INTERNATIONAL ECONOMIC REVIEW
Vol. 37, No. 4, November 1996

RECURRENT HIGH INFLATION AND STABILIZATION: A DYNAMIC GAME*

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We analyze the dynamics of inflation that arise from fiscal deficits caused by the noncooperative behavior of interest groups. The "state" variable is the degree of financial adaptation, a proxy for the share of wealth agents hold in alternatives to domestic currency. As financial adaptation becomes widespread, the costs of financing a given budget deficit rise. In this context, there can be fully rational cycles of increasing inflation and financial adaptation, followed by stabilization and remonetization. The model seems applicable to the experience of many Latin American countries.

1. INTRODUCTION

Many Latin American countries have suffered from high and variable inflation rates. This variability can be characterized by frequent attempts to stabilize which succeed in rapidly bringing inflation down but which are gradually abandoned. The resulting price patterns for Argentina and Brazil during the 1980s are shown in Figure 1. Most of these stabilization efforts are supported by the population at their inception, but support eventually dwindles away. In this paper, we provide a model in which this pattern develops and is repeated through time.

A possible hypothesis is that governments (societies) have a number of different goals. For instance, there may be demands on the government for redistribution, which can easily be met by printing money. At low inflation, those goals/demands become salient and policies are implemented that sooner or later lead to high inflation. At that stage the inflation problem becomes salient and stabilization is attempted.

In this paper, we take a political economy approach to the question of inflation, trying to explain the observed patterns within an individually optimizing setting. We

* Manuscript received March 1995; final version received October 1995.

[1] We are indebted to Alessandra Casella, George McCandless, Dani Rodrik, Andres Velasco, Yoram Weiss, Carlos Zarazaga, an anonymous referee, and seminar participants at Chicago, UCLA, I.DiTella, Georgetown, Maryland, USC, Irvine, NBER Economic Fluctuations Meeting, and the Latin American Meeting of the Econometric Society for valuable comments. This work was started while Sturzenegger and Tommasi were in the Department of Economics at UCLA, and we thank the support from the Academic Senate at UCLA. Tommasi also acknowledges financial support from the National Science Foundation through the Harvard/MIT RTG in Positive Political Economy.

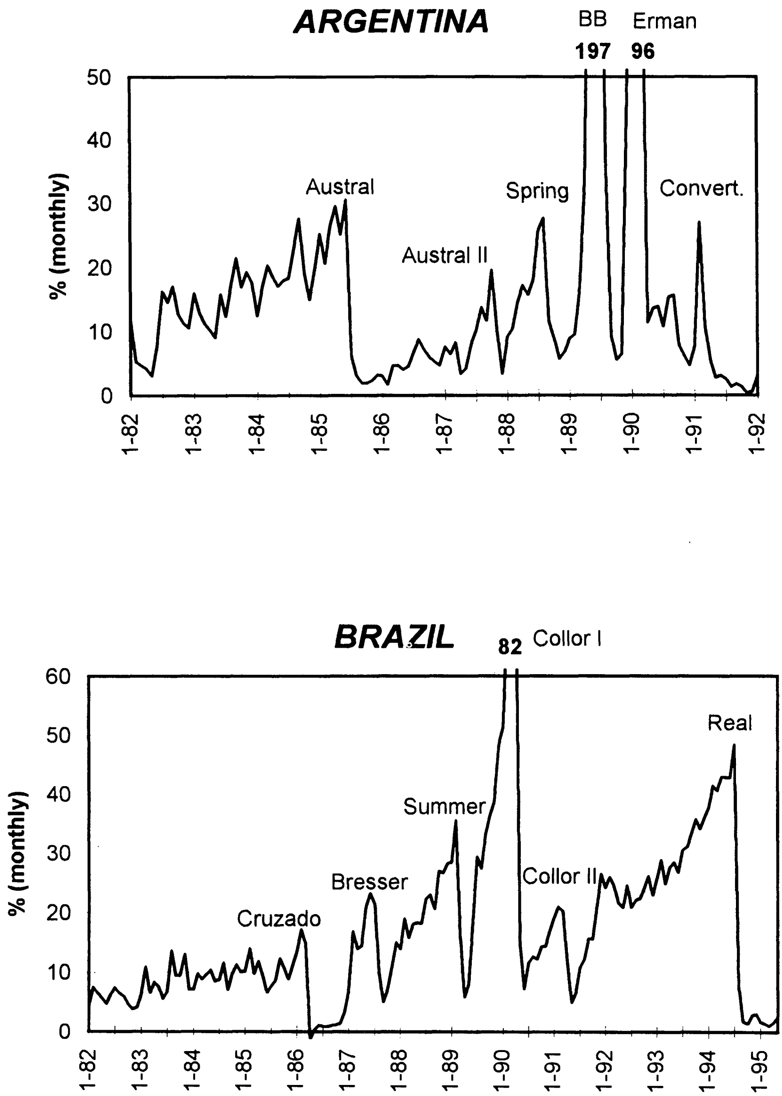

FIGURE 1

INFLATION CYCLES: ARGENTINA AND BRAZIL

model an economy consisting of (atomistic) agents who organize into pressure groups in order to request transfers from the government. These groups maximize the welfare of their constituents, affected positively by the transfers received, and negatively by inflation. The government accommodates the demand for subsidies from the pressure groups by printing money which ultimately results in inflation. We apply Bentley's (1908) hypothesis that government behavior is endogenous to underlying conflicts of interest, and hence do not endow it with independent goals. To borrow political science jargon, we take a "society-centered" approach.[2]

The stage-game between groups alternates between a prisoners' dilemma and a coordination game. The dynamics arise from the optimal financial response of individuals. Agents conduct transactions either with currency or with costly alternatives that hedge them against inflation. These alternatives include indexed checking accounts, non-fiat money, barter, and foreign currency. We refer to the use of these alternatives as *financial adaptation.*

One of the equilibria the model generates takes the following form. Suppose the economy starts with low inflation and low financial adaptation. Each interest group weighs the advantages it can derive from receiving a subsidy from the government with the costs it understands will follow: the inflation and financial-adaptation costs forced upon its members in the current and future periods. Under some conditions, demanding the subsidy is optimal for the group and this leads to inflation. In response to the resulting inflation and given the technological constraints, the process of financial adaptation deepens over time. Under the accelerating inflation and widespread financial adaptation, the groups perform anew their intertemporal calculations. Eventually, demanding a subsidy would result in such a high inflation that it is optimal to accept a stabilization program that cuts subsidies. Since dealing with alternative financial instruments is expensive, stabilization leads to a process of remonetization which brings the economy back to the initial state. At that point pressure groups demand transfers once again, and inflation resumes.

The equilibrium just described seems to explain the three stylized facts introduced above: high average inflation, variability of the inflation rate over time, and periodic stabilization attempts that are "successful" only for a short time. The results are due to the presence of elements of both conflict and commonality of interests. The equilibrium strategy is state-dependent, including cooperation at high inflation and conflict at low inflation. Our formalization is consistent with the view of Havrilesky (1990, p. 714): "Inflation increases over time until it reaches a critical level where ever-rising, collectively-shared costs and zero long-run benefits force interest groups to coalesce and to demand the implementation of monetary restraint."

The equilibrium conditions we derive are suggestive of the type of structural reform necessary to permanently support price stability. In order to settle "distributional conflicts" in a permanent manner, reforms must take place to either change the payoffs of the game or to somehow induce more cooperative play. Recent successful stabilization programs in Latin America and Israel have been accompanied by "institutional" reforms. Institutional reforms that increase the costs of inflation (de-indexation), that allow for unrestricted use of financial adaptation, or

[2] Patinkin (1993) provides a view consistent with our formulation. He argues against the analysis of inflation as the outcome of a game the (monolithic and benevolent) government plays with the public. The type of accommodating behavior we assume can be justified by a variety of political micro foundations, i.e., maximization of survival chances (Ames 1987), minimization of a loss function whenever pressure groups have enough power to hurt the government, or the action of political entrepreneurs in the context of a decentralized decision making process. Aizenman (1992), Tabellini (1986), and Zarazaga (1993) have taken a similar approach to explain inflation.

other changes that render more difficult a transitory redistribution of income, could turn low inflation into a permanent equilibrium.

The model in this paper relates to some recent work on political economy. In particular, Fernandez and Rodrik (1991) show the possibility of *policy inaction* in the context of trade liberalization. They show how a positive sum game may not take place if interest groups do not, ex ante, know the distribution of gains and losses. Alesina and Drazen (1991) show the possibility of *policy delay* in the context of inflation stabilizations when parties, uncertain about the other's tolerance for pain, debate over the distribution of costs of the program. Guidotti and Vegh (1992) show the possibility of *policy reversals*: a stabilization program that has brought down the inflation rate may collapse if a balance of payments crisis occurs before the war of attrition over fiscal adjustment is over. All these papers assume some uncertainty or asymmetric information over the pay-offs of the other party. Once the relevant information is revealed, struggles are resolved immediately and permanently, eliminating the possibility of repeated inflation and stabilization cycles. In our model we integrate in a single framework the possibility of inaction, delays, and policy reversals while providing an explanation for the underlying inflation problem, without resorting to uncertainty or asymmetric information.

The rest of the paper is organized as follows. Section 2 introduces the economy's technology, preferences, and rules of engagement. Section 3 describes the conditions necessary for the existence of oscillating and of stable inflation equilibria. Section 4 analyzes some extensions. Section 5 discusses possible policy implications and interpretations of the model.

2. DESCRIPTION OF THE ECONOMY

The economy is inhabited by a continuum of infinitely-lived agents, who receive an endowment e every period. These agents are identical in every respect but for a characteristic that we index by $i \in [0,1]$ that differentiates them from a collective-action point of view. The agents are organized into two politically active groups, $A=[0,1/2]$ and $B=[1/2,1]$.[3] These groups demand transfers s_t^A and s_t^B from the government, which are financed via inflation. Individuals, knowing s_t^A and s_t^B, decide their level of financial adaptation based on their expectations of inflation.

Let $f_t(i)$ be the amount of the endowment that individual i transacts outside the domestic currency circuit. The payoff function is

$$(1) \qquad \sum_{t=0}^{\infty} \delta^t \left[e + s_t(i) - \pi_t(e - f_t(i)) - \phi(\pi_t) - T(f_t(i)) \right],$$

where e represents the endowment, $s_t(i)$ is the subsidy the individual receives (which equals either s_t^A or s_t^B, depending on which group he belongs to), $\pi(e-f)$ is

[3] The groups may represent capital–labor, agriculture–industry, Federal–State governments, workers–retirees, exporters–wage earners, state enterprises–private firms, different ministries within the government, or other dimensions of distributional conflict.

the inflation tax, $\phi(\ )$ are the costs of inflation, and $T(\ )$ is the cost of operating with financial alternatives.

Costs of Inflation. $\phi(\pi)$ captures the costs of inflation above and beyond those involved in substituting away from money (discussed below). It includes menu costs, distortions caused by relative price variability, misallocations of human capital, and credit market effects.[4] To observe stabilizations we require that groups eventually stop requesting transfers. They will find it optimal to do so when the costs of inflation grow larger than the benefits of government transfers. For this to happen, we require the cost of inflation function not to be too concave.[5] To simplify the presentation, we assume here the linear case $\phi(\pi)=\alpha\pi$.

Financial Technology. Following the empirical evidence on the dynamics of money demand reviewed in Appendix 2 of MST (1993; see footnote 5 below) we impose three conditions on the financial (transactions) technology which deliver a money demand function which responds to changes in inflation as in the data:

(1) Agents need to hold enough domestic currency *or* alternative means of transactions in order to purchase goods. In each period, agent i trades $(e-f_t(i))$ in domestic currency and $f_t(i)$ in "foreign" currency.[6] These latter transactions are exempt from the inflation tax.

(2) The process of changing f_t over time is restricted by the presence of *adjustment* costs. To keep the analysis simple and tractable we use the stark version of the convex adjustment cost model depicted in Figure 2: f can be increased at no cost by steps of size J, and can be reduced for free. Mathematically,

$$f_{t+1}\in\{0,J,2J,\dots,f_t,\min[f_t+J,e]\}. \tag{2}$$

This stark formulation enables us to generate (under some conditions) inflation cycles, as shown in Proposition 1. In Section 4 we discuss two generalizations of this formulation which deliver inflation escalation (Proposition 2) and permanent stabilizations (Proposition 3). These generalizations may be more appropriate descriptions of the dynamics of money demand and are easily accommodated within our framework.

(3) *Operating* in inflation-shielded assets is also costly. The cost arises from the inconvenience of exchanging currencies, gathering information on exchange rates, legal constraints to the use of foreign currency, and so on. The existence of such costs is necessary to obtain a demand for domestic currency. It is empirically clear that once inflation is brought down, the demand for domestic currency increases,

[4] On this see Ball and Romer (1992), Heymann and Leijonhufvud (1995), Fischer (1986), Mankiw (1994, Chapter 6), Patinkin (1993), and Tommasi (1994 and 1995).

[5] In the working paper version, Mondino, Sturzenegger, and Tommasi (1993), hereafter MST(1993), we show that our main results hold as long as $\phi(y/x)-\phi(y/2x)>y/2$ as $x\to 0$. This condition will be satisfied for all convex, linear, and some concave functions.

[6] In what follows, we drop the index i when no confusion arises. In equilibrium, it will be the case that $f_t(i)=f_t\ \forall i$.

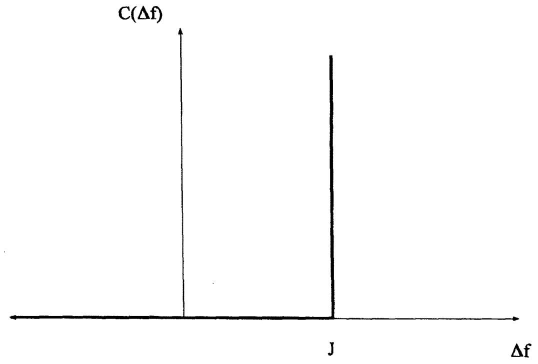

FIGURE 2

COST OF FINANCIAL ADAPTATION

indicating that operation in alternative technologies is relatively inefficient. Even more remarkable is the fact that during hyperinflations there is always a residual demand for domestic cash.[7] To keep the structure of the model as simple as possible we assume the costs of operating in financial alternatives to be proportional to the stock of "financial adaptation." Yet, to insure that domestic money remains valued at very high inflation rates, we add a large cost for completely substituting away from domestic money. Formally,

$$T(f_t) = \begin{cases} \tau f_t & \text{for } f_t < e \\ \tau f_t + K & \text{for } f_t = e, \end{cases} \tag{3}$$

where we assume the operation costs to be higher at the point where the level of financial adaptation equals the endowment. To further simplify the exposition, we assume $K > S$ in what follows.

Individual choice. Individuals must choose sequences $\{f_t\}_{t=0}^{\infty}$ to maximize (1) for given sequences $\{\pi_t\}_{t=0}^{\infty}$, subject to (2), the law of motion for f_t.

Groups. As mentioned in the introduction, the political structure is such that individuals can only access government subsidies through group pressure. Group decisions can be reached by any voting mechanism since we always have group unanimity. Each group's action set is $\{S, 0\}$ in every period; that is, it either requests (and gets) a transfer of size S for each of its members, or refrains from doing so. (As explained later, the main results also obtain with a convex action set $[0, S]$.) s_t^A and s_t^B denote the actions of groups A and B at time t. They choose strategies that

[7] See Cagan (1956) for the classical hyperinflations and Vegh (1992) for the more recent high-inflation episodes. Vegh shows that there is strong re-monetization after each stabilization, and that even at extremely high inflation rates there is a floor below which domestic money demand will not fall. In Appendix 2 of MST(1993) we discuss this evidence in more detail.

maximize discounted utility (1) of their members. Note that in so doing, they internalize the inflation costs paid by their members but not the costs imposed on the other group.

Government. As said, the government's role is the provision of subsidies financed by the inflation tax. We restrict the taxation choices to highlight the importance of inflation taxes as a short-term instrument, assuming that regular taxation is not very flexible in the short run. The nature of the subsidies is left unspecified. Cash transfers, cheap credit, monetary accommodation of price and wage increases, and devaluations can all be thought of as group subsidies that have inflationary effects.

The equilibrium in the money market once we substitute the government budget constraint gives,

$$\frac{1}{2}\left[s_t^A + s_t^B\right] = \pi_t(e - F_t), \tag{4}$$

which determines the inflation rate. Notice that here total subsidies equal revenue from the inflation tax. Additionally, the unitary measure of agents implies that the aggregate endowment equals individual endowment, e, which is constant over time. $F_t = \int_0^1 f_t(i)\,di$ represents aggregate financial adaptation.

3. EQUILIBRIUM

An equilibrium to our economy is a set of sequences $\{\pi_t, s_t^A, s_t^B, f_t, F_t\}_{t=0}^{\infty}$ such that: (i) individuals choose $\{f_t\}_{t=0}^{\infty}$ to maximize (1) subject to (2) given $\{\pi_t\}_{t=0}^{\infty}$, (ii) $f_t = F_t$ for all t, and (iii) the sequences $\{s_t^A, s_t^B\}_{t=0}^{\infty}$ constitute an equilibrium to the game between sectors, given (4), (i), and (ii).

The game between sectors is a dynamic one, in that stage payoffs are dependent upon past actions through financial adaptation and hence inflation. Introducing general strategy profiles in such games is complicated. For that reason, we restrict the equilibrium concept to Markov Perfection (Fudenberg and Tirole 1991, Chapter 13). A Markov Perfect Equilibrium (MPE) is a profile of Markov strategies that yields a Nash equilibrium in every proper subgame. "Markov" or "state-space" are strategies where the past influences current play only through its effect on a state vector which summarizes the direct effect of past information on the current environment. In our game, the proper state variable is the degree of aggregate financial adaptation F. However, we refer to the inflation rate π as our state variable to aid the intuition of the results in terms of a publicly known and easily observable variable.

In the proposition below we characterize all Symmetric Markov Perfect Equilibria (SMPE), in which both groups follow the same strategy.[8] Using (4) and the fact that

[8] We analyze the case in which $e \in (2J, 3J)$, so that the financial technology reduces to $f \in \{0, J, 2J, e\}$. As we will see, this restricts the cycles (when they exist) to be two-period phased. Section 4 addresses extensions. In Section 3.5 of MST(1993) we also discuss nonsymmetric equilibria.

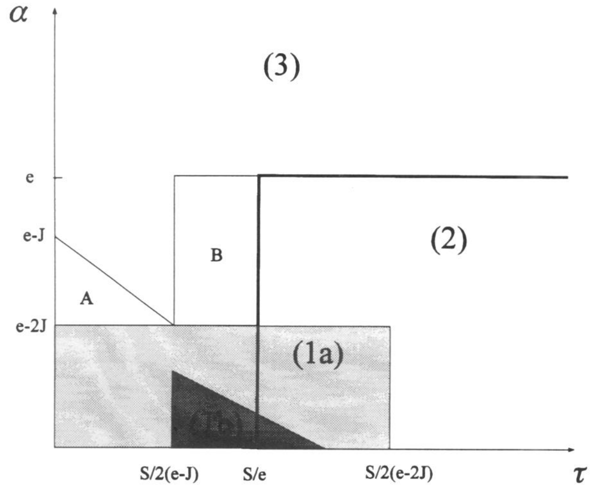

FIGURE 3

EQUILIBRIA

there is a unit mass of agents, we see that in a SMPE inflation can take values 0, $\pi_1 = S/e$, $\pi_2 = S/(e-J)$, and $\pi_3 = S/(e-2J)$.

PROPOSITION 1. (1) *Inflation Cycles.* (1a) *Cycles of High Inflation. An equilibrium in which inflation oscillates from* 0 *to* π_3 *exists for* $\tau < [S/2(e-2J)]$ *and* $\alpha < (e-2J)$. (1b) *Cycles of Low Inflation. An equilibrium in which inflation oscillates from* 0 *to* π_2 *exists for* $S/2(e-J) < \tau < S$ *and* $S/2 > \tau J + \alpha S[1/(e-J) - 1/2e]$.

(2) *Steady Low Inflation. An equilibrium in which* $\pi_t = \pi_1$ $\forall t$, *exists for* $\tau > S/e$ *and* $\alpha < e$.

(3) *No Inflation. For* $\alpha > e$, *or* $\tau < S/2(e-J)$ *and* $\alpha > (e-J)[1 - 2J\tau/S]$, *equilibrium implies* $\pi_t = 0$ $\forall t$.

COROLLARY. *High inflation implies cyclical inflation* (π_2 $\forall t$ *and* π_3 $\forall t$ *are not equilibria*).

The Proposition is proven in the Appendix. Figure 3 illustrates the possible combinations of τ and α that generate the different types of equilibrium discussed in the Proposition.[9]

As the proposition indicates, inflation cycles result when the costs of operating in a financially adapted economy (τ) are relatively low and when the marginal costs of inflation (α) are also low. The equilibrium (Markov) strategies that generate inflation cycles consist of demanding subsidies when past inflation (and hence,

[9] The sets A and B of parameter values for which none of the equilibria described in the Proposition exists, become empty with a more convex cost of inflation function ϕ.

financial adaptation) is low, and not demanding subsidies when last-period inflation is high. In general, the inflation-cycle strategies take the form

$$(5) \qquad s_t^j = \begin{cases} 0 & \text{for } \pi > \overline{\pi} \\ S & \text{for } \pi \leq \overline{\pi} \end{cases} \quad \text{for } j = A, B.$$

where $\overline{\pi} = 0$ in the case of two-period cycles, as in Proposition 1, and $\overline{\pi} > 0$ in the more general case explored in Section 4, where inflation will escalate before a stabilization takes place.[10]

The intuition behind the inflation-cycle equilibria is simple. Assume that the economy was operating under low inflation. Since the marginal costs of inflation are low ($\alpha < e - 2J$) and since the level of financial adaptation is relatively low (as no incentives existed to keep it high) the groups will find it optimal to request subsidies. Since individuals understand that a subsidy request has to be financed via the inflation tax, they engage in some financial adaptation (in fact, they try to dollarize as much as they can). The resulting macroeconomic equilibrium will then show an abandonment of fiscal discipline and an acceleration of the inflation rate together with a deepening of the financial adaptation of the economy. Next period, inflation will have already been high and financial adaptation widespread. Hence, the choice is for groups to ask for subsidies again (forcing further financial adaptation and hence a further increase in the inflation rate) or to refrain from demanding a subsidy. Suppose that adaptation was already very high (case (1a)) last period. If the groups demand subsidies, given the already high level of dollarization and the new possibility for further adaptation, the inflation rate will explode. Fearing hyperinflation, and the costs that it entails, one group may consider a second option and accept a stabilization package. Because of symmetry, both groups decide to "cooperate" and accept a stabilization program where no subsidies are granted. Since both groups will accept the stabilization program, inflation will now go to zero. Next period, given that the costs of inflation are low due to remonetization, groups will demand subsidies again, and the cycle restarts.

The model also generates equilibria with constant low inflation. They obtain when the costs of operating in a financially adapted economy, τ, are large enough that it is preferable for individual agents to suffer the inflation tax rather than to operate with alternatives. A case of no inflation results whenever the costs of inflation are large enough; groups fear any resulting inflation and hence refrain from demanding subsidies.

It is easy to verify that welfare in the no-inflation region is greater than welfare with constant low inflation, which in turn is greater than welfare with high (cyclical)

[10] The restriction that groups can only demand subsidies $s_t^j = \{0, S\}$ can be easily convexified to $s_t^j = [0, S]$. In the working paper version, Section 3.1, we show that there will exist an equilibrium with a sequence of subsidy demands $\{S, \Sigma, S, \Sigma, \dots\}$ with $\Sigma < S$. Σ is the point where incremental subsidy demands trigger jumps in the inflation rate that turn this demand suboptimal. Also, the result of inflation cycles carries through to more general financial adaptation technologies. In MST(1993), Section 3.2, we allow individuals to choose whether to adapt (from $f = 0$) upwards by J and pay a cost of βJ or to adapt up by $2J$ at a cost $2\beta J$. It is easy, though tedious, to find conditions on β, τ, and α such that inflation cycles exist.

inflation. The main reason for this result is that (in any equilibria) the transfers received cancel out with the inflation tax, and only the deadweight losses of inflation and of financial adaptation remain.

4. EXTENSIONS

In the previous section we discussed the conditions under which a cyclical inflation pattern was feasible. In that specification high and low inflation alternate over time. However, a quick inspection of the inflation rates observed in Figure 1 indicates that this path does not truly characterize the inflation dynamics observed in these two economies. Particularly, inflation appears to be increasing over several periods before a stabilization takes place. Additionally, though not explicit in Figure 1, many countries (Bolivia 1985, Israel 1985, Mexico 1987, Argentina 1991) do eventually implement successful stabilization. The question arises as to whether our model can accommodate this fact, or whether it forces countries to experience inflation forever. The purpose of this section is to develop two extensions which show that our previous specification can, with appropriate adjustments to the financial adaptation technology, accommodate these two additional properties of extreme inflation experiences. The results are contained in the following two propositions. As before, the proofs are in the Appendix.

PROPOSITION 2. *Inflation Escalation. Consider the economy described in Section* 2, *but with* $3J \le e \le 4J$. *An equilibrium in which inflation follows* $\{0, \pi, \Pi\}$, *with* $0 < \pi < \Pi$ *exists for* $S/(e-2J) - K/(e-J) < \tau < S/2(e-2J)$ *and* $\alpha < (e-3J)$.

In our previous specification, the rigidity in money demand was low because the feasible cost-free adjustment in money demand was very large relative to the volume of transactions. In Section 2, two periods of inflation were sufficient to induce complete substitution away from domestic currency. The threat of hyperinflation provided, then, the incentives to avoid requesting subsidies for two consecutive periods. In Proposition 2, the size (J) of the cost-free adjustment is reduced in comparison to the size (e) of the endowment. Thus, the risk of hyperinflation does not develop immediately, but only after several periods of rising inflation. The restrictions on τ are such that the expected disinflation (after stabilization) provides a sufficient incentive for remonetization.

PROPOSITION 3. *Delayed (Permanent) Stabilizations. Consider the economy described in Section* 2, *but with possible values for financial adaptation being* $f_t \in \{0, J, 2J, \dots, \max[f_i; i < t]\}$ *and* $f_t \le e$. *Let* $T^* = \min\{\text{int}[x \mid \alpha - xJ > 0]\}$. *An equilibrium in which inflation is increasing until time* T^* *and* 0 *afterwards, exists for* $\alpha < (e-J)$ *and* $\tau < S/(e-J)$.

In this specification we assume full memory in the financial adaptation technology (i.e., it is costless to return to any level of financial adaptation previously attained). Once the economy learns how to deal with alternative means of payments it retains this capacity even when inflation is low and the economy has remonetized. Even though there is remonetization after stabilization, agents can automatically switch away from domestic currency up to the maximum substitution previously exercised. Hence, once stabilization has been achieved, there is never again an incentive to request subsidies, as this will automatically lead to a hyperinflation.

This specification induces delayed stabilization as in Alesina and Drazen (1991) where a spell of inflation is required to generate the consensus for a permanent stabilization. In their model, whoever first agrees to stabilize pays a higher fraction of the stabilization cost. Hence, groups engage in a war of attrition in an attempt to shift the burden of stabilization on their opponent. The Alesina-Drazen setup depends heavily on the assumption of imperfect information regarding the way in which inflation affects your opponent. We find that assumption implausible. Our specification provides the same dynamics in the absence of asymmetric information. In our model the consensus arises because money-demand dynamics lead to explosive rates of inflation which increases the cost of inflation to the point where stabilization becomes a dominant choice. Also, in Alesina-Drazen, the source of inflation is exogenous, while here it is derived as part of the equilibrium.

We believe that a case in-between the assumption in (2) (no memory) and that in Proposition 3 (full memory), would be the more realistic. Although we do not model that case explicitly (it gets much harder due to nonstationarity) we conjecture it has the potential to replicate closely the time series of inflation observed in Figure 1, with cycles being bigger and faster each round. Eventually, when agents' expertise in dealing with alternative transaction technologies becomes large enough, permanent stabilizations take place, as suggested by Proposition 3.

5. CONCLUDING REMARKS

The paper was motivated by the high and volatile inflation experiences of a number of developing countries, where inflation accelerates until stabilization programs are implemented. At stabilization points, the inflation rate is dramatically reduced, but it does not remain low for a long time. After a brief success, the programs are abandoned and inflation resumes. We explained those cycles in a simple political economy framework. We also showed that high inflation necessarily implies variable inflation, providing an alternative explanation for the correlation between inflation levels and variability (see Ball 1992 and references there).

The recurrent inflation-stabilization equilibrium entails high welfare losses for society, losses associated with the costs of inflation, its variability and the costs of operating in a financial system that is efficient as an inflation hedge but less so as a resource allocator. Societies like the ones described in this paper will long for a stabilization program. However, when a program of fiscal restraint is assembled and offered to society, it will only be successful for a short time. While the lower inflation rate is welfare-enhancing, pressure groups will find it in their best interest to request transfers again, leading to a resumption of inflation.

Every time a stabilization plan falls apart—after some initial success—analysts argue that the necessary adjustments were not made. What those long-run adjustments are, is also a prediction of this model. In order to settle "distributional conflicts" in a permanent manner, structural reforms must either change the payoffs of the game or somehow induce more cooperative play: we believe that the key to a "durable" stabilization is a change in the rules of the game. These adjustments may sometimes include increasing the costs of inflation (i.e. de-indexation) or the costs of operation in currency substitutes. The last case is of particular interest since a large number of countries that suffer from inflation resort to financial repression (Giovannini and de Melo 1993, Roubini and Sala-i-Martin 1992). While repression is usually associated with a desire for an increased inflation tax base, we could interpret it as a move towards a more stable inflation rate. This relates to the observed difficulty of many economies that control high inflation to move to international levels of inflation. Many times, high inflation is followed by moderate inflation (Dornbusch and Fischer 1993). That feature is explained in our model by an increase in τ but not in α.

There are a number of possible extensions. If the pressure groups were of different size, the same pattern of equilibria would follow, but with high cyclical inflation obtaining for a smaller set of parameter values. In the limit, when only one group exists, the political economy game disappears and stable zero inflation is the only equilibrium. This exercise stresses the importance of "distributional conflict." Once the cost of transfers is perfectly internalized, inflation is no longer an equilibrium. On the other hand, if we increase the number of players, inflation will have to reach even higher values in order to induce the incentive to stabilize. (Similar results appear in Aizenman 1992 and Zarazaga 1993.)

While the game was worded in terms of demands for transfers, its logic could apply to the award of tax exemptions, trade policy, or any other policy intervention with distributional consequences and deadweight losses. To what extent recurrent policy cycles will appear in these situations is a question open to further research.

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APPENDIX

Proof of Proposition 1. Throughout the proof, $\{x, y\}$ will denote a sequence $\{x, y, x, y, \dots\}$. In particular, $\{x, x\}$ denotes the sequence $\{x, x, x, x, \dots\}$.

Let $W^*(\pi_{t-1})$ be the (equilibrium) value function for an agent in an economy that experienced inflation rate π_{t-1} last period. Without loss of generality, we work with the function $V^*(\pi_{t-1}) = W^*(\pi_{t-1}) - e/(1-\delta)$.

(1a) To observe the high inflation cycle $\{0, \pi_3\}$, it is necessary that subsidy demands $\{s_t\}$ be $\{0, S\}$ and that aggregate financial adaptation $\{F_t\}$ be $\{J, 2J\}$.

First, we verify the conditions for the path of F to constitute a monetary equilibrium (i.e., $f_t = F_t$ for all t). Given an oscillatory path of inflation, it is clear that the optimal path for f is also oscillatory. The possible choices are $\{0, J\}$ and $\{J, 2J\}$.[11] The value of these paths (we use time averaging) is $v(\{0, J\}) = -\tau J + JS/(e-2J)$ and $v(\{J, 2J\}) = -\tau J - \tau 2J + 2JS/(e-2J)$. In order for $\{J, 2J\}$ to be the individually dominant strategy, we need $\tau < S/2(e-2J)$, as stated.

[11] We do not need to consider $\{2J, e\}$, from the assumption of large K.

Second, we verify the (MP) equilibrium to the game between groups. To observe cycles, the MP strategy has to be of the form of equation (5). The values of payoffs for the equilibrium path are

$$V^*(0) = -\tau 2J - \alpha\left(\frac{S}{e-2J}\right) + \delta V^*(\pi)$$

and

$$V^*(\pi) = -\tau J + \delta V^*(0)$$

(notice that subsidies cancel with the inflation tax). Consider the case when $\pi_{t-1} = 0$. Strategy (5) requires $s = S$, giving payoff $V^*(0)$. Let $V^0(0)$ be the value of a group deviating to $s = 0$. Given $\tau < [S/2(e-2J)]$, it is easy to verify that monetary equilibrium along the deviation implies $F = f = 2J$. Hence,

$$V^0(0) = -\frac{S}{2} - \tau 2J - \alpha\left(\frac{S/2}{e-2J}\right) + \delta V^*(\pi).$$

For the deviation to be unprofitable we need $S/2 > [\alpha S/(e-2J)] - [\alpha S/2(e-2J)]$, or $\alpha < e - 2J$.

The alternative deviation is to demand subsidies during a "stabilization" period ($\pi_{t-1} = \pi_3$). Notice that, because the cost of transacting in an alternative currency is low and last period financial adaptation was at $2J$, individuals will move to $f = F = e$. This would lead to hyperinflation, making the deviation unprofitable for the group.

(1b) The proof for low-inflation cycles is similar to (1a) and it is omitted. We refer the reader to Theorem 3 of MST(1993), where we find conditions for the general $\phi(\pi)$ case. Those conditions simplify to $\tau < S/2(e-J)$ and $S/2 > \tau J + \alpha S[1/(e-J) - 1/2e]$ when $\phi(\pi) = \alpha\pi$.

(2) $\pi_t = \pi_1$ $\forall t$ implies $\{s_t\} = \{S, S\}$ and $\{F_t\} = \{0, 0\}$. $f = F = 0$ $\forall t$ requires $\tau > S/e$. The value of the equilibrium strategy is $V^*(\pi) = -[\alpha S/e] + \delta V^*(\pi)$. The value of deviating to $s = 0$ is $V^0(\pi) = -[S/2] - [\alpha s/2e] + \delta V^*(\pi)$. (Notice that $f = F = 0$ also along the deviation, since π is even smaller.) The deviation is not profitable as long as $V^*(\pi) - V^0(\pi) > 0$, or $e > \alpha$.

(3) $\pi_t = 0$ for all t, requires $\{s_t\} = \{0, 0\}$ and $\{F_t\} = \{0, 0\}$. It is obvious that $f_t = F_t = 0$ for all t is the optimal choice of f. In order to evaluate the profitability of deviating to $s = S$, we have to specify off-equilibrium monetary behavior. For $\tau < S/2e$, the only consistent monetary behavior is $f = F = J$. For $\tau > S/2(e-J)$, the only consistent monetary behavior is $f = F = 0$. For intermediate values, both monetary equilibria are self-fulfilling. In that case, we consider $f = F = J$, since it induces no-inflation equilibrium for the larger set of parameter values. We proceed now to verify the conditions for profitable deviations for the two cases of τ smaller and greater than $S/2(e-J)$.

(a) When $\tau < S/2(e-J)$, an aggregate level of financial adaptation $F = J$ induces $f = F = J$, since $\tau < \pi = S/2(e-J)$. The value function of a deviation given that inflation was zero in last period and will be zero again next period is,

$$V^S(0) = S - \pi(e-J) - \tau J - \alpha\pi + \delta V^*(0).$$

From (4) we have that $\pi = S/2(e-J)$ so that the above equation reduces to,

$$V^S(0) = \frac{S}{2} - \tau J - \alpha\left(\frac{S/2}{e-J}\right).$$

Given that $V^*(0) = 0$, for a deviation to be profitable we require $V^S(0) > 0$ which results in

$$\frac{S}{2} > \tau J + \alpha\left(\frac{S/2}{e-J}\right),$$

so that zero-inflation will be an equilibrium (when τ is low) iff

$$\alpha > (e-J)[1 - 2J\tau/S].$$

(b) When $\tau > S/2(e-J)$, then $f = F = 0$. In that case, the gains from deviating from the postulated equilibrium are $V^S(0) = [S/2] - [\alpha S/2e]$. A deviation is unprofitable (when τ is high) as long as $\alpha > e$.

Proof of Proposition 2. We will show that there exists an oscillating equilibrium of phase 3, with demand for subsidies $\{S, S, 0\}$ and aggregate financial adaptation $\{2J, 3J, J\}$. The resulting inflation rates are $\{\pi, \Pi, 0\}$, where $\pi = S/(e-2J)$ and $\Pi = S/(e-3J)$.

The value of deviations from the monetary equilibrium is:

i) $v(J, 2J, 0) - v(2J, 3J, J) = 3J\tau - JS/(e-2J) - JS/(e-3J) < 0$

ii) $v(3J, e, 2J) - v(2J, 3J, J) = -2J\tau - (e-3J)\tau - K + JS/(e-2J) + S < 0.$

The first condition can be simplified to

$$\text{(A1)} \qquad \tau < \frac{1}{3}\left[\frac{S}{(e-2J)} + \frac{S}{(e-3J)}\right]$$

and the second to

$$\text{(A2)} \qquad \frac{S}{e-2J} - \frac{K}{e-J} < \tau.$$

If both conditions are satisfied, all other deviations are not profitable.

The value functions for group behavior along the equilibrium path are:

$$V^*(0) = -\alpha\frac{S}{e-2J} - \tau 2J + \delta V^*(\pi)$$

$$V^*(\pi) = -\alpha\frac{S}{e-3J} - \tau 3J + \delta V^*(\Pi)$$

$$V^*(\Pi) = -\tau J + \delta V^*(0).$$

When we analyze deviations from $V^*(0)$ we will require $\tau < S/2(e-2J)$ (stricter than A1) in order for the monetary equilibrium to remain unchanged. When this is satisfied, the value of the deviation is,

$$V^0(0) = -(S/2) - \alpha\frac{S}{2(e-2J)} - \tau 2J + \delta V^*(\pi)$$

(since the monetary equilibrium remains unaltered, the state of the system next period will not change due to the deviation). The profitability condition is,

$$V^*(0) - V^0(0) = (S/2) - \alpha\frac{S}{2(e-2J)} > 0,$$

or $\alpha < (e-2J)$.

A second local deviation is $s = 0$ when last period inflation was π (the intermediate level). The monetary equilibrium will remain the same if $\tau < [S/2(e-3J)]$, which is true if $\tau < [S/2(e-2J)]$. The value function is then,

$$V^0(\pi) = -(S/2) - \alpha\frac{S/2}{e-3J} - \tau 3J + \delta V^*(\Pi),$$

which gives a profitability condition

$$V^*(\pi) - V^0(\pi) = (S/2) - \alpha\frac{S/2}{e-3J} > 0,$$

which implies $\alpha < (e-3J)$. This is stronger than $\alpha < (e-2J)$, thus this is the restriction imposed on α in the proposition.

Finally, we have to verify whether subsidies are demanded after periods of high inflation. But in this case hyperinflation results and this deviation is not profitable.

Proof of Proposition 3. This equilibrium requires a path of subsidies $\{S, S, \ldots, S, 0, 0, \ldots\}$. Value functions are now dated as the game becomes nonstationary. T^* is the period in which $V_t^S = -\infty$, so that the equilibrium strategy in that period is to stabilize. For previous periods, the value along the equilibrium path is:

$$V_t^*(\pi_t) = -\tau tJ - \alpha\left[\frac{S}{(e-tJ)}\right] + \delta V_{t+1}^*(\pi_{t+1}).$$

The path of subsidies induces F to follow $\{J, 2J, \ldots, TJ, 0, 0, 0\}$ as long as $\tau < S/(e-J)$, which insures that financial adaptation takes place in the first period (and thus in all subsequent ones).

The incentive to deviate from the equilibrium path is given by

$$V_t^0 - V_t^* = \alpha\left[\frac{S}{(e-tJ)}\right] - \alpha\left[\frac{S/2}{(e-tJ)}\right] - S/2,$$

which reduces to $\alpha > (e - tJ)$, monotonic in t. As long as $\alpha > (e - J)$, subsidies are demanded in the first period and keep being demanded until $t \geq (e - \alpha)/J$.

Finally, we should verify that deviations after the stabilization date are not profitable. But this follows from the fact that the set of feasible f's is now the same as at the stabilization date.

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