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Working Paper No. C94-039

Political Stabilization Cycles in High Inflation Economies

Ernesto Stein
University of California, Berkeley
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August 1994

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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 a political cycle: Governments can defer inflation until after elections to increase their chances of being reelected. This is modelled as a two-period game of incomplete information where voters try to pick the most competent candidate, and inflation (which is used as a signal of competency) can be lowered by the government in the short run through foreign debt accumulation.

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Political stabilization cycles in high-inflation economies

1. Introduction

Stop-go cycles of inflation and recurrent balance of payment crises have been widely observed in high inflation economies. We approach these phenomena 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 to enhance their chances of being reelected. Models that address this issue typically assume a short-run trade-off between inflation and unemployment, and voter myopia. The government reduces unemployment (which is observed immediately) at the cost of increased inflation (which, with sticky prices, is only observed after a lag, once elections have taken place).

More modern versions of political cycles depart from these assumptions of myopic voters and nominal rigidities. Rogoff (1990), for example, models political budget cycles as an equilibrium outcome of a signalling game between the voters and the government. It is this modelling approach that will be followed in the present paper.

In some instances, the critical issue before elections is inflation rather than employment (as in Nordhaus) or fiscal policy (as in Rogoff). In such cases, governments might be willing to stabilize prices rapidly even at the cost of unemployment. For the economies with chronically high inflation on which we focus, money-based stabilizations do indeed produce a recession. But this short-run trade-off between inflation and output is not present in exchange rate-based stabilizations, which are the ones we have in mind in this paper. In these stabilizations, output often increases in the short run (Calvo and Végh, 1990). Exchange rate-based stabilizations can give rise to a different trade-off, namely one between present and future inflation. Politicians can exploit this trade-off in an opportunistic way, in an effort to win elections.

In Section Two we briefly review several stabilizations based on pegging exchange rates where we believe political considerations played an important role in determining their timing. These episodes additionally illustrate how, in the absence of a serious fiscal adjustment, stabilizations are short lived and end up giving way to inflationary outbursts.

In Section Three, we develop a stylized background model as an approximation for high inflation economies. We assume for simplicity that output is exogenous, while prices are driven by changes in money. The goal is to capture the trade-off between current and future inflation. By borrowing abroad now, the government can shift the inflation tax burden to the future, when the debt has to be fully repaid. Thus, an attempt to stabilize prices can build up repressed inflation, 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. Election dates will be assumed exogenous. The political stabilization cycle is described as a two-period signalling game between the government and the voters, like in Persson and Tabellini (1990). The government can be competent or incompetent, where competency is associated with the size of the budget deficit. Voters are forward-looking rational agents. Information asymmetries are introduced by assuming that they observe inflation immediately, but can only observe foreign debt after a lag. In this setting governments can lean more heavily on debt financing, since low current inflation acts as a signal of competency that increases the incumbent's reelection chances.

Section Five presents our conclusions on the relevance of the present model to interpret stop-go cycles in high inflation economies, suggesting why governments tend to postpone devaluations even at the risk of balance of payments crises.

2. Politically determined price stabilizations in high inflation countries

When inflation is high it often displaces unemployment as the key electoral issue. This gives governments a strong incentive to bring inflation under control.

Why would inflation become the most important variable prior to an election? One reason may be that, in high inflation economies, a substantial reduction in the rate of inflation will significantly affect the lives of all the voters, while changes in employment affect only a portion of the population.[2]

More importantly, stabilizations are not always 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.[3] For simplicity, in our

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[2]The cases where inflation becomes the most important variable prior to elections are not restricted to high inflation countries. In the United States, for example, Volcker was appointed at the Fed in 1979, during the Carter Administration, to take a tough stance against inflation.

[3]See the description of the business cycles associated with money-based and exchange rate-based price stabilizations in Kiguel and Liviatan (1992). Calvo and Végh (1990) review the literature on this topic, developing a model to explain the main stylized facts. Lack of credibility of the stabilization programs plays an important role in explaining the consumption boom in the short run: in expectation of higher inflation, households substitute intertemporally in favor of present consumption. This seems to be specially

models of Sections Three and Four we abstract from these issues, assuming that output is independent of inflation and exogenously fixed.

We argue that political motivation has had an important role in the timing of several stabilization episodes. An interesting regularity that seems to support this view is the start of stabilization programs between five and nine months before the elections, in cases such as the Austral, Primavera and Convertibility Plans in Argentina, the Cruzado Plan in Brazil and the Pacto in Mexico. In each one of these cases, a reduction of the rate of crawl or an exchange rate freeze was an important component of the program (in some, they were accompanied by price freezes). There is evidence of a close relationship between the initial success of these programs and the outcome of elections.

In Mexico's stabilization of December 1987, the Pacto, which occurred nine months before the elections, or the February 1991 Convertibility Plan in Argentina, seven months prior to congressional elections, the stabilization effort was accompanied by substantial fiscal adjustment, and the rate of inflation remained low after the elections (figures 1 and 2).

But in other episodes, like Brazil's February 1986 Cruzado Plan, nine months before congressional elections, inflation increased immediately after the elections. In reference to this stabilization program, Cardoso (1991)

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relevant in the case of durable goods.

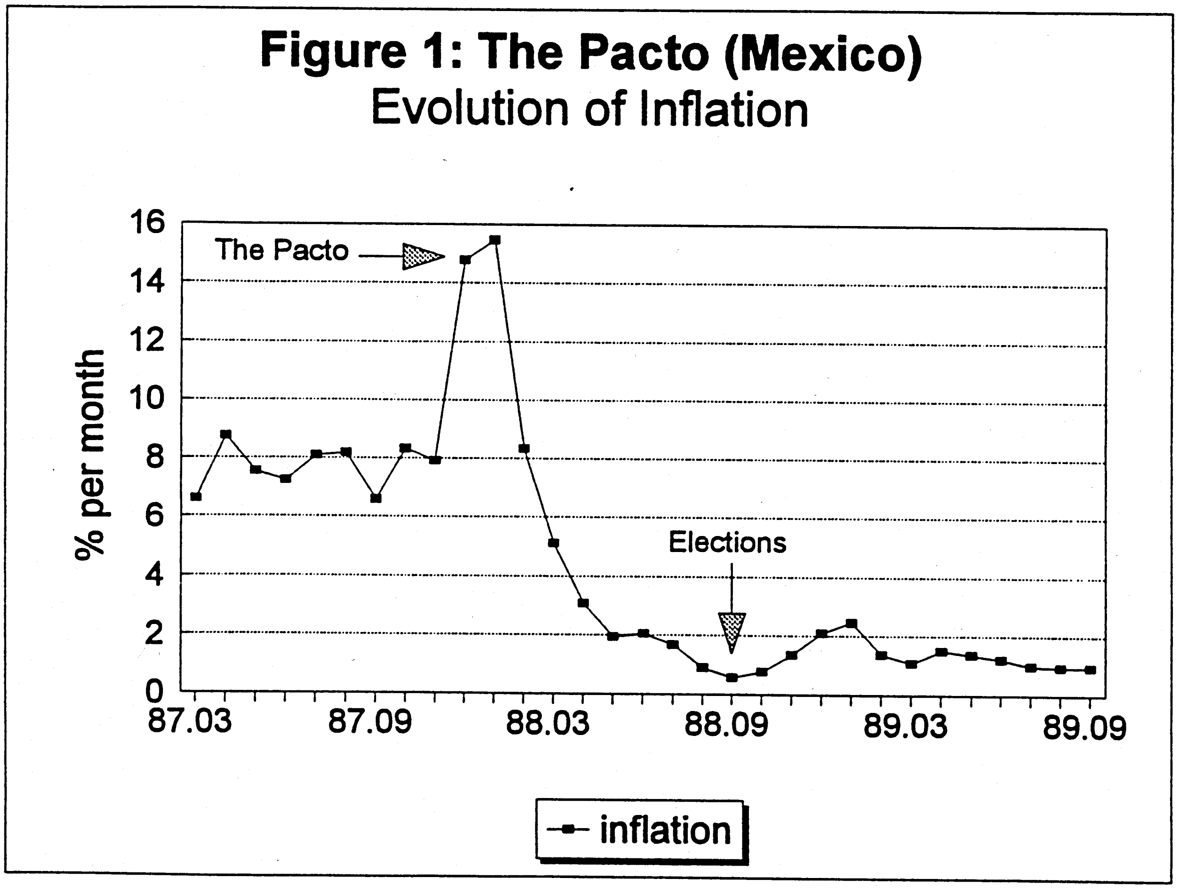
Figure 1: The Pacto (Mexico)
Evolution of Inflation
% per month
The Pacto
Elections
0
2
4
6
8
10
12
14
16
87.03
87.09
88.03
88.09
89.03
89.09
inflation

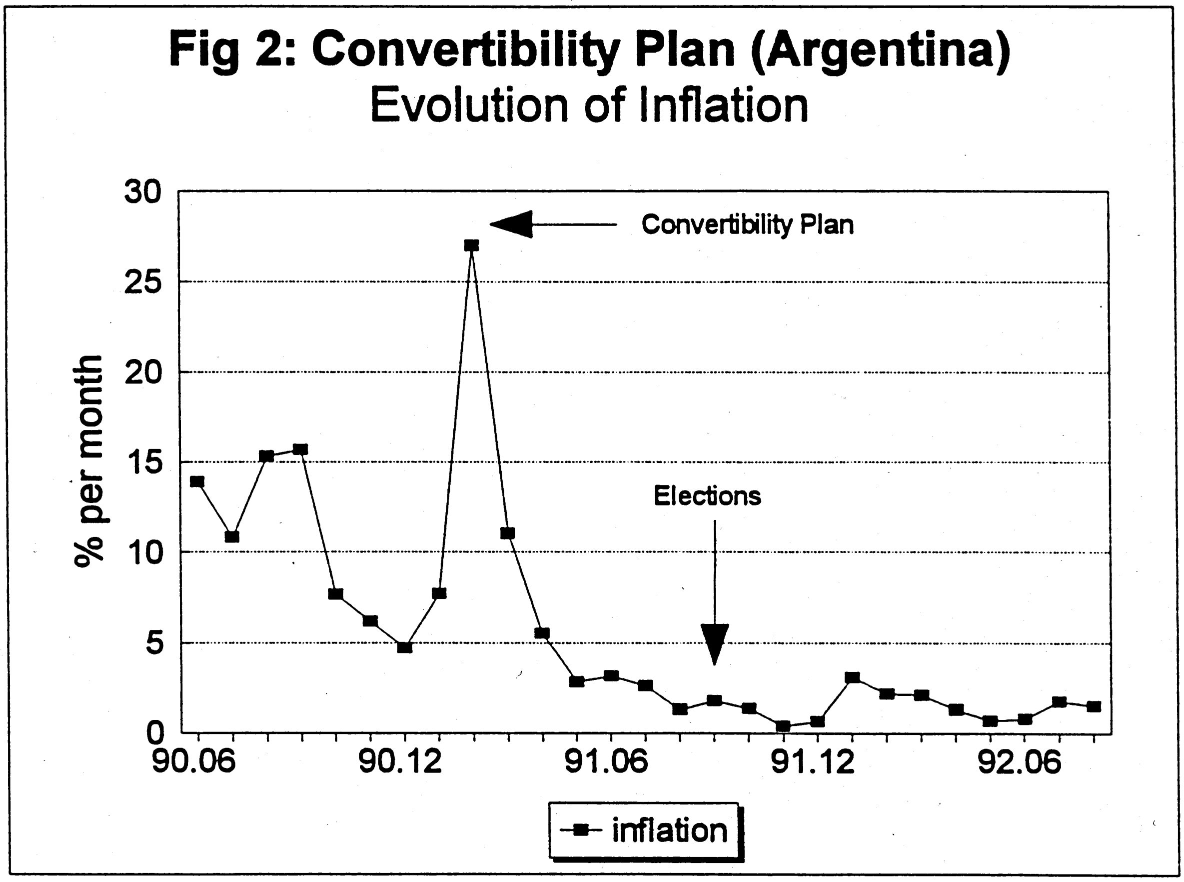
Fig 2: Convertibility Plan (Argentina)
Evolution of Inflation
30
25
20
15
10
5
0
% per month
Convertibility Plan
Elections
90.06
90.12
91.06
91.12
92.06
inflation

writes: "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 (figures 3 and 4). 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 (figure 5).

The Primavera Plan in Argentina, launched nine months before the May 1989 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

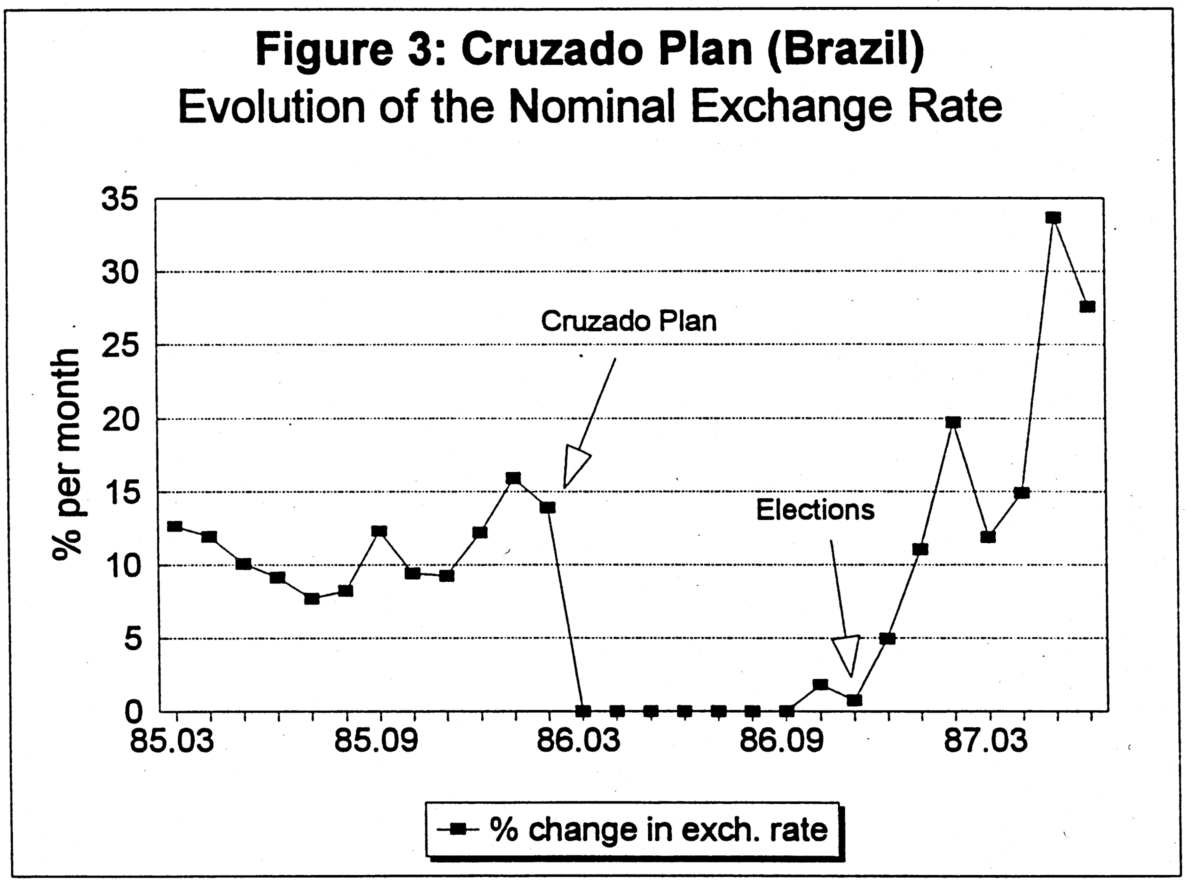

Figure 3: Cruzado Plan (Brazil)
Evolution of the Nominal Exchange Rate
35
30
25
20
15
10
5
0
% per month
Cruzado Plan
Elections
85.03
85.09
86.03
86.09
87.03
% change in exch. rate

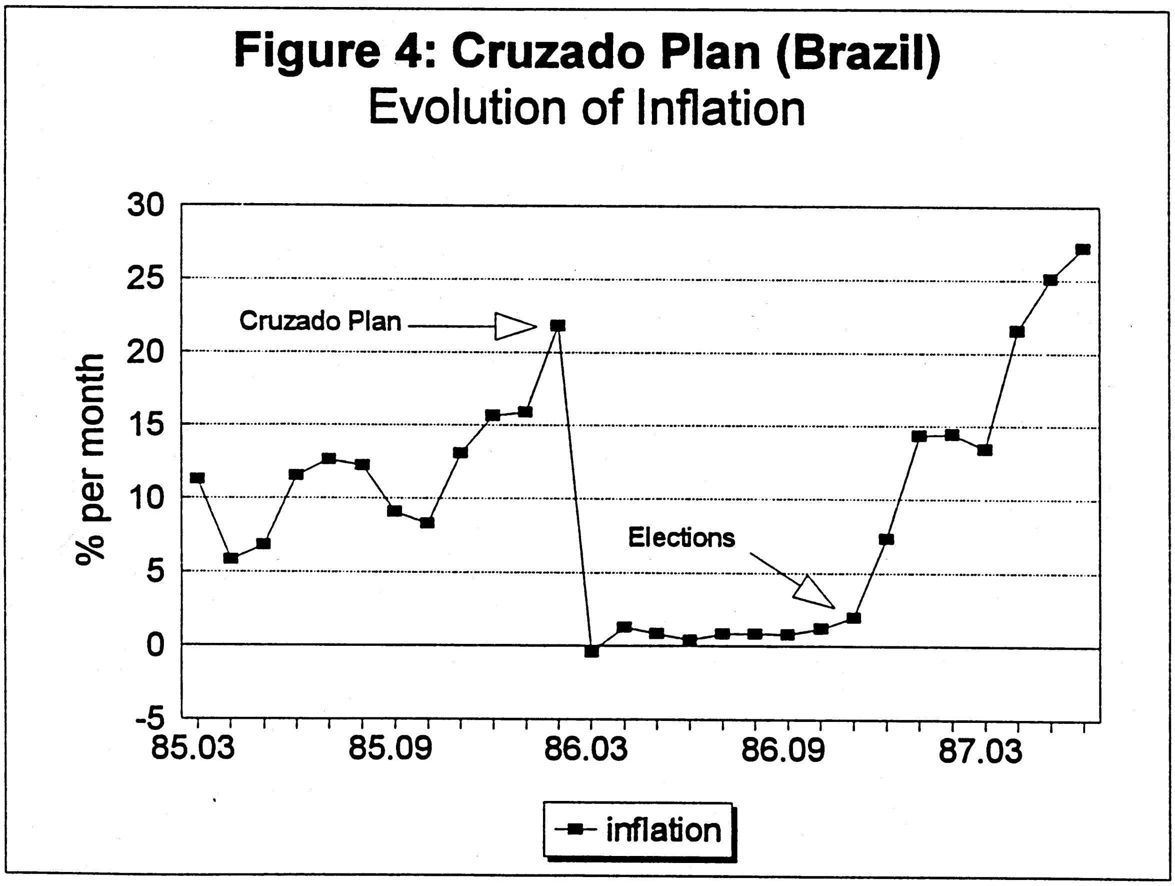
Figure 4: Cruzado Plan (Brazil)
Evolution of Inflation
30
25
20
15
10
5
0
-5
% per month
Cruzado Plan
Elections
85.03
85.09
86.03
86.09
87.03
inflation

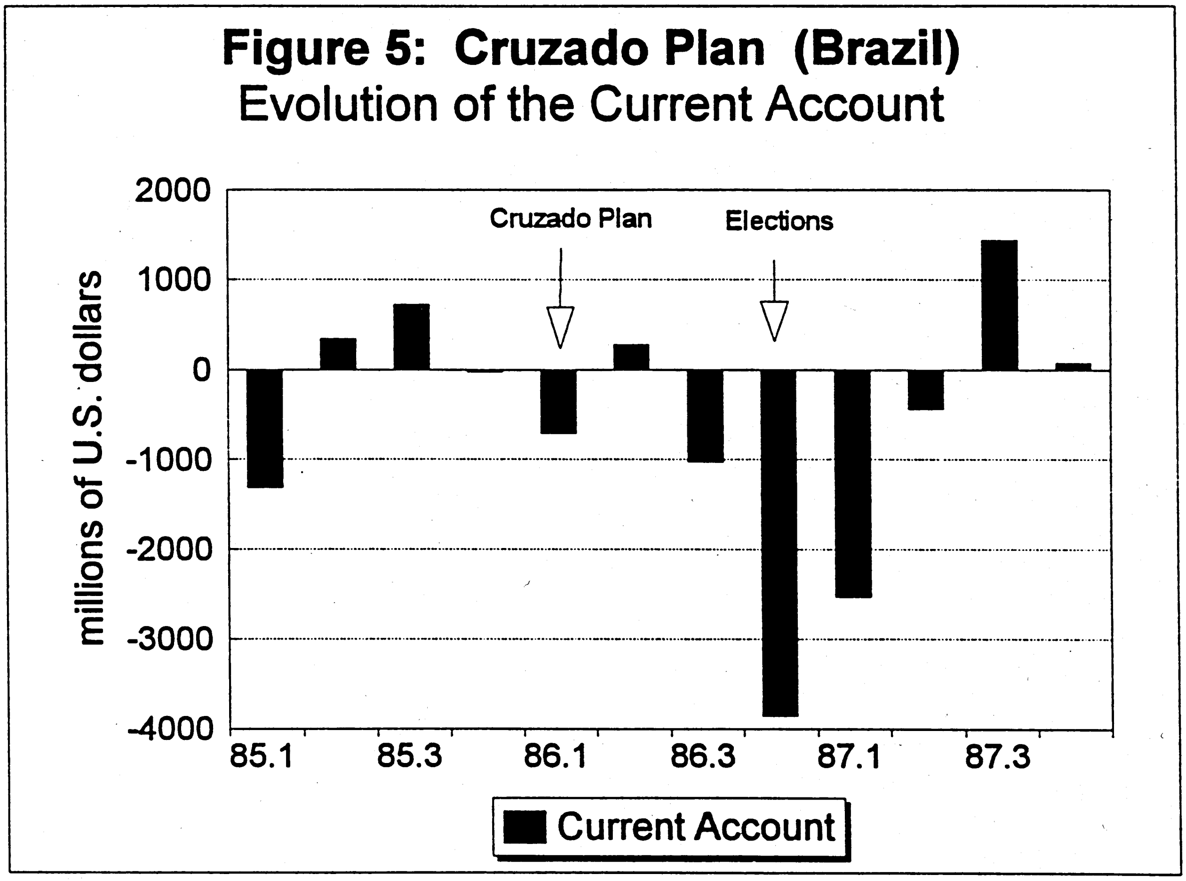
Figure 5: Cruzado Plan (Brazil)
Evolution of the Current Account
millions of U.S. dollars
2000
1000
0
-1000
-2000
-3000
-4000
Cruzado Plan
Elections
85.1
85.3
86.1
86.3
87.1
87.3
Current Account

elections, causing prices to bounce back up with disastrous electoral consequences for the Radical Party, in office at the time (figures 6 and 7). The reduction of the rate of crawl resulted again in current account deficits, which 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 (figure 8).

Besides these episodes, Israel in 1988 and Bolivia in 1989 are further examples of postponements of devaluations to slow down inflation before the elections, according to Bruno and Meridor (1991) and Morales (1991). This points to a phenomena common to many high inflation economies.

The evidence seems to indicate that under price stabilizations based on the use of 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.[4]

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[4]Even in the successful cases, where inflation has been kept under control for extended periods of time, these programs have resulted in substantial real appreciation and important trade deficits. Mexico's trade deficit was close to twenty billion dollars during 1992, while for Argentina it was about three billion dollars. These phenomena exceed the framework of this paper, but in Calvo and Végh (1990) a successful stabilization brings about a permanent real appreciation, and in De Gregorio, Guidotti and Végh (1992) it initially causes a current account deficit.

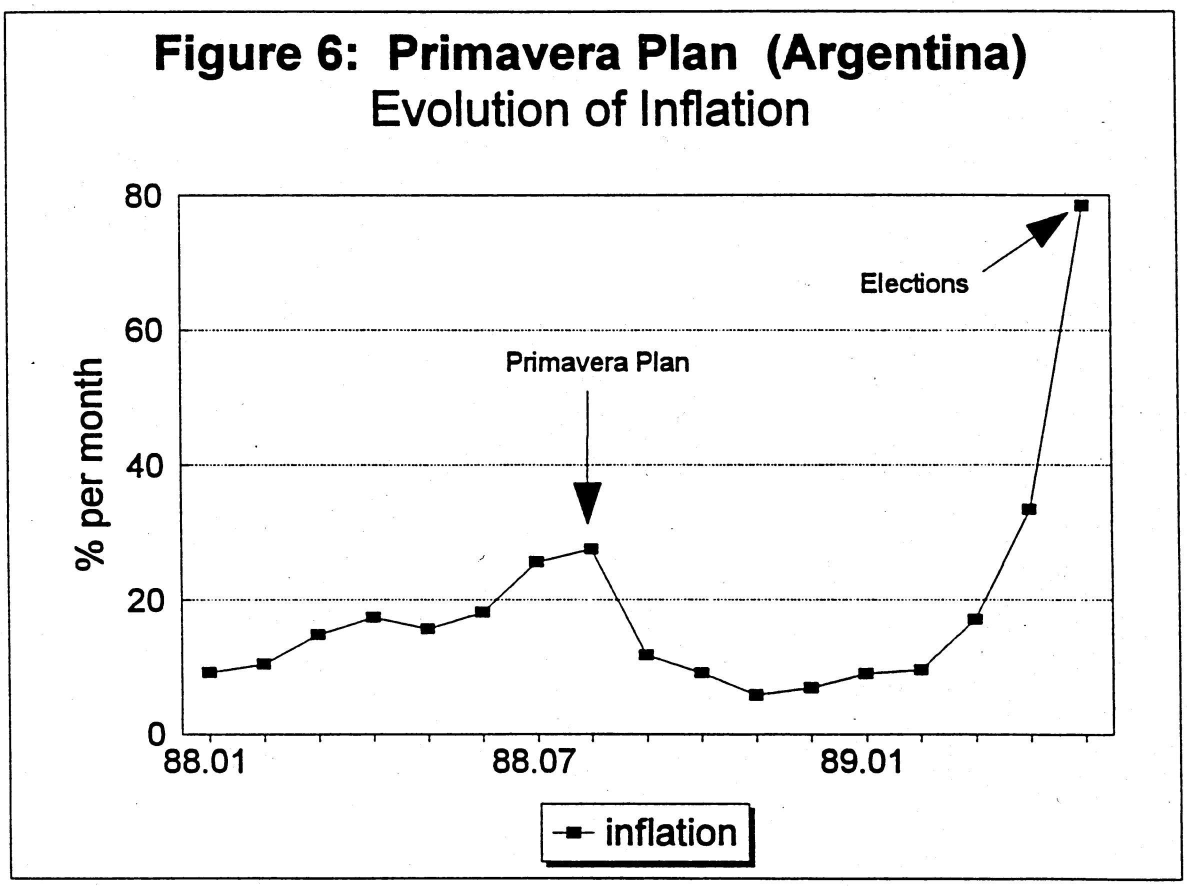
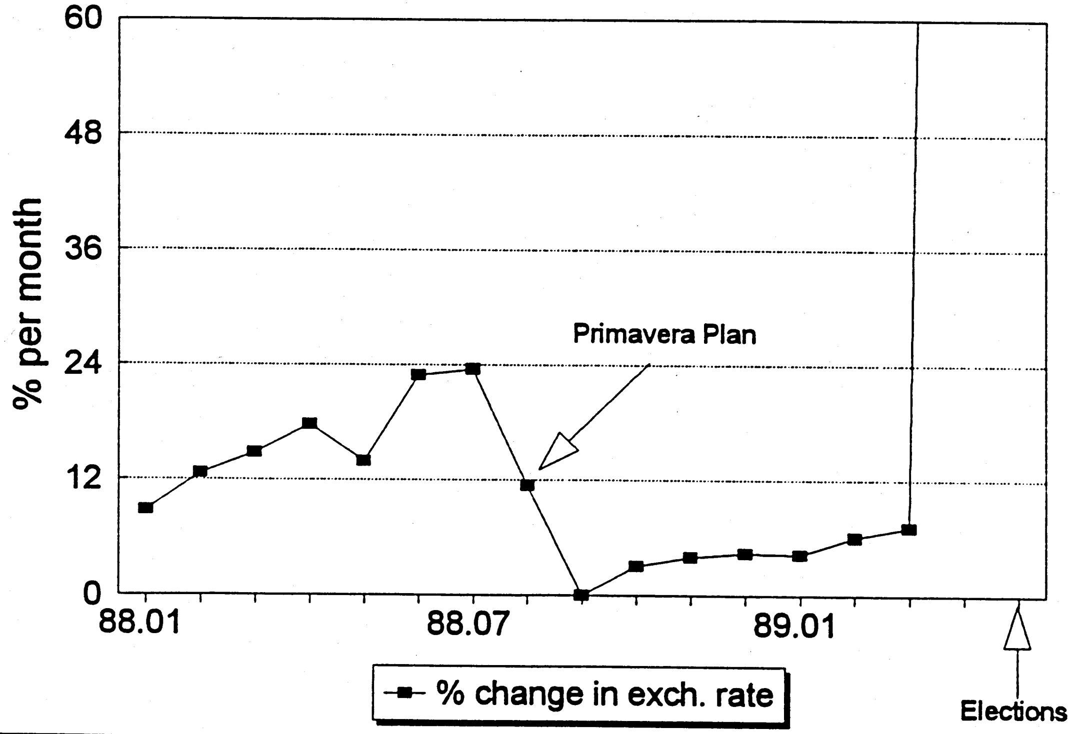


Figure 6: Primavera Plan (Argentina)
Evolution of Inflation
80
60
40
20
0
% per month
Primavera Plan
Elections
88.01
88.07
89.01
inflation

Figure 7: Primavera Plan (Argentina)
Evolution of the Nominal Exchange Rate



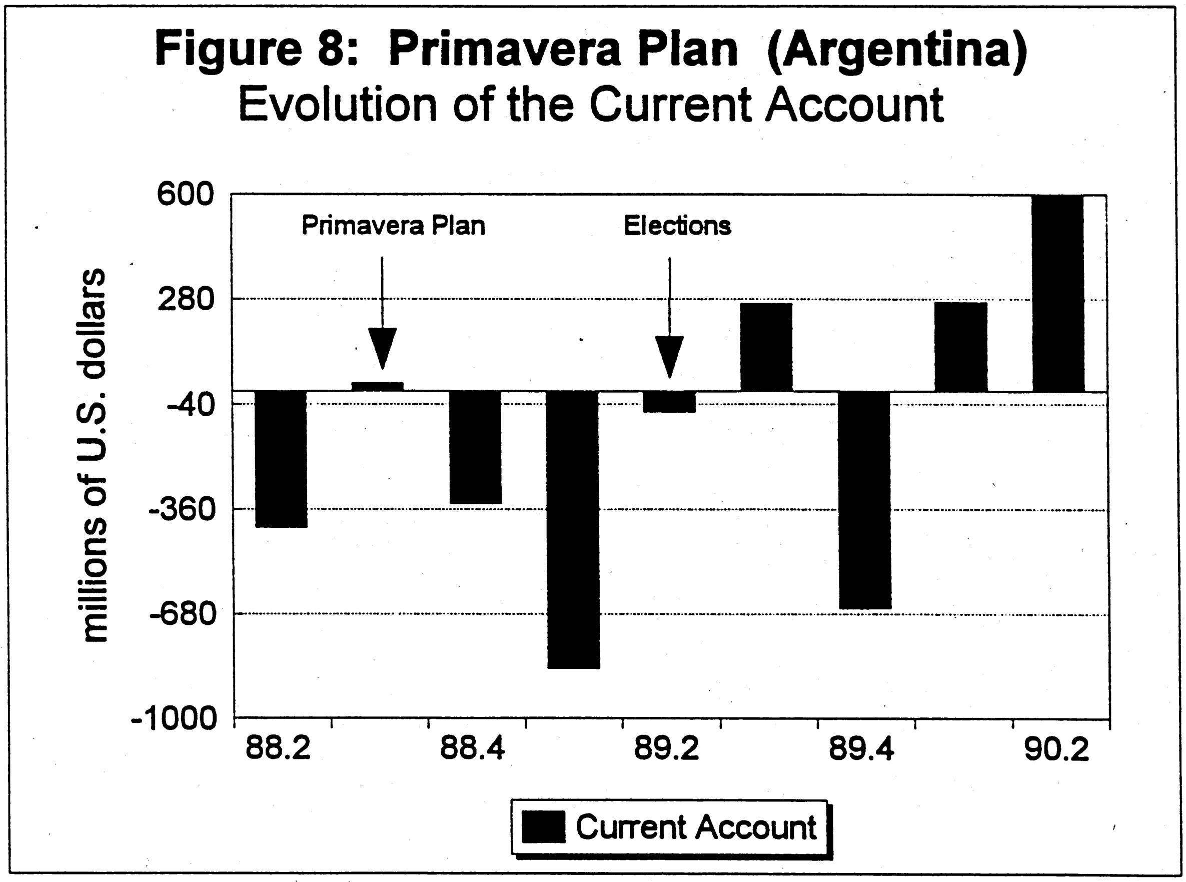


Figure 8: Primavera Plan (Argentina)
Evolution of the Current Account
600
280
-40
-360
-680
-1000
millions of U.S. dollars
Primavera Plan
Elections
88.2
88.4
89.2
89.4
90.2
Current Account

At the same time, these episodes suggest 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 seems to be an intertemporal trade-off between inflation today and inflation tomorrow, which governments have exploited for political purposes. This gives rise to a politically driven cycle of inflation. In Sections Three and Four we build a model consistent with this pattern.

In addition to the stop-go cycles of inflation, the 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 two-period model that yields a trade-off between current and future inflation. It is in the spirit of Sargent and Wallace (1981): if the government doesn't undertake a fiscal adjustment, substituting debt financing for the inflation tax today only leads to a transitory reduction of inflation and even more inflation tomorrow.

The model is a stylized version for high inflation economies. 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 more Keynesian and high inflation economies as more Classical.

i. Real endowments and international trade

An exogenously given amount of a single perishable good, y_t, is available 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.

Since there is only one tradable good, international trade is a device to engage in intertemporal trade. The government 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

[5]The interest rate i is assumed exogenous, which is equivalent to the assumption that the economy is small and open.

interest accrued on previous debt: $d_t - d_{t-1} = m_t + i d_{t-1}$.

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

In terms of present discounted value, the overall restriction for the economy implies that private consumption equals production net of government expenditure.

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

ii. Budget restrictions, money and prices

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.

$$M_0 = p_1 c_1 + p_2 c_2 \tag{2}$$

The government can either issue money, or else incur foreign debt to finance its expenditures. Denoting the nominal exchange rate e_t, the budget restriction the government faces each period 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-1} is negative, the government receives an interest payment): $\Delta M_t + e_t \Delta d_t = p_t g_t + e_t i d_{t-1}$.

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 $e_t=p_t$. The amount of money the government needs to print can be found from the per period budget constraints: seignorage is less than expenditures when the government becomes indebted abroad, while it is more when the debt must be repaid.

$$\Delta M_1 = p_1(g_1-d_1), \qquad \Delta M_2 = p_2(g_2+(1+i)d_1) \tag{3}$$

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, it follows that the nominal price is directly proportional to the amount of money spent by consumers and the government each period.

$$p_1 = \frac{(M_0-M_1^d)+\Delta M_1}{y_1}, \qquad p_2 = \frac{M_1^d + \Delta M_2}{y_2} \tag{4}$$

iii. Consumption decisions and inflation

The behavior of each voter and household is depicted by a representative agent. Utility in period t is a concave function of consumption with a constant intertemporal elasticity of substitution.[6] We assume that a constant amount of public good is provided by the government each period, so

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

we do not include it explicitly in the utility function (only its cost of production can vary, as will be seen in Section Four). Total utility is additive in the per-period functions of consumption c_t, and the future is discounted at a rate delta, $0<\delta\leq 1$:

$$U(c_1, c_2) = u(c_1) + \delta\, u(c_2) \tag{5}$$

We normalize the initial monetary endowments in hands of the private sector to equal the present discounted value of output times an arbitrary initial price level p_0, $M_0=(y_1+y_2/(1+i))p_0$. The consumer must spread the 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 percentage change in the price level $(p_t-p_{t-1})/p_{t-1}$. The budget constraint consumers face depends on the prices in effect each period, or equivalently on inflation in periods one and two.

$$c_1 + \frac{M_1{}^d}{p_1} \equiv \frac{M_0/p_0}{1+\pi_1}, \qquad c_2 \equiv \frac{M_1{}^d/p_1}{1+\pi_2} \tag{6}$$

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

$$u'(c_1) = \frac{\delta}{1+\pi_2} u'(c_2) \tag{7}$$

Inflation in the second period has both an income and a substitution effect. The income effect can be seen in the budget constraint (6): for a given money demand in the first period, higher second period inflation results in lower second period consumption. The substitution effect is shown in (7): a higher π_2 results in the agents substituting away from c_2 and in favor of c_1. Inflation in the first period only has an income effect, since it equally reduces the buying power in periods 1 and 2.

iv. The government as a social planner

The incumbent shares the voter's objective function (5). Maximizing this objective function subject to the overall constraint for the economy given by (1), we can derive the first-order intertemporal condition to optimize consumption.

$$u'(c_1) = \delta(1+i)\,u'(c_2) \tag{8}$$

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 (1) and (8).

The government can print money, which is tantamount to setting the price level. The optimal price levels can be determined using the results derived above. A comparison of intertemporal conditions (7) and (8) leads to the optimal policy in the second period, while optimal policy in the first period follows from this and budget restrictions (1) and (6):

$$\pi_2^* = -\frac{i}{1+i}, \qquad \pi_1^* = \frac{(M_0/p_0)-A}{A} \tag{9}$$

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 maximizes the welfare of society through its financial policy.

v. Trade-off between current and future inflation

Solving the problem of maximizing the utility function of consumers (5) subject to the budget constraint (6), first and second period consumption can be expressed as a function of inflation, $c_t=c_t(\pi_1,\pi_2)$, for t=1,2. An equivalent statement is that optimal consumption and real money demand in the first period depend on the rates of inflation in both periods.

Though money demand depends in general on expected inflation, in the special case of log-utility money demand (and first-period consumption) is independent of the rate of inflation expected in the future, as can be observed below:

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

Since consumption is subject to transformation frontier (1), the link between present and future consumption leads to a link between present and future inflation. Continuing with the special case of log-utility, first and second period inflation are inversely related for all values of π_2.

$$\frac{d\pi_1}{d\pi_2} = -\frac{\frac{\delta}{1+i}\frac{1}{1+\pi_2}}{1+\frac{\delta}{1+i}\frac{1}{1+\pi_2}}\frac{1+\pi_1}{1+\pi_2} < 0 \tag{11}$$

For the general case, there is also a trade-off between present and future inflation, within what we define as the expected range for π_2.[7] This is the key intertemporal link in the model, capturing the fact that inflation can be repressed in the short run, but not in the long run. Debt shifts the inflation 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 will soon 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=1), which a simple citizen cannot enjoy.

$$\begin{aligned} &V(c_1,c_2,s_1,s_2) = u(c_1)+v(s_1)+\delta[u(c_2)+v(s_2)], \\ &\textit{where } s_t \in \{0,1\},\ v(0)=0,\ v(1)>0 \end{aligned} \tag{12}$$

We will basically be following the procedure in Persson and Tabellini (1990) on elections and signalling by the

[7]Lemma 1 in Appendix.

government.[8] 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 reelected.

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. 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, we establish in the next Sub-Section that a competent government will lead to lower inflation than an incompetent one in the first period, and that this is associated with 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 in the Sub-Section with incomplete information to be phrased in terms of c_1 instead of π_1.

i. Elections under complete information

The benchmark for our analysis is the situation with

[8]The analysis of Persson and Tabellini (1990) is contained in chapter 5. They draw in turn on the work by Cukierman and Meltzer (1986), Rogoff and Sibert (1988), and Rogoff (1990).

complete information. There are two government types, competent (c) and incompetent (nc). They differ in their efficiency in producing the required level of public good. The per-capita expenditure, and the budget deficit, is lower with a competent government: $g^c=g-\varepsilon<g+\varepsilon=g^{nc}$. Let i denote the incumbent in the first period and j the incumbent in the second period (i=j is possible). Total consumption is hence lower with incompetent governments since the resources $A^{i,j}$ available for consumption are lower when either i,j=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.

The solution concept under complete information is sub-game perfect equilibrium, solving the game by backwards induction. Expected utility for voters is higher when the government in the second period is competent.[9] Voters will reelect the incumbent if it is competent with a higher probability than somebody drawn at random from the population, so a competent incumbent will be reelected, Pr(reel c)=1, while an incompetent one will not, Pr(reel nc)=0.

Given voter's reactions, in the first period there are two decision problems, one for each government type. Expected

[9]Lemma 2 in Appendix.

utility is conditional on incumbent i's type.

$$\underset{c_1}{Max}\ EV(c_1/i) = u(c_1) + v(1) + \delta\, Pr(reel\, i)\, [u(c_2^{i,i}(c_1)) + v(1)]$$
$$+ \delta\,(1 - Pr(reel\, i))\, [qu(c_2^{i,c}(c_1)) + (1-q)\, u(c_2^{i,nc}(c_1))], \qquad \textbf{(13)}$$
$$where\ c_2^{i,j}(c_1)\ given\ by\ c_1 + \frac{c_2^{i,j}}{1+i} = A^{i,j},\ for\ i,j \in \{c, nc\}.$$

Keeping in mind that the resources $A^{i,j}$ available for consumption are larger when either i,j=c, it is easy to infer from the first-order conditions for each type of incumbent that $c_1^c > c_1^{nc}$, i.e. consumption in the first period will be higher with a competent government.[10]

$$\begin{aligned} i=c &\rightarrow u'(c_1^c) = \delta(1+i)\, u'(c_2^{c,c}) \\ i=nc &\rightarrow u'(c_1^{nc}) = \delta(1+i)\, [qu'(c_2^{nc,c}) + (1-q)\, u'(c_2^{nc,nc})] \end{aligned} \qquad \textbf{(14)}$$

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. The same result holds for the general case: first period inflation is lower with a competent government.[11]

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 rates to implement a given level of consumption.

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[10]Since $c_2^{i,j} = (A^{i,j} - c_1)(1+i)$ and $u(c_2)$ 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 $c_1^{nc} < c_1^c$.

[11]Lemma 3 in Appendix.

ii. Elections under incomplete information

The solution concept we use here is perfect Bayesian equilibrium, introducing a refinement that restricts out-of-equilibrium beliefs, the intuitive criterion.

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.

a. 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:

$$\begin{aligned} c_1 < c_1^s \quad &\rightarrow \quad Pr(reel\ i) = 0 \\ c_1 \geq c_1^s \quad &\rightarrow \quad Pr(reel\ i) = 1 \end{aligned} \tag{15}$$

Since c_1 will be either high or low in equilibrium (namely, c_1^s or c_1^{nc}, as established below), for those values of c_1, beliefs are determined by the equilibrium strategies and Bayes rule. The beliefs for out-of-equilibrium values of c_1, however, are not similarly restricted.

Incompetent government: if equilibrium is separating, the government knows it will not be reelected. It thus faces exactly the same problem as in (13), picking the level of consumption c_1^{nc} given by first-order condition (14) 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:

$$T(c_1^s, c_1^{nc}/nc) = G(c_1^s, c_1^{nc}/nc) - C(c_1^s, c_1^{nc}/nc) \leq 0 \qquad \textbf{(16)}$$

The gain from deviating to c_1^s is the utility $\delta v(1)$ from being in office during the second period. The cost of deviating is the loss in the expected utility of consumption, which for the sake of intuition can be broken down into a fixed cost and a variable cost. The fixed cost is associated with the loss in the expected resources available for consumption in the second period as the probability of an incompetent being in office jumps from 1-q (which is the probability that an incompetent will be elected given that the incumbent is not reelected) to 1, since the incompetent is reelected with certainty when it plays the signal c_1^s. The explanation for the variable cost is as follows: when the incompetent plays the signal c_1^s, it results in a departure from the optimal time profile of consumption. This occurs because the government is playing a higher consumption than the one that would be played in the absence of elections, which would be the optimal one for the case where an incompetent government is in office in both periods. The distortion on the time profile of consumption is increasing in c_1^s.

Competent government: its signal in a separating equilibrium must satisfy condition (16). If value c_1^c that results from (14) for i=c satisfies this condition, it will be the first-best for a competent government, since it will be able to signal its type effectively and at the same time achieve optimal consumption profile. Otherwise, it will need to signal with a higher level of consumption: let us pick the level such that (16) is exactly an equality.[12]

$$T(c_1^c, c_1^{nc}/nc) \leq 0 \quad \rightarrow \quad c_1^s = c_1^c \tag{17}$$
$$T(c_1^c, c_1^{nc}/nc) > 0 \quad \rightarrow \quad c_1^s = \max\{\, c_1 \,\}\ s.t.\ T(c_1^s, c_1^{nc}/nc) = 0$$

It remains to be established that a competent government actually wants to send this signal. This follows from the fact that the cost of signalling is lower in the case of a competent government as compared to that of an incompetent

[12]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, since the relevant interval for c_1^s is for values of $c_1 \geq c_1^c$.

government.[13] This is depicted in graph 1, where the relevant interval for signals is $c_1 \geq c_1^c$. At a consumption level c_1^s such that an incompetent is just indifferent between signalling or not, a competent government will be tempted to signal.

Levels of consumption below c_1^s can be ruled out for a competent government, since if the best alternative to c_1^s when competent is not reelected is not as good as c_1^s, the others will, a fortiori, do even worse. Levels of consumption above c_1^s can also be ruled out, being weakly dominated because the cost of sending a signal is increasing in c_1, while the gain is just the same. They just create a greater distortion without providing new information. Thus,

<u>Proposition 1</u>: provided inflation rates π_1^{nc}, π_1^s can be found for respective consumption levels, a separating equilibrium exists where an incompetent government picks $c_1 = c_1^{nc}$, and a competent government picks $c_1 = c_1^s$ that satisfies condition (17).

There is a caveat, because a separating equilibrium may not exist when there is no interior solution, but rather a corner solution. 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 lower bound on π_1. In other cases, there may be no π_1^s to implement c_1^s. Intuitively, this can occur in cases where the utility derived from holding office is sufficiently high, and the difference

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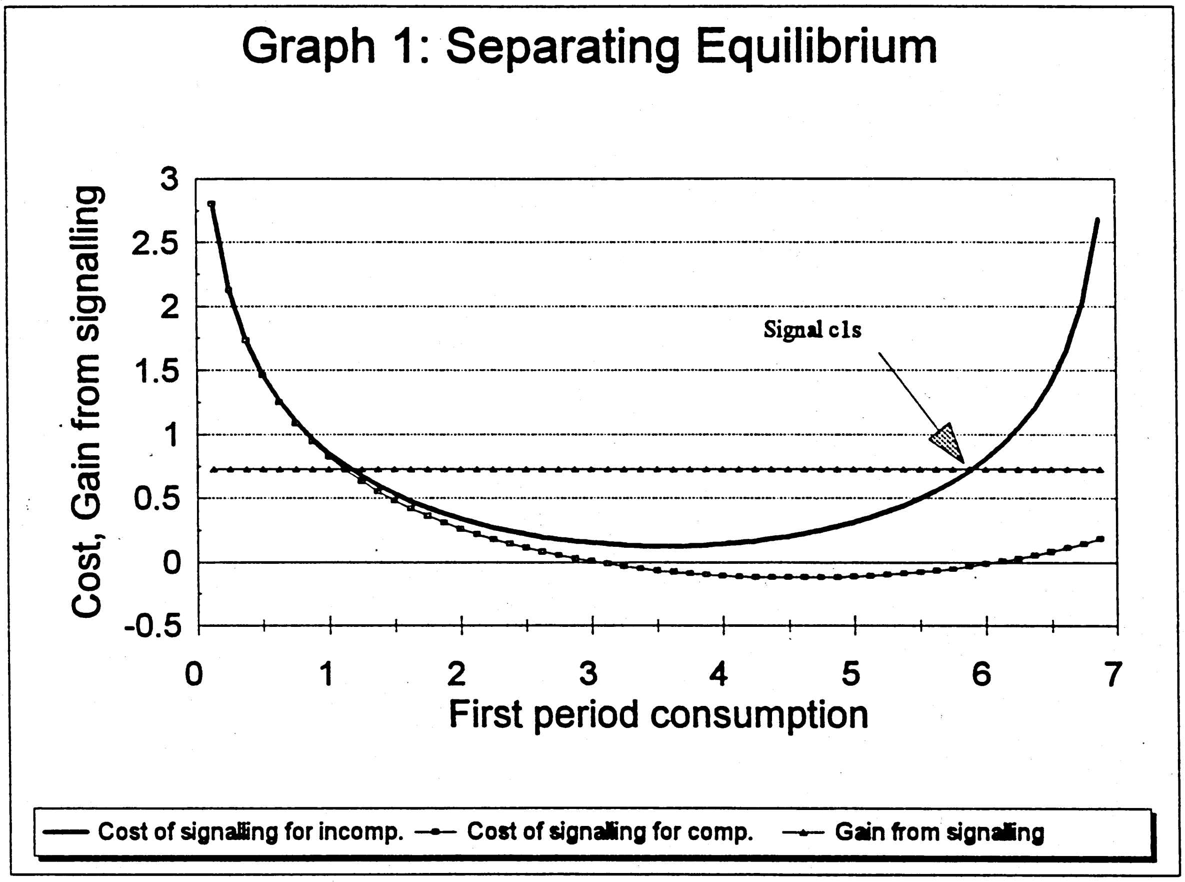
[13]Lemma 4 in Appendix.



Graph 1: Separating Equilibrium
Cost, Gain from signalling
3
2.5
2
1.5
1
0.5
0
-0.5
0
1
2
3
4
5
6
7
First period consumption
Signal c1s
Cost of signalling for incomp.
Cost of signalling for comp.
Gain from signalling

between a competent and an incompetent is sufficiently low. We can see in graph 1 that under these conditions the signal c_1^s would be high, and a low enough level of first period inflation to implement this consumption might not exist (see Lemma 1, in particular graph 4). We will get back to this discussion in our analysis of the pooling equilibrium.

b. Pooling equilibrium

Voters' beliefs here are that both types of government will set consumption 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.

$$\begin{aligned} c_1 \geq c_1^p \quad &\rightarrow \quad Pr(reel\ i) = \frac{1}{2} \\ c_1 < c_1^p \quad &\rightarrow \quad Pr(reel\ i) = 0 \end{aligned} \qquad \textbf{(18)}$$

We characterize the signal that voters expect to see in a pooling equilibrium as the level of consumption that maximizes a competent government's expected utility under pooling.[14] For off-equilibrium events, we momentarily accept that more consumption does not increase the incumbent's probability of reelection.

Competent government: the probability that a competent

[14]The level of consumption c_1^c could seem to make sense as the signal in pooling equilibrium. However, this level is higher than the optimal value of consumption for a competent government. The reason is that there is a probability (1-q)/2 that an incompetent will be elected for the second period, and this has to be accounted for when the competent government chooses consumption in the first period.

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:

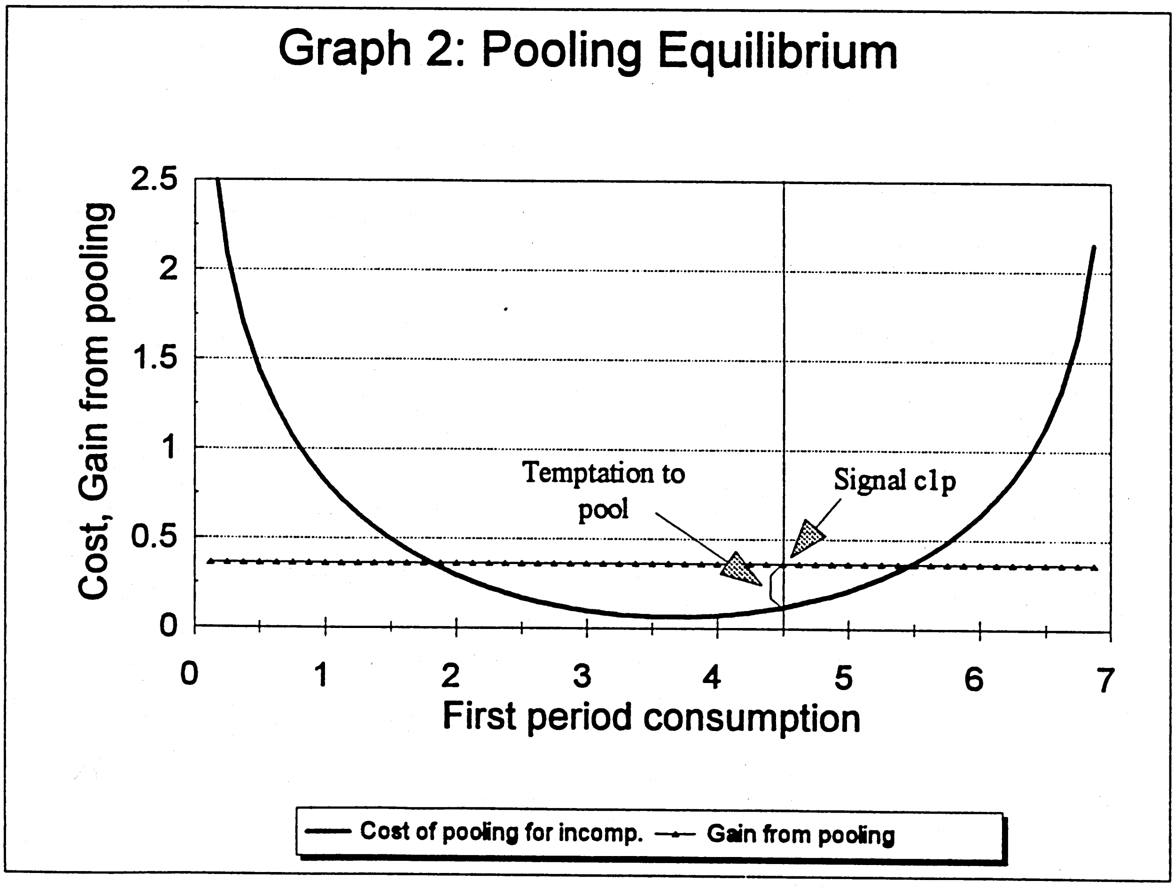
$$u'(c_1^p) = \delta(1+i)\left[\frac{1+q}{2}u'(c_2^{c,c}(c_1^p)) + \frac{1-q}{2}u'(c_2^{c,nc}(c_1^p))\right] \quad \textbf{(19)}$$

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 can again be broken down in two parts, the loss in consumer utility from increasing Pr(reel nc) from 0 to 1/2, plus the distortion from pushing consumption in the first period upwards to mimic a competent government, which is increasing in c_1^p. The expected cost must be less than the expected gain from increasing the probability of staying in office.

$$T(c_1^p, c_1^{nc}/nc) = \delta\frac{v(1)}{2} - C(c_1^p, c_1^{nc}/nc) \geq 0 \quad \textbf{(20)}$$

A case where condition (20) is satisfied is represented in graph 2. The pooling equilibrium is possible, with $c_1 = c_1^p$ for both types of governments, when the reward v(1) from



Graph 2: Pooling Equilibrium
2.5
2
1.5
1
0.5
0
Cost, Gain from pooling
Temptation to
pool
Signal c1p
0
1
2
3
4
5
6
7
First period consumption
Cost of pooling for incomp.
Gain from pooling

holding on to power exceeds some minimum level.[15]

We now ask whether the pooling equilibrium survives the temptation of a competent government to separate out. We apply the intuitive criterion, which puts restrictions on the beliefs about off-equilibrium events.

Consider a deviation by the competent government from the pooling equilibrium with a signal c_1^d. The potential signal for the deviation can be found computing the level c_1 where the incompetent is just indifferent between the expected gain, half the utility $\delta v(1)$ from holding political office, and the cost, the distortion in the optimal time profile of consumption plus the reduction in the resources available for consumption when Pr(reel nc) rises from 1/2 to 1. This is represented in graph 3.

If the competent is tempted to deviate to c_1^d, voters can

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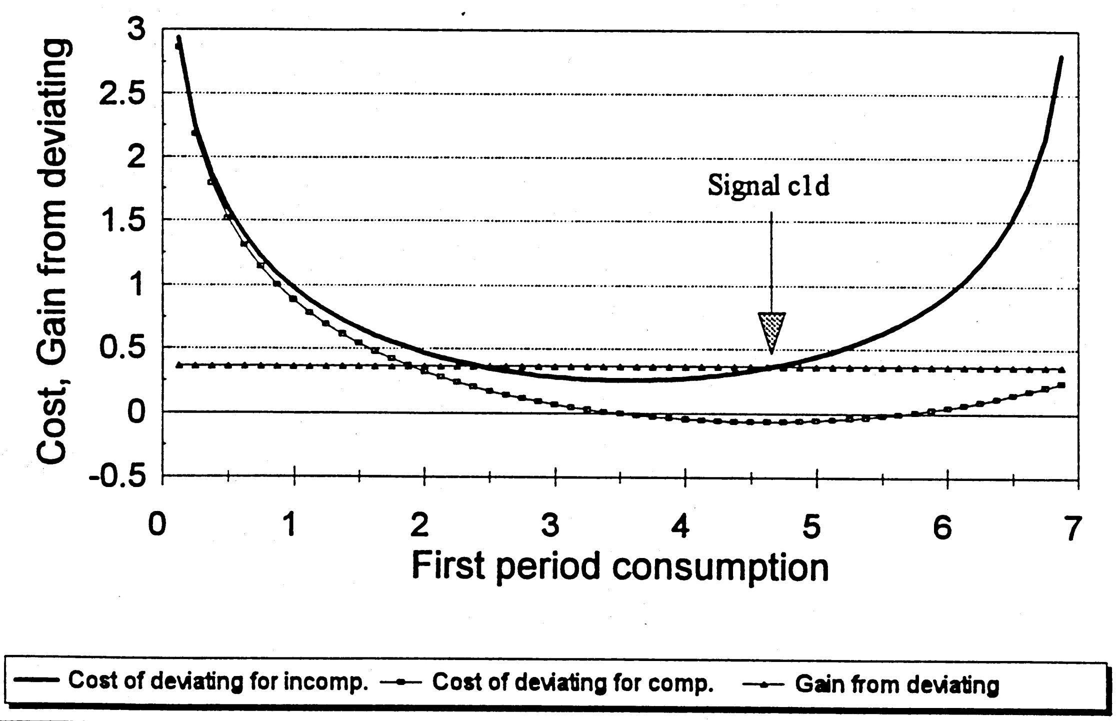
[15]If the utility v(1) from being in office is smaller than necessary for a pooling equilibrium, a semi-separating equilibrium is possible, though some complications arise.

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

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

A way out is to assume that voters reelect the incumbent with a probability that just makes the incompetent indifferent between mimicking or not. If the incompetent mimics with certainty, the voters will indeed be indifferent between government and opposition. With refinement, semi-separating equilibrium can be eliminated.

Graph 3: Deviating from pooling



infer from this deviation that the incumbent is signalling it is competent, to make them revise their beliefs and raise Pr(reel i) from 1/2 to 1. Hence, voters will not expect a competent government to ever send the pooling signal in the first place. The condition for the pooling equilibrium to stand is thus

$$T(c_1^d, c_1^p/c) = \delta \frac{V(s_2)}{2} - C(c_1^d, c_1^p/c) \leq 0 \quad \textbf{(21)}$$

The cost of deviating from pooling equilibrium is always lower for a competent government.[16] Therefore, the competent will effectively be tempted to deviate at the point where the incompetent is just indifferent, as long as a π_1^d exists to implement c_1^d. The pooling equilibrium survives only if a corner solution is hit, which is precisely the instance where a separating equilibrium cannot be attained. The likelihood of a pooling equilibrium is larger when reelection (rather than social welfare) is the overriding concern of the incumbent, and when the difference in the degree of competence between both types is small.

<u>Proposition 2</u>: if there is no inflation rate π_1^s to implement c_1^s, there is an inflation rate π_1^p to implement pooling equilibrium, where $c_1 = c_1^p$ for both types of government. Otherwise, only a separating equilibrium exists.

Thus multiple equilibria can be ruled out when out-of-equilibrium beliefs are restricted with forward rationality

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[16]Lemma 5 in Appendix.

requirements. There will either be a separating equilibrium, or else, when the gain from reelection is overriding concern of incumbent, a pooling equilibrium.

c. Welfare implications

Is signalling optimal from a social welfare perspective? The answer depends on the type of equilibrium. Under a pooling equilibrium, it is the incompetent government that deviates by mimicking what a competent government would do. This is obviously welfare-reducing: it involves a fixed cost, as the probability of an incompetent being in office in the second period increases from (1-q) to (1-q/2). And it also involves a variable cost, that depends positively on how far the incompetent has to deviate to mimic the competent.

In the case of the separating equilibrium, it is the competent that deviates. The welfare effects of signalling in this type of equilibrium are ambiguous. The cost of signalling for the competent (depicted in graph 1) has a fixed component that is negative, since the signal insures that a competent will be in office in the second period. Given that it is beneficial, we can call this component a "fixed benefit". This benefit will depend, among other things, on the parameter q. If q is close to 1, this benefit will be very small, since most likely a competent will be in office in the second period, whether the competent incumbent signals or not.

The variable cost component is positive, and increasing in c_1^s. The signal c_1^s is greater when the utility of holding office is large and when the difference in competence between the two types is small. Therefore, the variable cost will be larger under those same conditions.

Whether signalling by the competent is socially optimal depends on the relative importance of the fixed benefit and the variable cost. Signalling in the separating equilibrium is more likely to be "good" when the utility of holding office is small, when the difference in competence between both types of government is large, and when q is small. In the case shown in graph 1, signalling by the competent is marginally beneficial (the cost of signalling is slightly negative).

5. Conclusions

In Section Four we developed a model of elections where low inflation is the signal that the incumbent 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 an incompetent government in a pooling equilibrium, when it mimics a competent government to be reelected. Which equilibrium is achieved depends on the importance of the personal gains from reelection: when the stakes of reelection are sufficiently high, there is switch to pooling equilibrium.

Since this is a one-sector model, there is no distinction between devaluation and inflation, so another way to interpret our model is to say governments tend to defer devaluations until after elections. 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, the stop-go cycles of inflation and balance of payments crises. This furnishes a reason for governments to allow exchange rate overvaluation, even at the risk of a balance of payments crisis.

Appendix

Lemma 1: There is a trade-off between current and future inflation over the expected range for π_2 (Section 3.v).

Differentiating the (implicit) consumption functions and plugging them into the overall transformation frontier for the economy (1), 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.

$$\frac{d\pi_1}{d\pi_2} = -\frac{\dfrac{\partial c_1}{\partial \pi_2} + \dfrac{1}{1+i}\dfrac{\partial c_2}{\partial \pi_2}}{\dfrac{\partial c_1}{\partial \pi_1} + \dfrac{1}{1+i}\dfrac{\partial c_2}{\partial \pi_1}} \tag{22}$$

An alternative way to derive the trade-off involves a slight change of steps. By the overall transformation frontier (1) and the intertemporal condition for consumers (9), 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).

$$\begin{aligned} \frac{dc_1}{d\pi_2} &= \frac{-1/(1+\pi_2)}{u''(c_1) + \dfrac{(1+i)\delta}{1+\pi_2}u''(c_2)}u'(c_1) > 0 \\ \frac{dc_2}{d\pi_2} &= -(1+i)\frac{dc_1}{d\pi_2} < 0 \end{aligned} \tag{23}$$

The relationship with first-period inflation can be established using the budget restriction (6) consumers face. This expression is equivalent to the one derived previously (as can be verified doing the requisite substitutions).

$$\frac{d\pi_1}{d\pi_2} = -\frac{(1-(1+i)(1+\pi_2))\frac{dc_1}{d\pi_2}+c_2}{(M_0/p_0)/(1+\pi_1)^2}, \quad \frac{d\pi_1}{d\pi_2}\Big|_{1+\pi_2=\frac{1}{1+i}} < 0 \qquad \textbf{(24)}$$

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-positive.

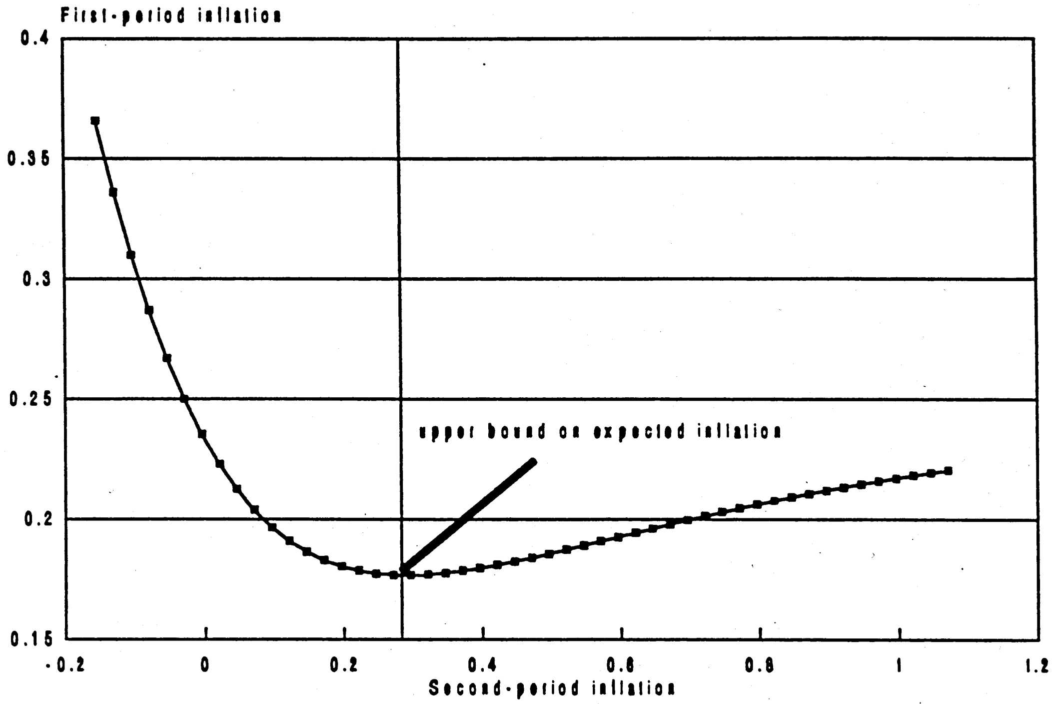
For the class of concave CRRA utility functions we analyze, with a constant elasticity ε, the sign of the numerator depends on the sign of the expression within brackets, a function that is initially negative but monotonically increasing in π_2.

$$\frac{d\pi_1}{d\pi_2} = \frac{(1+\pi)^2}{M_0/p_0}\frac{c_1c_2}{A\epsilon}\left[1-\frac{1}{(1+\pi_2)(1+i)}-\frac{A\epsilon}{c_1}\right] \qquad \textbf{(25)}$$

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, so the minimum value of π_1 is attained there (Graph 4, with $u(c_t)=c_t^{4/5}$).

This fact means that for some values of π_1 second period inflation is not defined uniquely, but rather there is a pair

Graph 4- Trade-off between present and future inflation



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 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.[17]

[17]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 can correspond to each π_1, this is a reason to restrict expected π_2 to be the smallest of the two.

Consequently, the expected range for π_2 is defined as those values that do not exceed upper bound of π_2.[18] Given this restriction on beliefs, there is a negative relationship between first and second period inflation, as stated in text.

Furthermore, this implies that 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.

Lemma 2: Consumer's expected utility increases with the likelihood that the substitute of the current incumbent is competent (Section 4.i.).

Utility is evaluated at optimal consumption profile. 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.

$$\underset{c_1}{Max}\ EU(c_1/nc) = u(c_1) + \delta\,[q\ u(c_2^{nc,c}(c_1)) + (1-q)\,u(c_2^{nc,nc}(c_1))] \quad (26)$$

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

[18]Note that if the expected range for π_2 has an upper bound, this imposes an upper bound on c_1 that is smaller than A.

an increasing, continuous function of q.

$$\frac{dc_1^{nc}}{dq}=\frac{\delta(1+i)\,[u'(c_2^{nc,c}(c_1^{nc}))-u'(c_2^{nc,nc}(c_1^{nc}))]}{u''(c_1^{nc})+\delta(1+i)^2[qu''(c_2^{nc,c}(c_1^{nc}))+(1-q)\,u''(c_2^{nc,nc}(c_1^{nc}))]}>0 \tag{27}$$

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, expected utility is increasing in the likelihood the government in second period is competent.

$$\frac{\partial EU(c_1^{nc}(q)/nc)}{\partial q}=\delta\,[u(c_2^{nc,c}(c_1^{nc}(q)))-u(c_2^{nc,nc}(c_1^{nc}(q)))]>0 \tag{28}$$

Lemma 3 First period inflation is lower with a competent government (Section 4.i).

Consider i=nc.[19] Once it finds optimal c_1^{nc}, it must determine the inflation π_1^{nc} needed to implement this plan. 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 consumption will be lower than with substitute j=c ($c_2^{nc,nc}<c_2^{nc,c}$), and hence inflation will be higher, but in any case the following product is equal to real money demand in the first period.

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

$$c_2^{nc,c}(1+\underline{\pi}_2) = c_2^{nc,nc}(1+\overline{\pi}_2) = M_1^{d,nc}/p_1 \tag{29}$$

The first-order condition for consumers, given inflation expected with competent and incompetent replacements, is

$$u'(c_1^{nc}) = \delta\,[q\,u'(c_2^{nc,c})\frac{1}{1+\underline{\pi}_2} + (1-q)\,u'(c_2^{nc,nc})\frac{1}{1+\overline{\pi}_2}] \tag{30}$$

Comparing this to the first-order condition (14) for i=nc in text, we can infer that a weighted average of the expressions $1/(1+\pi_2)$, where π_2 is either low or high, equals (1+i). Since both weights are positive, it follows that

$$\underline{\pi}_2 < -\frac{i}{1+i} < \overline{\pi}_2 \tag{31}$$

Using the budget restrictions for consumers and for the economy as a whole, we can derive inflation when i=nc. 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,

$$\begin{aligned} \pi_1^c &= \frac{M_0/p_0}{A^{c,c}} - 1 \\ \pi_1^{nc} &= \frac{M_0/p_0}{A^{nc,c} + c_2^{nc,c}[\frac{i}{1+i} + \underline{\pi}_2]} - 1 \end{aligned} \tag{32}$$

Since $A^{c,c}>A^{nc,c}$, and $i/(1+i)+\underline{\pi}_2<0$, we have $\pi_1^{nc}>\pi_1^c$.

Lemma 4 The cost of signalling is lower for competent government over the relevant range for separating signal, $c_1 \geq c_1^c$ (Section 4.ii).

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 can be denoted c_1^{nsnc}, which equals c_1^{nc}, while for i=c it can be denoted c_1^{nsc}, which is smaller than c_1^c. These values c_1^{nsi} are the ones that do not distort optimal consumption profile, given fact that incumbent will not be reelected.

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^{nsi}, where i is not reelected. This cost can be broken down into a fixed cost (since second period consumption decreases when probability second period government is incompetent rises), and a variable cost (which depends on upward distortion of first period consumption). Note c_1^{si} which minimize signalling costs for each government type i differ, where $c_1^{snc}<c_1^{nsnc}<c_1^{nsc}<c_1^{sc}$.

$$C(c_1^s, c_1^{nc}/nc) = \delta\, q[u(c_2^{nc,c}(c_1^{nc}))-u(c_2^{nc,nc}(c_1^{nc}))] + u(c_1^{nc}) + \delta\, u(c_2^{nc,nc}(c_1^{nc})) - [u(c_1^s) + \delta\, u(c_2^{nc,nc}(c_1^s)] \tag{33}$$

$$C(c_1^s, c_1^{nsc}/c) = \delta(1-q)\,[u(c_2^{c,nc}(c_1^{nsc})-u(c_2^{c,c}(c_1^{nsc}))] + u(c_1^{nsc}) + \delta\, u(c_2^{c,c}(c_1^{nsc})) - [u(c_1^s) + \delta\, u(c_2^{c,c}(c_1^s))]$$

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^{snc} that does not distort optimum consumption profile. By Lemma 2, $C(c_1^{snc}, c_1^{nc}/nc) > 0$, since Pr(reel nc) rises from 0 to 1. As to i=c, at $c_1^{sc} = c_1^{c}$ cost curve attains minimum for same reason. By Lemma 2, $C(c_1^{c}, c_1^{nsc}/c) < 0$, since Pr(reel c) rises from 0 to 1.

If the signal is $c_1^{s} = c_1^{c}$, $C(c_1^{s}, c_1^{nsc}/c) < C(c_1^{s}, c_1^{nc}/nc)$. Furthermore, differentiating these functions, the derivative of the incompetent's cost function is larger for all $c_1 \geq c_1^{c}$, so it remains above the competent's cost function.

<u>Lemma 5</u> The cost of deviating from a pooling equilibrium is lower for a competent government (Section 4.ii).

The argument is very similar to Lemma 4. The cost of deviating for each type of incumbent i is the difference between expected utility of consumers at c_1^{d}, where i is reelected for sure, and at c_1^{P}, where i is reelected with probability 1/2. This cost can be broken down into a fixed cost (since second period consumption decreases when probability second period government is incompetent rises), and a variable cost (which depends on upward distortion of first period consumption).

$$C(c_1^d, c_1^p/nc) = \delta\,\frac{q}{2}[u(c_2^{nc,c}(c_1^p)) - u(c_2^{nc,nc}(c_1^p))]$$
$$+u(c_1^p) + \delta\, u(c_2^{nc,nc}(c_1^p)) - [u(c_1^d) + \delta\, u(c_2^{nc,nc}(c_1^d)] \qquad \textbf{(34)}$$
$$C(c_1^d, c_1^p/c) = \delta\,\frac{1-q}{2}[u(c_2^{c,nc}(c_1^p) - u(c_2^{c,c}(c_1^p))]$$
$$+u(c_1^p) + \delta\, u(c_2^{c,c}(c_1^p)) - [u(c_1^d) + \delta\, u(c_2^{c,c}(c_1^d))]$$

The deviation cost functions are both convex in c_1^d, as can be verified by differentiation. Note that minimum for i=nc is at c_1^{snc}, while minimum for i=c is at c_1^c. Furthermore, evaluated at $c_1=c_1^p$, the cost function is positive for incompetent and negative for competent. Differentiating them, the derivative of the incompetent's function is larger for all $c_1 \geq c_1^p$, remaining above the competent's function.

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