23) shows that a higher h magnified the effect of the operational deficit on the inflation rate. In the

¹⁶ I am indebted to Carlos Viana for conversations on this point.

extreme case where $b=1$, any positive operational deficit would generate unlimited hyperinflation.

There is still much debate in the literature about the role that the 1994 fiscal adjustment played in the success of the Real Plan. For contrasting viewpoints, see Cardoso (1998), Portugal (2016), Ayres et al. (2021), and Arida (2024). The model in the main text of Bacha (1994) suggested that this adjustment alone was sufficient to end inflation. The model in the appendix more realistically showed that fiscal adjustment was primarily necessary to prevent inflation from accelerating. Fiscal equilibrium was needed to ensure that observed inflation was not higher than expected. However, to deal with high expected inflation, it was necessary to neutralize the lagged indexation of prices and wages, which was achieved with the introduction of the URV.

The 1994 fiscal adjustment was lost over the following four years. But, with the abolishment of generalized lagged indexation, it was possible to sustain the reduction in inflation with an exchange rate anchor and an active monetary policy. The fiscal pillar was only fully established in 1999 with the institution of the so-called economic policy tripod—primary surpluses, floating exchange rate, and inflation targets—complemented by the Fiscal Responsibility Act of 2000. See Werneck (2014) for the complete story.

5. Conclusions

In this paper, we discussed some analytical antecedents of the Real Plan. The first relates to the role of inflation in reducing budgeted spending, thereby allowing the government deficit not to exceed the revenue from the inflation tax. This implied that an unmanageable deficit would emerge in the government's accounts if inflation disappeared. The success of any sudden stabilization plan would, therefore, depend on reducing government spending in the budget proposal. This was the basis for the approval by the Brazilian

Congress in February 1994 of a constitutional reform proposal, reducing by 20% the mandatory spending in the budget proposal for that year.

The economic literature on the impact of inflation on the government deficit is dominated by the Olivera-Tanzi effect, according to which, due to the lag between the incidence and collection of taxes, the higher the inflation, the larger the government deficit. This effect did not apply to the Brazilian case because the daily tax indexation made inflation's impact on revenue very small. On the other hand, as government spending was recorded in the budget in nominal terms, the higher the inflation, the lower the spending in real terms. This is the Guardia effect, in honor of the Brazilian economist (who died prematurely) who identified the phenomenon in his master's thesis. Most of the paper was devoted to formalizing and numerically illustrating the Guardia effect, given the innovation it introduced into the literature.

The second theme is interest-bearing money. Most of the Brazilian government's deficit in the pre-Real period was financed by public debt largely monetized by the Central Bank, bearing an interest rate that depended on the inflation expected by investors. Therefore, eliminating the operational deficit was not enough to suppress inflation; dealing with the expectations that kept the interest rates on public debt high was also necessary.

The third theme is that the Brazilian economy before the Real was characterized by widespread indexation of prices and wages to past inflation. Lagged indexation caused past inflation to project into current inflation and, consequently, future inflation expectations. For inflation expectations to fall, it was necessary to address the issue of lagged indexation.

The Real Plan created an inflation-protected unit of account, called the URV, in which prices and wages were denominated. Thus, indexation started referring to current inflation. The next step was a monetary reform in which the URV transfigured into the country's new currency, the Real, at parity with the US dollar. With the introduction of the Real as the country's legal tender,

all contracts whose value had previously been set in real terms (in URV units) became fixed in nominal terms (in Reais). The subsequent anchoring of the Real to the US dollar guaranteed the end of hyperinflation in Brazil.

Declaration of competing interest

None.

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