

Inflation inertia and the failure to stabilize

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Summary: 1. Introduction; 2. Simple inflation inertia; 3. Catching up inertia; 4. Generalization; 5. Concluding remarks.

1. Introduction

The standard explanation for the many failed stabilization attempts in Brazil and other Latin American countries is that they resulted from lack of correct fundamentals in fiscal and monetary policy (eg. Dornbusch et al., 1990; Kiguel & Liviatan, 1991 and 1992; Dornbusch, 1992). This paper offers an alternative explanation using only the notion of inflation inertia.

It is not our purpose to deny the importance of a proper handling of fundamentals in the stabilization process. Fighting inflation obviously requires dealing with both inertia and fundamentals, but we want to point out that inertia may by itself present a rather difficult challenge, one that perhaps has not been adequately recognized in the literature. Failing to deal with inertia adequately may be sufficient to destroy a stabilization attempt.

Section 2 presents the simple notion of inflation inertia in a two sector model. Section 3 introduces the more realistic concept of catching up inertia, showing that under it a price restraint policy may fail to produce stabilization. Section 4 derives the same results for the general case of an n -sector economy. The final section presents some concluding remarks on the role of fundamentals.

2. Simple inflation inertia

The notion of inflation inertia as a result of overlapping multiperiod contracts has been used by such authors as Edmund Phelps (1978), John Taylor (1979), or James Tobin (1980, 1981), but it has received far greater attention on the local discussion of inflation in the highly indexed economies of Latin America, particularly Brazil. For a taste of the local literature see Edmar Bacha & Francisco Lopes (1983), P rsio Arida & Andr  Lara Resende (1985), Mario H. Simonsen (1986) or Luiz Bresser Pereira & Yoshiaki Nakano (1987). In the simplest inflation inertia model all prices are increased every month in proportion to the rate of inflation of the previous month. Monetary policy is fully passive (in the sense of Oliveira, 1970) or accommodative (in the sense of Taylor) and we simplify by ruling out supply shocks. Assuming there are only two sectoral prices, and writing their percentage rate of increase in month t , as q_t and s_t , we simplify further by assuming the overall rate of inflation to be:

$$p_t = 0.5(q_t + s_t) \quad (1)$$

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Hence, since $q_t = p_{t-1}$ and $s_t = p_{t-1}$, we derive $p_t = p_{t-1}$ implying that the rate of inflation reproduces itself over time. This is a dynamic equilibrium in which the rate of inflation remains constant over time. Past inflation is the cause of current inflation.

The inflation equilibrium can be changed into a stabilization path if, by means of price controls or free international competition under a fixed exchange rate, sectoral prices are made to increase in smaller proportion than previous month's inflation, that is:

$$q_t = \theta_t p_{t-1} \text{ and } s_t = \theta_t p_{t-1} \text{ with } \theta_t < 1 \quad (2)$$

In this case we get:

$$p_t = \theta_t p_{t-1} \quad (3)$$

implying that the rate of inflation will fall over time towards zero. In the case of a price freeze, which would set the value of the price restraint coefficient θ_t to zero, inflation would disappear in a single month.

3. Catching up Inertia

But the price setting behavior implied by (2) is very unlikely. It cannot be found in the experience of Brazil or other high inflation Latin American countries. The more usual pattern is for prices to be periodically pushed by wages and other costs (such as rentals) into catching up with actual inflation. For example, in our two sector model if a sectoral price is restrained to increase less than previous inflation at a given month, in the following month it will typically catch up for any inflation loss over the two previous months. Assuming these catching up moves to be staggered in time, whenever price s is being restrained, price q will be in the process of catching up with actual inflation and, vice versa, whenever price q is being restrained, price s will be in the process of catching up.¹ Hence, if at month t price s_t is being restrained:

$$s_t = \theta_t p_{t-1} \text{ with } \theta_t < 1 \quad (4)$$

then price q_t is catching up:

$$q_t = (p_{t-1} + p_{t-2}) - \theta_{t-1} p_{t-2} \quad (5)$$

This last equation assumes, in a simplifying logarithm approximation, that the percentage rate of increase of price q is set in catching up month t so as to recover the inflation accumulated over months $t-2$ and $t-1$, that is $(p_{t-1} + p_{t-2})$, with due allowance for the restrained price increase already achieved in month $t-1$, which was $q_{t-1} = \theta_{t-1} p_{t-2}$. Note that the current price restraint coefficient θ_t may differ from last month's price restraint coefficient

¹ Without staggering, catching up behavior would not substantially modify the conclusions of the simple inertia model.

θ_{t-1} . Another way of putting this is to say that catching up makes the overall increase of price q over months $t-1$ and t equal to the overall inflation over months $t-2$ and $t-1$, that is:

$$q_t + q_{t-1} = p_{t-1} + p_{t-2} \quad (5)$$

Catching up behavior, as described by (5), may seem irrational in the context of the simple model being used here, but it is easy to justify in the real world where economic agents try to insure themselves against possible asymmetries in the stabilization process. For if the intensity of price increase restraints is not the same in different sectors, we will have differentiated values of θ_t in (2) and arbitrary relative price changes will result from stabilization. Catching up behavior is an attempt to avoid that. In Brazil, for example, catching up on an annual basis for wages has been traditionally established by either law or court rulings and it is widely seen as a fairness standard in wage setting. Catching up is also prescribed in rent or services contracts, in which it usually occurs on a semester or quartely basis.²

Since the behavior of our two prices oscillates symmetrically between (4) and (5), we can derive the inflation dynamics by simply substituting them into (1):

$$p_t = 0.5[(1 + \theta_t)p_{t-1} + (1 - \theta_{t-1})p_{t-2}] \quad (6)$$

For the case of constant price restraint coefficient $\theta_t = \theta_{t-1} = \theta$, this can also be usefully rewritten in terms of inflation acceleration:

$$dp_t = -0.5(1 - \theta)dp_{t-1} \quad (7)$$

with $dp_t = p_t - p_{t-1}$.

This inflation dynamics has two important features. First, an inertial equilibrium with constant inflation is still possible even if price increases are being restrained. This results directly from (7) since $dp_{t-1} = 0$ implies $dp_t = 0$ in spite of $\theta_t < 1$. Second, as shown in appendix A, with a constant price restraint coefficient $\theta < 1$, inflation will converge to a positive rate given by:

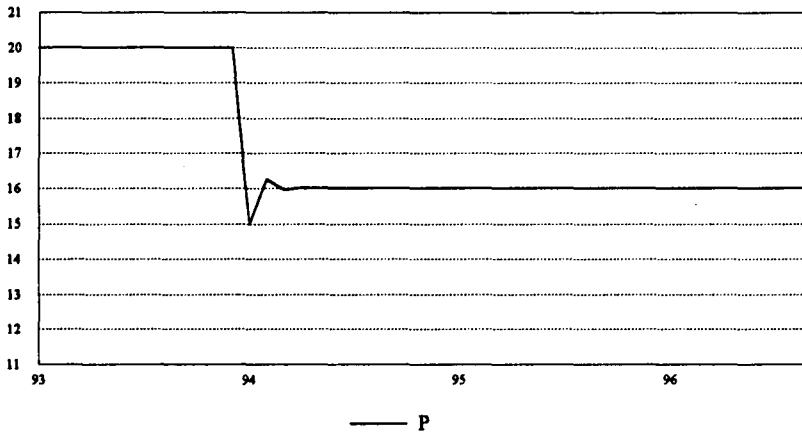
$$p^* = \frac{z}{1 + 0.5(1 - \theta)} \quad (8)$$

that is, inflation does not fall to zero even though $\theta < 1$. In the case of a price freeze, with $\theta = 0$, inflation stabilizes at $p^* = z / 1.5$. Figure 1 shows the inflation path that results from a computer simulation for $z = 20$ percent and $\theta = 0.5$, leading to $p^* = 16$ percent.

We can see at this point why a stabilization program based on price restraint may fail in the presence of catching up inertia. The rate of inflation will not fall continuously towards zero, as in the simple inertia model of the previous section, but will converge instead to a positive value after going through a minimum at $t = 1$. Hence after an initial honeymoon, when expectations of an approaching stabilization will be heightened by the drastic inflation deceleration, disappointment will set in as inflation bounces back in spite of the continuing

² Usually the catching up period tends to decrease when inflation increase but this relationship is ignored here.

Figure 1
Inflation path simulation
($n=2$)



Note: $\theta = 0.5$ after Jan. 94.

price restraint. As inflation converges to its new equilibrium at rate p^* instead of going to zero, the stabilization program will be deemed a failure.

What happens if frustration leads to rejection of the price restraint, which at this point must anyway seem rather pointless? Suppose for example that $\theta_t = 1$ for $t \geq u$. Take the system to be already in equilibrium before $t = u$ with $\theta_t = \theta$, so that $p_{u-1} = p^*$ and $p_{u-2} = p^*$. Hence from (4) $s_{u-1} = p^*$ and, from (5), $q_{u-1} = 2p^* - \theta p^*$. Substituting into (1) we get $p_u = p^* [1 + 0.5(1 - \theta)]$ or, using (11), $p_u = z$. The elimination of price restraint brings inflation back to the same value it had at the start of the stabilization program. At this stage there is total failure. The price restraint policy, which could only be sustained for a temporary period of time, failed to have any permanent effect on the inflation path.

Let us emphasize this fundamental result. Under catching up inertia, price restraint does not erase the memory of past unrestrained inflation. The equilibrium rate of inflation given by (8) is a function of both the price restraint coefficient and the previous unrestrained rate of inflation, that is, $p^* = p^*(z, \theta)$. Therefore, a temporary change in θ will only produce an equally temporary change in p^* .

4. Generalization

So far we simplified the analysis by restricting it to an unrealistic two sector economy where staggered catching up follows a bimonthly cycle. We now show that our results generalize nicely to an n sectors economy where catching up follows a n -monthly cycle. In this case at any month t , while the prices s_{it} of $n-1$ sectors are being restrained:

$$s_{it} = \theta_t p_{t-1} \text{ for } i = 1 \dots n-1 \quad (9)$$

one other price q_t is catching up:

$$q_t = \sum_{k=1}^n p_{t-k} - \sum_{k=2}^n \theta_{t+1-k} p_{t-k} \quad (10)$$

so the rate of inflation is:

$$p_t = \alpha \theta_t p_{t-1} + (1 - \alpha) q_t \quad (11)$$

with $\alpha = (n - 1)/n$. Hence inflation acceleration is:

$$dp_t = -\alpha (1 - \theta_t) p_{t-1} + (1 - \alpha)(q_t - p_{t-1}) \quad (12)$$

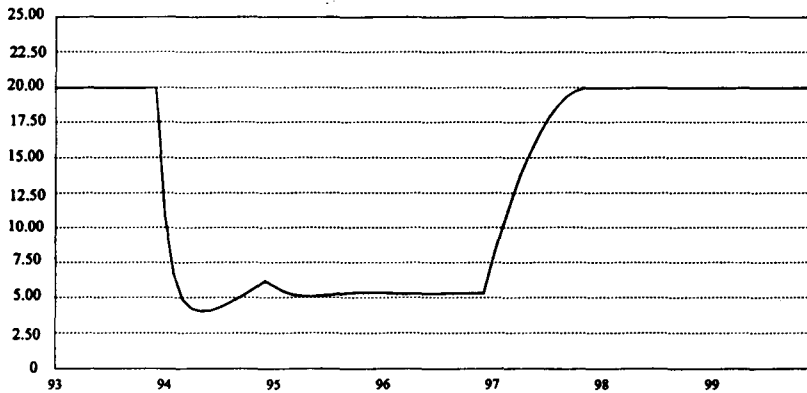
With this last equation it is easy to see how the dynamics of the model will unravel. The inflation path is the resultant of two opposite forces, one produced by the $(n - 1)$ restrained prices and the other by the single catching up price. In the first months of the stabilization program there will be relatively little previous price restraining to catch up. Hence inflation will decelerate as the price restraint will be pushing it down while catching up will be almost neutral. This means that in (12) the first term will be negative, due to $(1 - \theta_t) > 0$, while the second term will be close to zero. As time goes on, however, the inflation restraint backlog will increase, pushing up the catching up component in (12). At some point catching up will overpower price restraint and inflation will accelerate. As shown in appendix B, with $\theta_t = \theta$ in the long run the two components tend to equalize and inflation converges to a positive rate given by:

$$p^* = \frac{z}{1 + 0.5(1 - \theta)(n - 1)} \quad (13)$$

As in the previous section, the equilibrium rate of inflation is a function of both the price restraint coefficient and the previous unrestrained rate of inflation, that is, $p^* = p^*(z, \theta)$. Hence the elimination of price restraint will bring inflation back to its previous unrestrained rate. The only difference here with respect to the previous section is that this return will occur gradually.

Figure 2 illustrates the inflation path that results from the model with $n = 12$. The computer simulation assumed: (a) $z = 20$ percent until December 1993; (b) price restraint introduced in January 1994 with $\theta = 0.5$, and maintained until December 1996; (c) price restraint lifted in January 1997, with $\theta = 1$ afterwards. It can be seen that the rate of inflation falls continually in the first five months, reaching a minimum of 4 percent in May 1994. Then it moves up and, as predicted by (13), converges to $p^* = 5.34\%$. After January 1997, with the lifting of price restraint, inflation moves up again and gradually approaches its pre-restraint level of 20 percent, which is reached 11 months later.

Figure 2
Inflation path simulation
($n = 12$)



Note: $\theta = 0.5$ from Jan. 94 to Dec. 96; $\theta = 1$ after Jan. 97.

5. Concluding remarks

The paper has shown that if prices are periodically pushed by wages and other costs (such as rentals) into catching up with actual inflation, a stabilization program based on price restraint, such as the heterodox plans used in various Latin American countries, is bound to fail. Even though the program forces each individual price to increase in smaller proportion than previous month's inflation for most of the time, catching up behavior will not allow the rate of inflation to fall all the way to zero. For example, if prices are restrained to increase less than previous inflation for 11 months but are allowed to catch up with past accumulated inflation in the twelfth month, the rate of inflation will tend to converge to a positive rate. Since price restraint can only be justified by the hope of future stabilization, the program will most likely be deemed a failure and at some stage price restraint will be eliminated. This will make the rate of inflation return to the same unrestrained rate that existed before the program.

In order to achieve stabilization in the presence of catching up inertia, a price restraint policy will need the help of proper handling of fundamentals. A restrictive monetary policy that makes nominal demand grow less than the inflation floor produced by the price restraint may be able to change catching up behavior as a by-product of recession. Since this violates the hypothesis of passive money used in the paper, in this case its result no longer holds.

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Appendix A

We show here that p_t converges to p^* and that the convergence path is oscillatory with a minimum value being attained in the month after the introduction of price restraint.

Assume that until month $t = 0$ inflation is in inertial equilibrium at a rate z . Hence $\theta_0 = 1$ and $p_0 = z$. Price restraint is introduced at month $t = 1$ and sustained indefinitely so that $\theta_t = \theta < 1$ for all $t \geq 1$. From (5) we get $p_1 = 0.5 (1 + \theta) z$, therefore $dp_1 = p_1 - p_0 = 0.5 (1 - \theta) z$. From (7) we have:

$$dp_t = [-0.5(1 - \theta)]^t z \quad (A1)$$

showing that the path of p_t will be oscillatory. Also since $\text{abs}(dp_t) \leq \text{abs}(dp_{t-1})$, and, by definition:

$$p_t = p_0 + \sum_{k=1}^t dp_k \quad (A2)$$

it is clear that p_1 is the minimum value for p_t .

From (A1) and (A2) we derive the explicit solution for the inflation dynamics:

$$p_t = z(1 + \sum_{k=1}^t [-0.5(1-\theta)]^k) \quad (\text{A3})$$

which implies that p_t converges to p^* when t goes to infinite.

Appendix B

We show here that p_t converges to p^* in the general case. As before we assume that until month $t = 0$ inflation is in inertial equilibrium at rate z , with $\theta_t = 1$ for $t \leq 0$, and that price restraint comes into effect at month $t = 1$ with $\theta_t = \theta < 1$ for all $t \geq 1$.

From (10) and (11) we get:

$$p_t = a p_{t-1} + b \sum_{k=2}^m p_{t-k} \quad (\text{B1})$$

with $a = \alpha \theta + (1 - \alpha)$, $b = (1 - \alpha)(1 - \theta)$, $m = t$ for $t = 1, 2, \dots, n$ and $m = n$ for $t \geq n$. Observe that because $\theta_t = 1$ for $t \leq 0$, the end point of the summation in (B1) has to change as a function of t for the first n post-plan inflation rates. It is easy also to check that $a + b = \theta$.

By induction it can be shown that the first n post-plan inflation rates satisfy:

$$p_n + b \sum_{k=2}^{n-1} (n-k) p_{n-k} = z \quad (\text{B2})$$

From (B1), assuming $t \geq n$, we get:

$$dp_t = -b \sum_{k=1}^{n-1} (n-k) dp_{n-k} \quad (\text{B3})$$

By definition:

$$p^* = p_n + \sum_{x=n+1}^{\infty} dp_x \quad (\text{B4})$$

hence, using (B3):

$$p^* = p_n - b \sum_{k=1}^{n-1} (n-k) \left[\sum_{x=n+1}^{\infty} dp_{x-k} \right] \quad (\text{B5})$$

Again by definition:

$$\sum_{x=n+1}^{\infty} dp_x = p^* - p_{n-k} \quad (\text{B6})$$

Substitution of (B6) into (B5) gives:

$$p^* = p_n - b \sum_{k=1}^{n-1} (n-k) [p^* - p_{n-k}] \quad (\text{B7})$$

and solving for p^* :

$$p^* = \frac{1}{1 + 0.5(1-\theta)(n-1)} [p_n + b \sum_{k=2}^{n-1} (n-k) p_{n-k}] \quad (\text{B8})$$

Using (B2) we get:

$$p^* = \frac{z}{1 + 0.5(1-\theta)(n-1)} \quad (\text{B9})$$