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Political stabilization cycles in high inflation economies

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Abstract: High inflation economies do not always exhibit smooth inflationary processes, sometimes stop-go cycles of inflation are observed. This paper relates these stop-go episodes to the political business cycle: governments can defer devaluations until after elections to increase their chances of reelection. This is modelled as a two-period game of incomplete information where voters try to pick the most competent candidate, and inflation in the short run can be lowered through debt accumulation.

* The views expressed here are strictly personal.

Chapter Three. Political stabilization cycles in high-inflation economies[1]

1. Introduction

Stop-go cycles of inflation and recurrent balance of payment crises have been widely observed in high inflation economies. We approach this phenomenon as a manifestation of the political business cycle.

There is a vast body of literature on the issue of political business cycles. The traditional view, first suggested by Nordhaus (1975), is that governments try to increase employment before elections in order to increase their chances of being reelected. Models that address this issue usually assume a short-run trade-off between inflation and unemployment. The government reduces unemployment (which is immediately observed) at the cost of increased inflation (which is only observed after a lag, once elections have taken place, if prices are sticky).

In some instances the critical election issue is inflation rather than employment. This creates an incentive for the government to stabilize prices before the elections, even at the cost of unemployment. Nevertheless, in the

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specific case of stabilizations based on the use of the exchange rate as a nominal anchor, the key trade-off seems to be rather between present and future inflation. Governments have often exploited this in an opportunistic way, in an effort to win the elections.

In Section Two we will briefly review several episodes where we believe political considerations played an important role in determining both the timing and type of price stabilizations. These episodes will additionally illustrate how, in the absence of serious fiscal adjustment, these exchange rate-based stabilizations lead to a trade-off between current and future inflation, which is key to our model.

In Section Three, we develop a stylized "background" model as an approximation to high inflation economies. For simplicity we assume that prices are driven by changes in money, while output is exogenous. In this, we follow the Lucas (1973) characterization of low inflation economies as being more Keynesian and high inflation economies as being more Classical.

The goal of this Section is to build a model that captures the trade-off between current and future inflation. The key to this trade-off is that if the government covers the budget deficit today by borrowing abroad, the inflation tax burden is shifted from the first period to the second period, when the debt has to be fully repaid. Thus, an attempt to stabilize prices in the first period will build up repressed inflation, which resumes in the second period, thus generating the stop-go cycles described in Section Two.

In Section Four we show how governments interested in staying in office will exploit the trade-off between current and future inflation for electoral purposes. The political stabilization cycle is described as a two-period signalling game between the government and the voters. As in the work of Rogoff (1990), Rogoff and Sibert (1987) and Persson and Tabellini (1991), we assume that voters are forward-looking rational agents. The government can be competent or incompetent, where competency is associated with its efficiency in producing the required level of public good (and thus, to the size of the budget deficit). Information asymmetries are introduced by assuming that voters observe inflation immediately, but can only observe foreign debt after a lag. This setting can result in governments leaning more heavily on debt financing, since it results in lower inflation today, which is used as a signal of competency by the incumbent, increasing its chances of reelection.

Finally , Section Five presents the conclusions.

2. Episodes of politically determined price stabilizations in high inflation countries

In high inflation economies the key electoral variable often is the rate of inflation, rather than the rate of unemployment. Governments thus have incentives to keep inflation under control in the months that precede an election.

Why would inflation be the most important variable prior to an election? One reason may be that in high inflation countries, a substantial reduction in the rate of inflation will significantly affect the lives of all the voters. Changes in employment, on the other hand, will affect only a portion of the population.

More importantly, several of the episodes of price stabilization in high inflation economies have *not* been characterized by a short-run trade-off between inflation and unemployment. While orthodox programs based on contractionary monetary policy are recessionary in the short run, exchange rate based stabilizations, where the exchange rate is used as a nominal anchor, often lead to a boom in the short-run, only to give way to a recession later. There is no short-run trade-off between inflation and unemployment.[2] For simplicity, in our model of Sections Three and Four we will ignore these issues, assuming that output is fixed.

Political motivation has had an important role in the timing and type of stabilization in several episodes in high

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[2]In some of these episodes, like for example the 1985 Austral Plan in Argentina and the 1986 Cruzado in Brazil, price stabilization has been accompanied by an *increase* in output in the short-run. Cf. the studies on the different business cycles associated with price stabilization by Calvo and Vegh (1990) and Kiguel and Liviatan (1992).

inflation countries. An interesting regularity that seems to support this view is that in many important cases (e.g. the Austral, Primavera and Cavallo Plans in Argentina, the Pacto in Mexico and the Cruzado in Brazil), stabilization programs started between 5 and 9 months before the elections. In each one of these cases, a reduction of the rate of crawl or an exchange rate freeze were important components of the programs (in some, they were accompanied by price freezes).

In some instances, like Mexico's stabilization of December 1987 (the Pacto, which occurred 9 months before the elections), or Cavallo's plan in Argentina in February 1991, 7 months prior to congressional elections, the stabilization effort was accompanied by substantial fiscal adjustment, and the rate of inflation remained low after the elections.

But in other episodes, like Brazil's Cruzado Plan (9 months before congressional elections), inflation increased right after the elections. Cardoso (1991) says in reference to it that "Inflation was zero. For a few months it seemed true, and general euphoria set in. But signs of disequilibrium from excess demand mounted without eliciting an adequate compensatory response. Another election loomed, and, in the best Brazilian political tradition, corrective actions were placed on hold. This time the new measures were announced immediately after the elections ... The deterioration in the balance of payments became as significant as the mounting internal problem. Suddenly, Brazil's comfortable cushion of reserves, which could lend credibility to the maintenance of a fixed exchange rate, had vanished." (pp. 152-3). The government deliberately postponed a large devaluation until after the elections in order to keep inflation under control.

The postponement of the devaluation had severe consequences for Brazil's current account, which reached a deficit of nearly four billion dollars in the fourth quarter of 1986.

The Primavera Plan in Argentina in August 1988 (nine months before presidential elections) is an unsuccessful example of this strategy. Heymann (1991) states that "The announcement of the Primavera program in August 1988 was widely perceived as a final attempt to moderate inflation before the 1989 presidential elections." (p. 105) One of the main elements of this plan was the reduction of the rate of crawl, but speculative attacks on the exchange rate prevented the government from postponing the devaluation until after the elections, causing prices to bounce back up with disastrous electoral consequences for the Radical Party, which was in office at the time.

In this case, the reduction of the rate of crawl resulted again in current account deficits. These deficits were partly associated to the lack of credibility of the policy: exporters had incentives to delay their shipments in expectation of a large devaluation, which in fact occurred.[3]

The evidence seems to indicate that under price stabilizations based on the use the exchange rate as a nominal anchor, when a serious effort on the fiscal side of the economy is absent, inflation is kept under check for a limited time, only to resume (sometimes stronger) after a while, when adjustments in the exchange rate are made. These adjustments become necessary to avert a balance of payments crisis, or occur as a result of such crises (e.g. Primavera Plan).[4]

At the same time, this evidence indicates that governments have the possibility of "repressing" inflation, shifting it from the present to the future. Rather than the traditional inflation-unemployment trade-off, the key element in these episodes seems to be an intertemporal trade-off between inflation today and inflation tomorrow, which governments have exploited for political purposes. This results in a pattern of cycles of inflation which are politically determined. In Sections Three and Four we will build a model that is consistent with this pattern.

In addition to the stop-go cycles of inflation, the

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[3]Israel in 1988 and Bolivia in 1989 are further examples of postponements of devaluations to keep inflation under check until after the elections, according to Bruno and Meridor (1991) and Morales (1991).

[4]Even in the successful cases, where prices have been kept under control for extended periods of time, these programs have resulted in substantial real appreciation and important trade deficits. Mexico's deficit was close to twenty billion dollars during 1992; in the case of Argentina, the trade deficiit was over three billion dollars.

evidence points to the fact that these price stabilizations result in an appreciation of the real exchange rate and, until devaluations occur, in current account deficits. Since the model we work with in the following Sections is a one-sector model, there is no distinction between prices and exchange rates, so we cannot capture the real appreciation of the exchange rate. What we do capture with our model, though, is the current account deficits that are associated with these real appreciations prior to elections.

3. The background model

In this Section we develop a model that yields a trade-off between current and future inflation.

The real side of the economy is extremely simple. There is a single perishable private good, produced by the government using the labor provided by the consumers/voters. Within each period, part of this output goes to private consumption, and part is used by the government to transform it into a public good. By national accounting identities, demand (private consumption c_t plus public consumption g_t) must always equal supply (output y_t plus net imports m_t). All these magnitudes are expressed in per-capita terms. Output y_t is exogenously given, and we also assume that a constant amount of public good is provided by the government each period.

$$c_t + g_t = y_t + m_t \tag{1}$$

The government can engage in intertemporal trade, where it can exchange commodities with foreigners in the spot and futures market. An international interest rate of i per period applies to the external debt d_t (if d_t is negative, this means the country has foreign assets).[5] The change in the external debt is explained by the trade deficit and the interest accrued on previous debt.

$$\Delta d_t = d_t - d_{t-1} = m_t + id_{t-1} \tag{2}$$

The end value of external debt is constrained to be zero, and so is the initial debt, $d_0=d_2=0$. The only crucial point, however, is that a final debt ceiling exists in period two. In terms of present discounted value, the overall budget restriction for the economy thus implies that private consumption equals production net of government expenditure.

$$c_1 + \frac{c_2}{1+i} = A, \quad where\ A = y_1 + \frac{y_2}{1+i} - (g_1 + \frac{g_2}{1+i}) \tag{3}$$

As to the monetary side of the economy, households receive an initial monetary endowment that they can use for their consumption purchases in periods one and two. Money is the only asset they can hold.

$$M_0 = p_1 c_1 + p_2 c_2 \tag{4}$$

[5]The interest rate i is exogenous, which is equivalent to assume that the country is small.

The government can either issue money or incur foreign debt to finance its expenditures, so it has access to both domestic and foreign assets. Denoting the nominal exchange rate e_t, the budget restriction the government faces is that the money it prints plus the domestic value of the proceeds from external borrowing equal expenditures on the public good plus the domestic value of the interest on foreign debt (if d_t is negative, the government receives an interest payment).

$$\Delta M_t + e_t \Delta d_t = p_t g_t + e_t i d_t \tag{5}$$

There is only one tradable good, so international trade is a device to engage in intertemporal trade. We assume that the international price p^* of the good is fixed and equal to one. By purchasing power parity, the good must have the same price whether it is imported or not, so $p_t = e_t$.

The nominal price p_t is determined so as to clear the market each period. Denoting the money that the consumers do not spend in the first period M_1^d, consolidating budget restrictions (4) and (5), it follows that the nominal price is directly proportional to the amount of money spent by consumers and the government each period.[6]

$$p_1 = \frac{(M_0 - M_1^d) + \Delta M_1}{y_1}, \quad p_2 = \frac{M_1^d + \Delta M_2}{y_2} \tag{6}$$

[6]By intertemporal restriction embodied in (3), the factor of proportionality is simply the inverse of output.

i. Voters

The behavior of each voter and household is depicted by a representative agent. Utility in period t is a concave function with a constant intertemporal elasticity of substitution.[7] Total utility is additive in the per-period functions of consumption c_t, and the future is discounted at a rate delta, $0<\delta\leq 1$.

$$U(c_1, c_2) = u(c_1) + \delta\ u(c_2) \tag{7}$$

At the beginning of the first period, each agent receives an initial monetary endowment M_0 to buy consumption goods. Though it can be completely arbitrary, we normalize the initial monetary endowments in hands of the private sector to be equal to the present discounted value of output times an initial price level p_0, $M_0=(y_1+y_2/(1+i))p_0$.

The consumer must spread this monetary advance out over two periods. The desire to consume in period two can induce a positive demand for money in period one. By definition, inflation π_t is the proportion of change in the price level $(p_t-p_{t-1})/p_{t-1}$. The budget constraint consumers face thus depends on the prices in effect each period, or equivalently on inflation in periods one and two.

[7]The coefficient of relative risk aversion, namely $-[u(c_t)''/u(c_t)']c_t$, is constant for these class of functions, so they are also known as Constant Relative Risk Aversion (CRRA) utility functions. Log-utility is a member of this class of functions, with a CRRA of $\varepsilon=1$. Another member is $u(c_t)=c_t^{1/m}$, with $\varepsilon=1-1/m$, for any $m>1$.

$$c_1 + \frac{M_1{}^d}{p_1} = \frac{M_0/p_0}{1+\pi_1}, \quad c_2 = \frac{M_1{}^d/p_1}{1+\pi_2} \tag{8}$$

Maximizing the voter's objective function subject to the budget constraint, we derive the first-order condition that implicitly relates consumption in both periods.

$$\frac{\partial u(c_1)}{\partial c_1} = \frac{\delta}{1+\pi_2}\frac{\partial u(c_2)}{\partial c_2} \tag{9}$$

Optimal consumption and real money demand in the first period depend on the rates of inflation in both periods. In the special case of log-utility, however, they are independent of the rate of inflation expected in the future, as can be observed below:

$$c_1^* = \frac{1}{1+\delta}\frac{M_0/p_0}{1+\pi_1}, \quad \frac{M_1^{d*}}{p_1} = \frac{\delta}{1+\delta}\frac{M_0/p_0}{1+\pi_1} \tag{10}$$

Since second-period consumption depends on the real money holdings carried over from the first period, the general result is that first and second period consumption are (implicit) functions of inflation.

$$\begin{aligned} c_1 &= c_1(\pi_1, \pi_2) \\ c_2 &= c_2(\pi_1, \pi_2) \end{aligned} \tag{11}$$

ii. Government

The government can print money, which is tantamount to setting the price level. The incumbent shares the voter's objective function (7).

Maximizing this objective function subject to the overall constraint for the economy, we can derive the first-order optimal intertemporal condition for consumption.

$$\frac{\partial u(c_1)}{\partial c_1} = \delta(1+i)\frac{\partial u(c_2)}{\partial c_2} \tag{12}$$

If the effects of the interest rate and the rate of time preference cancel out, optimal consumption will be constant over time. Otherwise, optimal consumption can be determined solving the system of equations (3) and (12).

The optimal price levels can be determined using the results derived above. A comparison of the intertemporal conditions for consumers and the government leads to the optimal policy in the second period, while optimal policy in the first period follows from this result and the budget restrictions for each consumer and for the economy as a whole.

$$\pi_2^* = -\frac{i}{1+i}, \quad \pi_1^* = \frac{(M_0/p_0)-A}{A} \tag{13}$$

As long as the interest rate is positive, there will be a deflation in the second period. If government expenditure is positive, there will be inflation in the first period. The government acts in this instance as a social planner that is maximizing the welfare of society, through its financial policy.

Since the government is the only one with access to the international capital market, the foreign debt d_1 it can incur during the first period is identical to the trade deficit.

There can be a trade surplus, of course, if the government accumulates foreign assets during that period.

The amount of money the government needs to print so as to pay for its expenditures can be found from the per period budget constraints: seignorage is less than government expenditure when the government becomes indebted abroad, while it is more when the debt must be repaid.

$$\begin{aligned} \Delta M_1 &= p_1\ (g_1 - d_1) \\ \Delta M_2 &= p_2\ (g_2 + (1+i)\, d_1) \end{aligned} \tag{14}$$

iii. Trade-off between current and future inflation

The profile of consumption depends on the evolution of inflation over time. Since consumption is subject to transformation frontier (3), a link between present and future inflation can be established. Within what we define as the admissible range for π_2 there is a trade-off between them.[8] In the case of log-utility there is no upper bound on π_2, so first and second period inflation are inversely related for all values of π_2.

$$\frac{d\pi_1}{d\pi_2} = -\frac{\frac{\delta}{1+i}\frac{1}{1+\pi_2}}{1+\frac{\delta}{1+i}\frac{1}{1+\pi_2}}\frac{1+\pi_1}{1+\pi_2} < 0 \tag{15}$$

This tradeoff is the key intertemporal link in the model. This captures the fact that inflation can be repressed in the short run, but not in the long run. Debt shifts the inflation

[8]Lemma 1 in Appendix.

tax burden between the first and the second period.

While a social planner would not try to exploit this trade-off, an office-motivated politician will. We explore the consequences of this in Section Four.

4. The game

We now introduce elections, which make it possible for the incumbent to be voted out of office. Now it is time to make explicit that the incumbent government derives utility not only from consumption, but also from the perks of being in office (s_t), which a simple citizen cannot enjoy.

$$V(c_1, c_2, s_1, s_2) = u(c_1) + v(s_1) + \delta[u(c_2) + v(s_2)], \quad \text{where } s_t \in \{0, s\},\ v(0)=0,\ v(s)>0 \tag{16}$$

After presenting the benchmark case of complete information, we study the consequences of incomplete information, where voters can observe inflation but debt is not observable.

We will basically be following the procedure in Persson and Tabellini (1990) on elections and signalling by the government.[9] The main difference is that in our model the signal is not output but rather inflation. Given this setup, the incumbent can have an incentive to incur debt and distort inflation downward in the first period in order to be

[9]The analysis of Persson and Tabellini (1990) is contained in chapter 5.

reelected.

The timing is that the incumbent government moves first, choosing the money/debt mix. Then everybody observes inflation π_1 but not debt d_1, and elections are held for voters to decide who will govern in the second period.

To simplify the exposition, in the next Sub-section we establish that in the first period a competent government will lead to lower inflation than an incompetent one, and that this is associated to a higher level of consumption. Therefore, the signal that a government is competent can simply be given by a high level of c_1. That allows our arguments to be phrased in terms of c_1 instead of π_1.

The nature of the equilibrium depends on the beliefs of voters. In a separating equilibrium voters expect higher consumption with a competent government. They will reelect the incumbent if consumption is high, and choose the opponent otherwise.

In a pooling equilibrium voters expect the same level of consumption with either type. If voters cannot distinguish between them, they will be indifferent between the current incumbent and any potential replacement, so we assume they then reelect the incumbent with probability one half.

i. Elections

The benchmark for our analysis is the situation with complete information. There are two government types, competent (c) and incompetent (nc). The per-capita expenditure, and the budget deficit, is lower with a competent government: $g^c=g-\varepsilon<g+\varepsilon=g^{nc}$.

If there were no elections, people could be stuck with a bad government. Elections provide a way of sorting out incompetent governments. If the incumbent is not reelected, a new candidate is chosen at random from the population of voters, who can be either competent, with probability q, or incompetent, with probability 1-q.

Let i denote the incumbent in the first period and j the incumbent in the second period (i=j is possible). We have two preliminary remarks. First, total consumption is lower with incompetent governments since the resources $A^{i,j}$ available for consumption are lower when either i,j=nc. Second, expected utility for voters is higher with a competent government.[10] Voters will therefore keep the incumbent in office only as long as the probability that it is competent is higher than the probability that somebody drawn at random from the population is competent. With complete information a competent incumbent will be reelected, Pr(reel c)=1, while an incompetent one will not, Pr(reel nc)=0.

There are now two decision problems, one for each type of government. Expected utility can be expressed as conditional on incumbent i's type and its probability of reelection.

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[10]Cf. Appendix, Lemma 2.

$$\max_{c_1} EV(c_1/i, Pr(reel\ i)) = u(c_1)+v(s_1)$$
$$+ \delta\ Pr(reel\ i)\,[u(c_2(c_1/i,i))+v(s_2)]$$
$$+ \delta(1-Pr(reel\ i))\,[q\ u(c_2(c_1/i,c))+(1-q)\,u(c_2(c_1/i,nc))],$$
$$where\ c_2(c_1/i,j)\ given\ by\ c_1+\frac{c_2}{1+i} = A^{i,j}\ for\ i,j \in \{c,nc\}. \tag{17}$$

There is only one decision variable, the level of consumption in the first period. From the first-order conditions for each type of incumbent, it is easy to infer that $c_1^c > c_1^{nc}$, i.e. consumption in the first period will be higher with a competent government.[11]

$$i=c \rightarrow \frac{\partial u(c_1^c)}{\partial c_1} = \delta(1+i)\frac{\partial u(c_2/c,c)}{\partial c_2}$$
$$i=nc \rightarrow \frac{\partial u(c_1^{nc})}{\partial c_1} = \delta(1+i)\,[q\frac{\partial u(c_2/nc,c)}{\partial c_2}+(1-q)\frac{\partial u(c_2/nc,nc)}{\partial c_2}] \tag{18}$$

What about inflation in the first period? In the special case of log-utility the reasoning is straightforward: since c_1 only depends on π_1, inflation has to be lower with a competent government. In the more general case the same result also holds.[12]

From this point on, we work directly with c_1 instead of π_1, as a short-hand for the signal the government sends in the first period. It is a matter of algebra to find the inflation

[11]Given that $c_2=(A^{i,j}-c_1)(1+i)$ and that $u(c_2)$ is concave, at $c_1=c_1^c$ that establishes equality in marginal condition for i=c, LHS<RHS in marginal condition for i=nc. Thus, need $c_1^{nc}<c_1^c$.

[12]Lemma 3 in Appendix.

rates to implement a given level of consumption.

ii. Separating equilibrium

We start by the separating equilibrium. Let the signal that identifies a competent government be c_1^s. Voter's beliefs are updated according to the following scheme:

$$\begin{aligned} c_1 < c_1^s \quad &\rightarrow \quad Pr(reel\ i) = 0 \\ c_1 \geq c_1^s \quad &\rightarrow \quad Pr(reel\ i) = 1 \end{aligned} \tag{19}$$

Incompetent government: if equilibrium is separating, it knows it will not be reelected. It thus faces exactly the same problem as in (17), picking the level of consumption c_1^{nc} given by first-order condition (18) for i=nc.

For c_1^s to be effectively the signal of a competent government in a separating equilibrium, expected utility for an incompetent government has to be lower with c_1^s than with c_1^{nc}: the temptation T to deviate from c_1^{nc} to c_1^s, which can be also be expressed as the gain G minus the cost C of deviating, must be negative. We adopt the convention that if the incompetent government is indifferent, it doesn't deviate either.

The gain from deviating to c_1^s is the possibility of enjoying the utility K from being in office during the second period. The cost of deviating is the loss in the expected utility of consumption due to two factors: first, distorting optimal time profile of consumption; second, reducing the resources available for consumption in the second period.

$$T(c_1^s, c_1^{nc}/nc) = G(c_1^s, c_1^{nc}/nc) - C(c_1^s, c_1^{nc}/nc)$$
$$= EV(c_1^s/nc, Pr(reel\ nc)=1) - EV(c_1^{nc}/nc, Pr(reel\ nc)=0) \leq 0$$
$$where\ G(c_1^s, c_1^{nc}/nc) = \delta v(s_2),$$
$$C(c_1^s, c_1^{nc}/nc) = EU(c_1^{nc}/nc, Pr(reel\ nc)=0)$$
$$- EU(c_1^s/nc, Pr(reel\ nc)=1) \qquad (20)$$

<u>Competent government</u>: its signal in a separating equilibrium must satisfy condition (20). If value c_1^c that results from (18) for i=c satisfies this condition, that will be the first-best for a competent government, since it will be able to signal its type effectively and at the same time allow optimal consumption profile. Otherwise, it will need to signal with a higher level of consumption: let us pick the level such that (20) is exactly an equality.[13]

$$\begin{aligned} T(c_1^c, c_1^{nc}/nc) \leq 0 \quad &\Rightarrow \quad c_1^s = c_1^c \\ T(c_1^c, c_1^{nc}/nc) > 0 \quad &\Rightarrow \quad c_1^s = \max\ \{ c_1 \}\ s.t.\ T(c_1^s, c_1^{nc}/nc) = 0 \end{aligned} \qquad (21)$$

It remains to establish that a competent government actually wants to send this signal. This is accomplished in two steps.

First, if the government chooses a level of c_1 lower than c_1^s it will not be reelected. We can compute the cost of sending the signal c_1^s instead of optimum level of c_1 when it

[13]Working with the signalling cost function, that is convex, it is easy to verify that $T(c_1^s, c_1^{nc}/nc)=0$ has two roots. Only the largest of them qualifies as a signal.

doesn't signal and is not reelected, which we can call $c_1^{ns,c}$.[14] The cost of signal c_1^s, for $c_1^s \geq c_1^c$, is clearly smaller for a competent government than an incompetent government. For a given gain from signalling, at the c_1^s such that an incompetent government is just indifferent between sending the signal or not, a competent government will be tempted to signal. Therefore a competent government prefers c_1^s to lower levels of c_1.

Second, levels of consumption above c_1^s can also be ruled out. The cost of sending a signal is increasing in c_1 for values beyond c_1^s, while the gain is just the same. They are therefore weakly dominated for a competent government, because they create a greater distortion without providing any more information.

Putting these two remarks together, we proved

Proposition 1: a separating equilibrium exists where incompetent government picks $c_1 = c_1^{nc}$ and competent government picks $c_1 = c_1^s$ that satisfies condition (21).

This is subject to the following caveat: if c_1^s exceeds the upper bound for c_1 given by admissible range of π_2 there is no π_1 that can be used to send that signal, so separating equilibrium is not attainable. In the case of log-utility, whatever the gain $G(c_1^s, c_1^{nc}/nc)$ from being reelected, there is always a separating equilibrium because there is no upper

[14]Cf. Appendix, Lemma 4, for derivations. The relevant interval is for values of $c_1 \geq c_1^c$.

bound on c_1.

iii. Pooling equilibrium

Voters' beliefs are that both types of government will set inflation at the same level. Given that the signal is not informative about the government's type, voters will be indifferent between the incumbent and any possible replacement, so the probability of reelection is one half.

$$\begin{aligned} c_1 \geq c_1^p \quad &\Rightarrow \quad Pr(reel\ i) = \frac{1}{2} \\ c_1 < c_1^p \quad &\Rightarrow \quad Pr(reel\ i) = 0 \end{aligned} \tag{22}$$

We characterize the signal that voters expect to see in a pooling equilibrium as the level of inflation that maximizes a competent government's expected utility under pooling.

Competent government: the probability that a competent government is in office in the second period is the probability that the current incumbent is reelected, ½, plus the probability that it will be replaced by a competent administration if not reelected, q/2. The probability that an incompetent takes office next period is the complement to one, (1-q)/2. The first order condition yields the following signal in a pooling equilibrium:

$$\frac{\partial u(c_1^p)}{\partial c_1} = \delta(1+i)\left[\frac{1+q}{2}\frac{\partial u(c_2(c_1^p/c,c))}{\partial c_2} + \frac{1-q}{2}\frac{\partial u(c_2(c_1^p/c,nc))}{\partial c_2}\right] \tag{23}$$

Incompetent government: to complete the description of the pooling equilibrium, we need to verify that an incompetent administration will actually be willing to send this signal.

The expected cost for an incompetent government is the expected loss in consumer utility when consumption in the first period is distorted upwards to mimic a competent government with level c_1^p.

$$\begin{aligned} C(c_1^p, c_1^{nc}/nc) &= EU(c_1^{nc}/nc, Pr(reel\ nc)=0) \\ &- EU(c_1^p/nc, Pr(reel\ nc)=1/2) \end{aligned} \tag{24}$$

The expected cost of a distortionary signal must be less than the expected gain from increasing the probability of reelection.

$$T(c_1^p, c_1^{nc}/nc) = \delta \frac{v(s_2)}{2} - C(c_1^p, c_1^{nc}/nc) \geq 0 \tag{25}$$

If utility K from being in office is smaller than that, only separating or semi-separating equilibria can exist.[15]

iv. Deviations from pooling to separating equilibrium

In Sub-sections Two and Three the separating and pooling equilibria were characterized. The question now is whether the pooling equilibrium survives the temptation of a competent government to separate out.

The reasoning is as follows. If the competent government deviates from the pooling equilibrium and sends a signal c_1^d that the incompetent government would never send, it makes sense for voters to conclude that it is competent and so reelect the incumbent with probability one. Therefore, the expected gain from deviating is half the utility K from holding political office. On the other hand, the cost from deviating is the additional loss incurred by sending a signal

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[15]If the utility K from being in office is smaller than necessary for a pooling equilibrium, a semi-separating equilibrium is possible, though some complications arise.

The problem is that as long as the incompetent applies a mixed strategy, voters will reelect the incumbent when a high c_1 is observed, since the probability that a competent government is sending that signal is higher than the probability that someone drawn at random form the population is competent. But this leads to a contradiction, because then an incompetent would mimic the competent always.

If voters reelect incumbent with probability one-half when an incompetent government applies a mixed strategy, only the competent will have an incentive to send that signal. Again we derive a contradiction.

A way out is to assume that if voters observe the signal they will reelect the incumbent with a probability that just makes the incompetent indifferent between mimicking or not. If the incompetent is assumed to mimic with certainty, the voters will indeed be indifferent between government and opposition. We do not explore this issue further, since it brings no other new insights.

with a higher level of consumption than the pooling equilibrium.

$$C(c_1^{d}, c_1^{p}/c) = EU(c_1^{p}/c, Pr(reel\ c)=1/2) - EU(c_1^{d}/c, Pr(reel\ c)=1) \tag{26}$$

If the temptation is positive, i.e. the gain outweighs the cost, the competent will deviate. Therefore, voters will not expect a competent government to ever send the pooling signal, and so the pooling equilibrium can be eliminated. The condition for the pooling equilibrium to stand is thus

$$\cancel{(27)} \quad T(c_1^{d}, c_1^{p}/c) = \delta \frac{v(s_2)}{2} - C(c_1^{d}, d_1^{p}/c) \leq 0$$

The signal used in a deviation of the competent government can be found by the procedure in the Sub-section Two, computing the separating signal where the incompetent is just indifferent between mimicking or not. This signal then has to be plugged into the competent's objective function, to evaluate whether the temptation to deviate is positive or negative.

5. Conclusions

In Section Four we developed a model of elections where low inflation is the signal that the incumbent government is competent. This implies a pattern where governments try to reduce inflation before elections, to increase their chances of reelection. This is done by a competent government in a separating equilibrium, when it is not enough for it to signal with the optimal intertemporal rate of inflation, and by the incompetent government in a pooling equilibrium, when it mimics a competent government to be reelected.

Since we have a one-sector model, there is no distinction between devaluation and inflation, so another way to interpret the model is to say that governments tend to defer devaluations until after elections. A second result is that this tends to increase the trade deficit, which is corrected later on.

These two results seem to capture some of the features of the experiences described in Section Two, that have to do with the stop-go cycles of inflation and balance of payments crises.

Appendix

<u>Lemma 1</u> There is a trade-off between current and future inflation within the admissible range for π_2 (Section 2.iii).

Differentiating the (implicit) consumption functions (11) and plugging them into the overall transformation frontier for the economy, a relationship between first- and second-period inflation can be established. It depends on the signs of the partial derivatives: the denominator is always negative (only an income effect is present), so the sign of this expression depends on the numerator.

$$\frac{d\pi_1}{d\pi_2} = -\frac{\dfrac{\partial c_1}{\partial \pi_2} + \dfrac{1}{1+i}\dfrac{\partial c_2}{\partial \pi_2}}{\dfrac{\partial c_1}{\partial \pi_1} + \dfrac{1}{1+i}\dfrac{\partial c_2}{\partial \pi_1}} \tag{28}$$

An alternative way to derive the trade-off involves changing the steps of derivation slightly. By the overall transformation frontier and the intertemporal condition for consumers, if inflation expected in the second period goes up, consumption is shifted from the second to the first period (this involves total derivative of consumption w.r.t. inflation).

$$\frac{dc_1}{d\pi_2} = \frac{-1/(1+\pi_2)}{\dfrac{d^2u(c_1)}{dc_1^2} + \dfrac{(1+i)\delta}{1+\pi_2}\dfrac{d^2u(c_2)}{dc_2^2}} \frac{du(c_1)}{dc_1} > 0$$

$$\frac{dc_2}{d\pi_2} = -(1+i)\frac{dc_1}{d\pi_2} < 0 \tag{29}$$

The relationship with first-period inflation can be established using the budget restriction consumers face. This expression is equivalent to the one derived previously (as can be verified doing the requisite substitutions).

$$\frac{d\pi_1}{d\pi_2} = -\frac{(1-(1+i)(1+\pi_2))\dfrac{dc_1}{d\pi_2}+c_2}{(M_0/p_0)/(1+\pi_1)^2}, \quad \frac{d\pi_1}{d\pi_2}\bigg|_{1+\pi_2=\frac{1}{1+i}} < 0 \tag{30}$$

Observe that this expression is strictly negative when evaluated at π_2^*. Therefore, starting from (π_1^*, π_2^*), as inflation in the first period goes down, inflation in the second period goes up. This trade-off continues as long as the numerator is non-negative.

For the class of concave utility functions we analyze, with a constant elasticity of marginal utility ε, the sign of the numerator depends on the sign of a function that is initially negative but monotonically increasing in π_2.

$$\frac{d\pi_1}{d\pi_2} = \frac{(1+\pi)^2}{M_0/p_0}\frac{c_1 c_2}{A(-\epsilon)}\left[1-\frac{1}{(1+\pi_2)(1+i)}-\frac{A(-\epsilon)}{c_1}\right],$$

$$sign\left(\frac{d\pi_1}{d\pi_2}\right) = sign\left(1-\frac{1}{(1+\pi_2)(1+i)}-\frac{A(-\epsilon)}{c_1}\right) \tag{31}$$

An upper bound for π_2 can be defined as the point where the numerator becomes zero (in the case of log-utility, presented in the text, no such upper bound exists). Beyond this point, the curve starts bending up. Therefore, the minimum value of π_1 is attained there.

This fact means that there is some value of π_1 below which second period inflation is not defined uniquely, but rather there is a pair of values of π_2 that correspond to each π_1. In this interval, once π_1 is observed consumption decisions depend on which of the two π_2 is expected. To solve the coordination problem for consumers, we will impose the condition that all consumers expect the lower of these two inflation rates. This means that expected inflation will be always smaller than the upper bound defined in the previous paragraph.[16]

Consequently, the admissible range for π_2 is defined as those values that do not exceed upper bound of π_2. By construction, there is a negative relationship between first and second period inflation over the admissible range of π_2.

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[16]With incomplete information, all consumers can observe is π_1. The lowest inflation rate the government can send as signal is precisely the one that corresponds to the upper bound for π_2. In range where two π_2 correspond to each π_1, this is a reason to restrict expected π_2 to be the smallest of the two.

Note that if the admissible range of π_2 has an upper bound, this also imposes an upper bound on c_1. Furthermore, over this range there is unique correspondence between values of c_1 and π_1: consumption increases as inflation goes down in the first period.

<u>Lemma 2</u> Evaluated at optimal consumption profile, consumer's expected utility increases with likelihood that substitute of current incumbent is competent (Section 3.i.).

We review the case of first period incumbent i=nc, but the argument for i=c is similar. Given i=nc, a consumer's expected utility depends on the likelihood that a competent government will be in office next period. Let the parameter q be the likelihood replacement is competent.

$$\begin{aligned}\underset{c_1}{Max}\ EU(c_1/nc) = {} & u(c_1) \\ & + \delta\,[q\ u(c_2(c_1/nc,c)) + (1-q)\,u(c_2(c_1/nc,nc))]\end{aligned} \tag{32}$$

For a given q, the first-order condition for c_1^{nc} that maximizes consumers expected utility can be derived. To see how c_1^{nc} reacts to changes in q, the first-order condition must be differentiated totally. This yields the result that c_1^{nc} is an increasing, continuous function of q.

$$\frac{dc_1^{nc}}{dq} = \frac{N}{D}\bigg|_{c_1=c_1^{nc}} > 0, \quad where$$

$$N = \delta(1+i)\left[\frac{\partial u(c_2(c_1/nc,c))}{\partial c_2} - \frac{\partial u(c_2(c_1/nc,nc))}{\partial c_2}\right] < 0$$

$$D = \frac{\partial^2 u(c_1)}{\partial c_1^2} + \delta(1+i)^2 q \frac{\partial^2 u(c_2(c_1/nc,c))}{\partial c_2^2} + \delta(1+i)^2(1-q)\frac{\partial^2 u(c_2(c_1/nc,nc))}{\partial c_2^2} < 0 \qquad (33)$$

Therefore, the optimum levels of c_1^{nc} can be plugged into the function of expected utility of consumers, now a function of q. Differentiating this function and applying the envelope theorem, we have that expected utility is increasing in the likelihood the government in second period is competent.

$$\frac{\partial EU(c_1^{nc}(q)/nc)}{\partial q} = \delta\ u(c_2(c_1^{nc}(q)/nc,c)) - \delta\ u(c_2(c_1^{nc}(q)/nc,nc)) > 0 \qquad (34)$$

<u>Lemma 3</u> First period inflation is lower with a competent government (Section 3.i).

Consider i=nc.[17] Once it finds optimal c_1^{nc}, it must determine the inflation π_1^{nc} needed to implement this plan. This can be done through an argument similar to the one behind condition (13). Given π_1^{nc}, a certain amount of resources $M_1^{d,nc}/p_1$ will be set aside by households to purchase consumption goods in the second period. If the administration that substitutes current incumbent in second period is j=nc,

[17]Bear in mind i denotes incumbent in the first period, j in the second.

inflation will be higher and consumption will be lower than if substitute is j=c, but in any case the following product is equal to the same constant,

$$\overline{c}_2(1+\underline{\pi}_2) = \underline{c}_2(1+\overline{\pi}_2) = M_1^{d,nc}/p_1 \tag{35}$$

By the budget restrictions, substituting in the values of consumption, we have that

$$c_1^{nc}+\overline{c}_2(1+\underline{\pi}_2) = \frac{M_0/p_0}{1+\pi_1^{nc}}, \quad c_1^{nc}+\frac{\overline{c}_2}{1+i} = A^{nc,c} \tag{36}$$

Operating algebraically,

$$c_1^{nc}+\overline{c}_2(1+\underline{\pi}_2) = A^{nc,c}-\overline{c}_2\left[\frac{1}{1+i}-(1+\underline{\pi}_2)\right] \tag{37}$$

When i=c, the steps that lead to π_1^c are exactly the same as those behind condition (13). Therefore, inflation in the first period with competent and incompetent governments will be, respectively,

$$\begin{aligned} \pi_1^c &= \frac{M_0/p_0}{A^{c,c}}-1 \\ \pi_1^{nc} &= \frac{M_0/p_0}{A^{nc,c}-\overline{c}_2\left[-\frac{i}{1+i}-\underline{\pi}_2\right]}-1 \end{aligned} \tag{38}$$

Since $A^{c,c}>A^{nc,c}$, it suffices to show $\underline{\pi}_2<\pi_2^*$ to prove that $\pi_1^{nc}>\pi_1^c$ (remember $\pi_2^*=-i/(1+i)$: this is not only the optimal deflation when the same incumbent holds office both periods, as demonstrated in the text, but also when it is known with certainty who will be the replacement in the next period). But this follows from fact that c_1^{nc} is smaller than level of consumption that an incompetent government would aim at if it were sure it would be replaced by a competent government, so if competent government actually takes over in the second period it has to deflate by more than the absolute value of π_2^* in order to boost consumption in the second period.

Lemma 4 The cost of signalling is lower for competent government.

If the incumbent does not send signal c_1^s it will not be reelected. The best alternative to signal c_1^s for i=nc is $c_1^{ns,nc}$=arg max $EU(c_1/nc, Pr(reel\ nc)=0)$, which is simply c_1^{nc}, while for i=c it is $c_1^{ns,c}$=arg max $EU(c_1/c, Pr(reel\ c)=0)$.

The cost of signalling for each type of incumbent i is the difference between expected utility of consumers at c_1^s, where government is reelected, and at $c_1^{ns,i}$, where it is not reelected.

$$
\begin{aligned}
C(c_1^s, c_1^{nc}/nc) &= \delta\,[q\, u(c_2(c_1^{nc}/nc, c)) + (1-q)\, u(c_2(c_1^{nc}/nc, nc))] \\
&\quad - \delta\, u(c_2(c_1^s/nc, nc)) - [u(c_1^s) - u(c_1^{nc})] \\
C(c_1^s, c_1^{ns,c}/c) &= \delta\,[q\, u(c_2(c_1^{ns,c}/c, c)) + (1-q)\, u(c_2(c_1^{ns,c}/c, nc))] \\
&\quad - \delta\, u(c_2(c_1^s/c, c)) - [u(c_1^s) - u(c_1^{ns,c})]
\end{aligned} \tag{39}
$$

The signalling cost functions are both convex in c_1^s, as can be verified by differentiation. The cost function for i=nc attains minimum at signal $c_1^{s,nc}$=arg max EU(c_1/nc,Pr(reel nc) =1). By Lemma 2 $C(c_1^{s,nc}, c_1^{nc}/nc) = EU(c_1^{nc}/nc, Pr(\text{reel } nc)=0) - EU(c_1^{s,nc}/nc, Pr(\text{reel } nc)=1) > 0$. As to i=c, $c_1^{s,c}=c_1^c$ is signal where cost curve attains minimum. By Lemma 2, $C(c_1^c, c_1^{ns,c}) = EU(c_1^{ns,c}/c, Pr(\text{reel } c)=0) - EU(c_1^c/c, Pr(\text{reel } c)=1) < 0$. Note that c_1 that minimize signalling costs for each type are different, and $c_1^{s,nc} < c_1^{s,c}$.

If the signal is $c_1^s = c_1^c$, we have there that $C(c_1^s, c_1^{ns,c}) < C(c_1^s, c_1^{nc}/nc)$. Furthermore, differentiating these functions, the derivative of the cost function is larger for i=nc, so it stays above that function for $c_1^s \geq c_1^c$.

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