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WHY ARE STABILIZATIONS DELAYED?

by

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## WHY ARE STABILIZATIONS DELAYED?

Alberto Alesina and Allan Drazen\*

### ABSTRACT

When a stabilization has significant distributional implications (as in the case of tax increases to eliminate a large budget deficit) different socio-economic groups with conflicting distributional objectives may attempt to shift the burden of stabilization onto other groups. The process leading to a stabilization becomes a "war of attrition", with each group finding it rational to attempt to wait the others out, and stabilization occurring only when one group concedes and is forced to bear a disproportionate share of the burden of fiscal adjustment.

We solve for the expected time of stabilization in a model of "rational" delay based on a war of attrition and present comparative statics results relating the expected time of stabilization to several political and economic variables. We motivate this approach and its results by comparison to historical and current episodes.

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Countries often follow policies for extended periods of time which are recognized to be infeasible in the long run. For instance, large deficits implying an explosive path of government debt are allowed to continue even though it is apparent that such deficits will have to be eliminated sooner or later. A puzzling question is why these countries do not stabilize immediately, once it becomes apparent that current policies are unsustainable



and that a change in policy will have to be adopted eventually. Delays in stabilization are particularly inefficient if the longer a country waits the more costly is the policy adjustment needed to stabilize, and if the period of instability before the policy change is characterized by economic inefficiencies. Fiscal imbalances are often associated with high and variable inflation: the fiscal stabilization also stops inflation. This paper studies the politico-economic determinants of delays in the adoption of fiscal adjustment programs.

The literature on the pre-stabilization dynamics implied by an anticipated future stabilization (for example, Thomas Sargent and Neil Wallace (1981), Allan Drazen and Elhanan Helpman (1987,1990)) assumes that the timing of the future policy change is exogenous.<sup>1</sup> Since in these models the long-run infeasibility of current policy is known from the beginning, what is missing is an explanation of why the infeasible policy is not abandoned immediately. Explanations of the timing of stabilization based on irrationality, such as waiting to stabilize until "things get really bad," are unconvincing: since the deterioration in the fiscal position can be foreseen, the argument depends on countries which delay stabilization being more irrational than others. Explanations which give a key role to exogenous shocks leave unexplained both why countries do not stabilize as soon as unfavorable shocks occur and why stabilizations that are undertaken often don't seem to coincide with significant observable changes in external circumstances.<sup>2</sup>

This paper argues that the timing of stabilizations and, in particular, their postponement cannot be easily understood in models in which the policymaker is viewed as a social planner maximizing the welfare of a

representative individual: on the contrary, heterogeneity in the population is crucial in explaining these delays. In many cases the process leading to a stabilization can be described as a war of attrition between different socio-economic groups with conflicting distributional objectives. Delays in stabilization arise due to a political stalemate over distribution; stabilizations occur when a political consolidation leads to a resolution of the distributional conflict.

More specifically, even though it is agreed that stabilization requires a change in fiscal policy to eliminate budget deficits, there may be disagreement about how the burden of the policy change is to be shared. When socio-economic groups perceive the possibility of shifting this burden elsewhere, each group may attempt to wait the others out. This war of attrition ends and a stabilization is enacted when certain groups "concede" and allow their political opponents to decide on the allocation of the burden of the fiscal adjustment. Concession may occur via legislative agreement, electoral outcomes, or ceding power of decree to policymakers.

We present a simple model of delayed stabilization due to a war of attrition and derive the expected time of stabilization as a function of characteristics of the economy, including parameters meant to capture, in a rough way, the degree of political polarization. For example, the more uneven is the expected allocation of the costs of stabilization when it occurs, the later is the expected date of a stabilization. Hence, if unequal distribution of the burden of taxation is an indicator of political polarization, more politically polarized countries will experience longer periods of instability.<sup>3</sup> More institutional adaptation to the distortions associated with instability also implies later expected stabilization, while partial

attempts to control the deficit prior to a full stabilization may make the expected time of full stabilization either earlier or later. We also show that if it is the poor who suffer most in the pre-stabilization period, they bear the largest share of the costs of stabilization. The distribution of income is also related to the timing of stabilization. Conditions are derived under which a more unequal distribution of income implies either an earlier or later stabilization.

Our approach is related to the literature on dynamic games between a monetary and a fiscal authority with conflicting objectives (Sargent (1986), Guido Tabellini (1986,1987), Michael Loewy (1988)). In that literature a war of attrition is played between the fiscal and monetary authorities: an unsustainable combination of monetary and fiscal policies is in place until one side concedes.<sup>4</sup> Our shift in emphasis to a game between interest groups has several justifications. First, the assumption that the monetary authority is independent of the fiscal authority is unrealistic for most countries with serious problems of economic instability. Second, the difference in the objective functions of different branches of government may be related to their representing different constituencies; here we tackle issues of heterogeneity directly.<sup>5</sup>

The paper is organized as follows. Section I summarizes some regularities observed in a number of stabilizations which suggest using a war of attrition as a model. Section II presents a stylized model of stabilizations based on the empirical observations and shows how delays result from individually rational behavior. Section III presents comparative static results on how the expected date of stabilization will differ in economics with different characteristics. The final section suggests extensions.

## I. Delayed Stabilization as a War of Attrition

No single model can explain every episode of delay in enacting a macroeconomic stabilization. Historical and current evidence suggests, however, that in many cases of instability due to severe fiscal imbalances, it was disagreement over the allocation of the burden of fiscal change which delayed the adoption of a new policy. We begin by noting common features of the stabilization process across several episodes, features which suggest modelling stabilization as a war of attrition.

1. There is agreement over the need for a fiscal change, but a political stalemate over how the burden of higher taxes or expenditure cuts should be allocated. In the political debate over stabilization, this distributional question is central.

Sharp disagreements over allocating the burden of paying for the war were common in the belligerent countries after World War I (Alesina (1988), Barry Eichengreen (1989)). For example, in France, Germany, and Italy, the political struggle over fiscal policy was not about the need for reducing enormous budget deficits or the debt overhang, but over which groups should bear higher taxes to achieve that end. Parties of the right favored proportional income and indirect taxes; parties of the left proposed capital levies and more progressive income taxes (Robert Haig (1929), Charles Maier (1975)).

In particular, France in the first half of the twenties is a textbook example of a distributional war of attrition. The period 1919-1926 is marked by a high degree of polarization of the political debate and by large swings in the composition of the legislature. After it became clear, in the early



twenties, that the German war reparations would not have solved the French fiscal problem, the Chamber of Deputies was deadlocked for several years because of lack of agreement on feasible fiscal plans. For instance, in the fall of 1922 the centrist Minister of Finance proposed a 20 percent across the board increase in the income tax. The proposal was not approved in the Chamber, because of the opposition of both the Conservatives and the Socialists. The former proposed an increase in indirect taxes, which relied mostly on the poor (Maier (1975)) and a reduction in the progressivity of the income tax. The latter proposed a capital levy, a more progressive income tax and reduction in indirect taxation. The lack of a compromise led to an eighteen month period of complete fiscal inaction, which implied a sharp rise in the inflation rate, capital flight, and speculative attacks against the Franc. A conservative tax bill was not approved until March 1924. This attempted fiscal stabilization was, however, only temporary. The election of an internally divided "Cartel des Gauches" in the spring of 1924 initiated an additional period of fiscal instability. An endless debate within the leftist coalition on the imposition of a capital levy and the consequent fiscal inaction implied a further deterioration of the floating debt problem.

Britain after the war also faced a large budget deficit; however, in contrast to the experience of France, Germany and Italy, the dominant position of the Conservatives led to a rapid stabilization by means which favored the Conservatives' traditional constituencies.

Fiscal imbalances reappeared in the thirties, as a result of the Great Depression. France, once again, provides an excellent example of a political stalemate due to distributional conflicts.<sup>6</sup> After a period of relative political and fiscal stability (1926-1932), the effects of the economic

depression on fiscal revenues generated large budget deficits (after six years of surpluses) leading to the reappearance of a large stock of floating short-term debt (Julian Jackson (1985)): in contrast to the twenties, in the thirties budget deficits occurred in a deflationary situation. After six years of Conservative control of government, the left reported an electoral victory in 1932; however the center-left radicals refused to form a coalition with the Socialists. From 1932 to 1936 a series of short-lived centrist (or center-left) governments failed to adopt a coherent fiscal policy because of the opposite political pressures from the Conservatives and the Socialists. The former were firmly committed to the gold standard, argued for a sharp deflation of nominal wages and prices, cuts in government spending and increases in indirect taxation to eliminate the deficit. The Socialists opposed wage cuts, argued in favor of public investment to sustain aggregate demand and proposed, as in the twenties, an increase in the level and progressivity of income taxation and various forms of capital taxation to eliminate the fiscal imbalance (Jackson (1985)). The long debate over a proposal (opposed by the Socialists and favored by the Conservatives) for a cut of twenty percent of the salaries of public employees is emblematic of the political stalemate. In 1936 the Popular Front gained office and a few months later the franc was devalued. Divisions within the coalition and lack of confidence in the business community led to a further economic deterioration and to the fall, in 1938, of the government. A newly elected Conservative government attempted a fiscal stabilization: it is hard to say whether it would have succeeded or not because of the outburst of the Second World War. Eichengreen and Jeffrey Sachs (1985) argue that because of the delay in abandoning the gold standard and the incoherence and inaction of French

economic policy in the thirties, this country suffered particularly severe consequences of the Great Depression.

Current examples of delayed adjustments of fiscal imbalances due to political stalemate can be found in both OECD and LDC countries. Several authors have suggested that the recent increase in the debt/GNP ratios in several OECD economies is due to the failure of weak and divided coalition governments to agree on fiscal adjustments programs.<sup>7</sup> The cases of Belgium, Ireland and Italy, the three OECD countries currently with the highest debt/GNP ratio are good examples of this point of view. In several Latin American countries, and particularly in Argentina, the failure to stabilize in the face of endemic inflation has gone hand in hand with continued political polarization and instability and the failure of any group to consolidate its power effectively (Rudiger Dornbusch and Juan Carlos De Pablo (1988)). Similarly, in Israel in the 1980's, once the need for sharply restrictive aggregate demand policies to end the inflation was widely accepted, there was still disagreement over how the burden of restrictive policies would be distributed between labor and business.

2. When stabilization occurs it coincides with a political consolidation. Often, one side becomes politically dominant. The burden of stabilization is sometimes quite unequal, with the politically weaker groups bearing a larger burden. Often this means the lower classes, with the burden of a successful stabilization being regressive.

The successful stabilizations in France (1926) and Italy (1922-24) coincided with a clear consolidation of power by the right. In both cases, the burden fell disproportionately on the working class (Maier (1975)). Poincare's 1926 program included an increase of indirect taxes and of the

income tax on the lower middle class. Except for a very mild "once and for all" tax on real estate, no capital levies were introduced. On the contrary, tax rates on the wealthiest fraction of taxpayers were substantially reduced, as documented by Haig (1929). This author concludes that when the fiscal crisis came to an end "the remedy was sought in lightening the burden on rich taxpayers and by increasing the levy on those of moderate means."

The German stabilization of November 1923 followed a new Enabling Act giving the new Stresemann government power to cut through legislative deadlocks and quickly adopt fiscal measures by decree. Though the government which took power in August was a "Grand Coalition" of the right and the left, by autumn "the far right was more dangerous and powerful than the socialist left" and government policy reflected the perceived need to appease conservative interest groups (Maier (1975)).

Giavazzi and Pagano (1990) document that the successful Danish fiscal adjustment, started in 1982 was made possible by the election of a conservative government with a solid majority, which ended a period marked by a series of minority coalition governments, unable to stop the growth of government debt.

3. Successful stabilizations are usually preceded by several failed attempts; often a previous program appears similar to the successful one.

In a war of attrition the cost of waiting means that the passage of time will imply concession on the same terms that a player earlier found "unacceptable." The components of the successful Poincaré stabilization of 1926 are quite similar to his program of 1924. Several unsuccessful attempts in Germany appear quite similar ex ante to the November 1923 program

(Dornbusch (1988)). Many aspects of the July 1985 stabilization in Israel had been previously proposed, but rejected by the government.

In summary, the central role of conflict over how the burden of stabilization is to be shared; the importance of political consolidation in the adoption of a program; and the fact that programs which were previously rejected are agreed to after the passage of time, suggests modelling delayed stabilization as arising from a war of attrition between different socio-economic groups.

In the basic war of attrition model from biology (John Riley (1980)), two animals are fighting over a prize. Fighting is costly, and the fight ends when one animal drops out, with the other gaining the prize. Suppose that the two contestants are not identical, either in the costs of remaining in the fight or in the utility they assign to the prize. Suppose further that each contestant's value of these is known only to himself, his opponent knowing only the distribution of these values. The individual's problem is then to choose a time of concession based on his type, that is, the value of his costs and payoffs, on the distribution of his opponent's possible type, and on the knowledge that his opponent is solving the same problem. In equilibrium the time of concession is determined by the condition that at the optimal time, the cost of remaining in the fight another instant of time is just equal to the expected gain from remaining, namely the probability that the rival drops out at that instant multiplied by the gain if the rival concedes.

For a war of attrition between heterogeneous individuals to give expected finite delay in concession under incomplete information, two obvious features are important. First, there must be a cost to remaining in the fight, that is to not conceding. Second, the payoff to the winner must exceed that to the

loser. In the next section we show how stabilizations may be modelled with these features in mind.

## II. The Model

We consider an economy as in Drazen and Helpman (1987,1990) in which the government is running a positive deficit (inclusive of debt service) implying growing government debt.<sup>8</sup> Stabilization consists of an increase in taxes which brings the deficit to zero, so that government debt is constant. We assume that prior to an agreement on how to share the burden of higher taxes, the government is limited to highly inefficient and distortionary methods of public finance. In particular, monetization of deficits, with the associated costs of high and variable inflation, is often a main source of government revenue prior to a fiscal stabilization. The level of distortionary financing, and hence the welfare loss associated with it, rises with the level of government debt, where welfare losses may differ across socio-economic groups.<sup>9</sup>

A second type of cost to continuing in a war of attrition is political. For a group to prevent the burden of a stabilization being placed on it, it must mobilize and use resources for lobbying activities to influence the outcome of the legislative process. Different groups may differ in their political influence and therefore in the level of effort needed to continue fighting. In the development of the model the first interpretation of pre-stabilization costs is stressed, but we will return to political interpretations in the concluding section.

The benefit of stabilization derives from the move away from highly distortionary methods of financing government expenditures. In this respect,



stabilization benefits everybody. The differential benefits reflect the fact that the increase in nondistortionary taxes is unequally distributed.

Concession in our model is the agreement by one side to bear a disproportionate share of the tax increase necessary to effect a stabilization. As the examples in the previous section illustrate, effective concession may be reflected in a formal agreement between the various sides, as in the Israeli case; in the formation of a new government which is given extraordinary powers, as in the French or German cases; or in the outcome of elections in which one side gains a clear majority, and opposing groups decide not to block their program any longer.<sup>10</sup>

More formally, consider a small open economy which issues external debt to cover any deficits not covered by revenues. The economy is composed of a number of heterogeneous interest groups which differ from one another in the welfare loss they suffer from the distortions associated with the pre-stabilization methods of government finance.

Until  $t = 0$  the government budget is balanced, with external government debt constant at level  $b_0 \geq 0$ . At  $t = 0$  a shock hits reducing available tax revenues. From  $t = 0$  until the date of stabilization a fraction  $(1-\gamma)$  of government expenditure (inclusive of interest payments) is covered by issuing debt, and a fraction  $\gamma$  by distortionary taxation. What is important is not that  $\gamma$  is fixed, but that it is positive. Calling  $g_0$  the level of expenditures from  $t = 0$  until a policy change, debt  $b(t)$  evolves according to

$$(1) \quad \dot{b}(t) = (1-\gamma)(rb(t) + g_0)$$

where  $r$  is the constant world interest rate. Taxes before the date of stabilization are thus

$$(2) \quad r(t) = \gamma(rb(t) + g_0)$$

Equation (1) may be solved to yield

$$(3) \quad b(t) = b_0 e^{(1-\gamma)rt} + \frac{g_0}{r} \left[ e^{(1-\gamma)rt} - 1 \right].$$

This implies that (2) may be written as

$$(4) \quad r(t) = \gamma r \bar{b}^{(1-\gamma)rt}.$$

where  $\bar{b} = b_0 + g_0/r$ , which can be shown to be the present discounted value of future tax payments for any non-zero values of  $\gamma$  before and after stabilization.

A stabilization consists of an increase in taxes sufficient to prevent further growth in the debt. Hence taxes to be levied from the date of stabilization  $T$  onward are

$$(2') \quad r(T) = rb(T) + g_T,$$

where  $g_T$  is the level of expenditures after a stabilization. If we assume, for simplicity, that  $g_T = g_0$ , (2') becomes

$$(4') \quad r(T) = r\bar{b}e^{(1-\gamma)rT}.$$

Equations (3) and (4) imply that before the stabilization both the debt and the distortionary taxes grow exponentially. From the time of stabilization onward the level of debt is constant. At time  $T$ , taxes jump upward to the level given in (4') and remain constant afterward.

An agreement to stabilize is an agreement on how the taxes  $r(T)$  are to be apportioned between different interest groups. For simplicity assume there are only two groups.<sup>11</sup> The "loser" assumes a fraction  $\alpha > \frac{1}{2}$  of the tax burden at  $T$ , the "winner" a fraction  $1 - \alpha$ . The fraction itself is not bargained on: it is a given parameter meant to capture the degree of polarization in the society. A value of  $\alpha$  close to one represents a high degree of polarization or a lack of political cohesiveness.

Taxes after an agreement on a stabilization are assumed to be non-distortionary. What is important is that they are less distortionary than taxes before a stabilization; otherwise, there would in general be no incentive to concede, that is, to stabilize.

Infinitely-lived groups differ from one another in the utility loss they suffer due to distortionary taxes. Let us index group  $i$ 's loss by  $\theta_i$ , where  $\theta$  is drawn from a distribution  $F(\theta)$ , with lower and upper bounds  $\underline{\theta}$  and  $\bar{\theta}$ .  $\theta_i$  is known only to the group itself, other groups knowing only the distribution  $F(\theta)$ . For simplicity we assume that the utility loss from distortionary taxes,  $K_i$ , is linear in the level of taxes, namely<sup>12</sup>

$$(5) \quad K_i(t) = \theta_i r(t).$$

The pre-stabilization distortionary tax can be viewed as the inflation tax. Needless to say, the treatment of inflation in this non-monetary model is very stylized: what is crucial in this model is the problem of fiscal adjustment, not the monetary dynamics *per se*.<sup>13</sup>

Flow utility depends on consumption,  $c$ , government spending,  $g$ , and the cost,  $K$ . Though we leave the dependence of utility on government expenditure implicit (since  $g$  is constant over time), this dependence is important below in treating problems of feasibility. The level of income,  $y$ , is assumed for most of the paper constant across individuals. The possible effects of distribution of income on the timing of a stabilization are considered below. The flow utility of group  $i$  is linear in consumption and is of the form

$$(6) \quad u_i(t) = c_i(t) - y - K_i(t),$$

Subtracting  $y$  in the utility function is simply a normalization. The level of income is assumed to be high relative to the interest payments on the debt: the importance of this assumption will be made precise below. After a stabilization,  $K_i = 0$ , as taxes after a stabilization are non-distortionary. To simplify matters, the subscript on the function  $u_i$  is suppressed.

Each group maximizes expected present discounted utility by choice of a time path of consumption and a date to concede and agree to bear the share  $\alpha$  of taxes if the other group has not already conceded. Let us denote flow utility before a stabilization by  $u^D(t)$  and the lifetime utility of the loser and the winner from the date of stabilization onward by  $v^L(T)$  and  $v^W(T)$

respectively. Lifetime utility of the winner and of the loser if stabilization occurs at time  $T$  may then be written as

$$(7) \quad U^j(T) = \int_0^T u^D(x) e^{-rx} dx + e^{-rT} v^j(T) \quad j = W, L.$$

where the discount rate equals the interest rate  $r$ . Expected utility as of time zero as a function of one's chosen concession time  $T_1$  is the sum of  $U^W(X)$  multiplied by the probability of one's opponent conceding at  $X$  for all  $X \leq T_1$  and  $U^L(T_1)$  multiplied by the probability of one's opponent not having conceded by  $T_1$ . If we denote by  $H(T)$  the distribution of the opponent's optimal time of concession (this is of course endogenous and will be derived below) and by  $h(T)$  the associated density function, expected utility as a function of  $T$  is

$$(8) \quad \begin{aligned} EU(T_1) &= (1 - H(T_1)) U^L(T_1) + \int_0^{T_1} U^W(x) h(x) dx \\ &= (1 - H(T_1)) \left[ \int_0^{T_1} u^D(x) e^{-rx} dx + e^{-rT_1} v^L(T_1) \right] \\ &\quad + \int_{x=0}^{x=T_1} \left[ \int_0^x u^D(z) e^{-rz} dz + e^{-rx} v^W(x) \right] h(x) dx \end{aligned}$$

The time path of consumption and  $T_1$  are chosen to maximize (8).

With linear utility any consumption path satisfying the intertemporal budget constraint with equality gives equal utility. Denote by  $c^D$ ,  $c^L$ , and  $c^W$  consumption before a stabilization, after a stabilization for the loser, and after a stabilization for the winner respectively. Assuming that each of the

two groups pays one-half of taxes before a stabilization, we have the lifetime budget constraints

$$(9) \quad \int_0^T c^D(x) e^{-rx} dx + \int_T^\infty c^L(x) e^{-rx} dx =$$

$$\int_0^T \left( y - \frac{1}{2} \gamma \bar{r} \bar{b} e^{(1-\gamma)rx} \right) e^{-rx} dx + \int_0^\infty \left( y - \alpha \bar{r} \bar{b} e^{(1-\gamma)rT} \right) e^{-rx} dx$$

$$(10) \quad \int_0^T c^D(x) e^{-rx} dx + \int_T^\infty c^W(x) e^{-rx} dx =$$

$$\int_0^T \left( y - \frac{1}{2} \gamma \bar{r} \bar{b} e^{(1-\gamma)rx} \right) e^{-rx} dx + \int_T^\infty \left( y - (1-\alpha) \bar{r} \bar{b} e^{(1-\gamma)rT} \right) e^{-rx} dx$$

The following consumption path is then clearly feasible

$$(11a) \quad c^D(t) = y - \frac{\gamma}{2} \bar{r} \bar{b} e^{(1-\gamma)rT} \quad 0 \leq t < T$$

$$(11b) \quad c^L(t) = y - \alpha \bar{r} \bar{b} e^{(1-\gamma)rT} \quad t \geq T$$

$$(11c) \quad c^W(t) = y - (1-\alpha) \bar{r} \bar{b} e^{(1-\gamma)rT} \quad t \geq T. 14$$

Flow utility before a stabilization is the following:

$$(12) \quad u_1^D(t) = - \frac{\gamma}{2} \bar{r} \bar{b} e^{(1-\gamma)rT} - K_1$$

$$= - \gamma r \left( \frac{1}{2} + \theta_1 \right) \bar{b} e^{(1-\gamma)rt}$$



which is the income effect of taxes plus the welfare loss arising from taxes being distortionary.

With constant consumption after a stabilization, discounted utility  $V^j$  ( $j = W, L$ ) is simply constant flow utility for each group divided by  $r$ . Using (11) and (6) (where  $K_i = 0$  after a stabilization) one immediately obtains

$$(13) \quad V^W(T) - V^L(T) = (2\alpha - 1)\bar{b}e^{(1-\gamma)rT}$$

which is the present discounted value of the excess taxes that the loser must pay relative to the winner.

The optimal concession time for a group with cost  $\theta_i$ ,  $T_i$ , can now be determined.<sup>15</sup> We will first derive the solution for the case where the problem of debt service exceeding income is ignored and then show how this solution is modified when the issue of feasibility is explicitly considered.

We further assume, for the time being, that  $\underline{\theta} > \alpha - 1/2$ . We discuss the economic meaning of this assumption below. Since the distribution  $H(T)$  is not known, equation (8) cannot be used directly. However, by showing that  $T_i$  is monotonic in  $\theta_i$ , we can derive the relation between  $H(T)$  and the known  $F(\theta)$ , namely  $(1-H[T(\theta)]) = F(\theta)$ .

LEMMA 1:  $T'_i(\theta_i) < 0$ .

Proof: See Appendix.

We now want to find a symmetric Nash equilibrium in which each group's concession behavior is described by the same function  $T(\theta)$ . In this equilibrium, if all other groups behave according to  $T(\theta)$ , group  $i$  finds it optimal to concede according to  $T(\theta)$ . Thus, the expected time of stabilization is the expected minimum  $T$ , with the expectation taken over  $F(\theta)$ . There may be asymmetric equilibria (that is, where groups behave according to different  $T(\theta)$ ) even though each group's  $\theta$  is known to be drawn from the same distribution  $F(\theta)$ . For example, there are equilibria in which one group concedes immediately. We do not investigate such equilibria, since our interest is in demonstrating that this type of model can yield delay.<sup>16</sup>

PROPOSITION 1: There exists a symmetric Nash equilibrium with each group's optimal behavior described by a concession function  $T(\theta)$ , where  $T(\theta)$  is implicitly defined by

$$(14) \quad \left[ -\frac{f(\theta)}{F(\theta)} \frac{1}{T'(\theta)} \right] \frac{2\alpha - 1}{r} = \gamma\left(\theta + \frac{1}{2} - \alpha\right).$$

and the initial boundary condition

$$(15) \quad T(\bar{\theta}) = 0.$$

Proof: See Appendix

The right hand side of (14) is the cost of waiting another instant to concede. The left-hand side is the expected gain to waiting another instant to concede.

which is the product of the conditional probability that one's opponent concedes (the hazard rate, in brackets) multiplied by the gain if the other group concedes. Concession occurs when the (group-specific) cost of waiting just equals the expected benefit from waiting.

The role of the assumption  $\underline{\theta} > \alpha - 1/2$  should now be clear. If a group has a cost  $\theta$  such that  $\theta + 1/2 < \alpha$ , they would always prefer to wait than to concede, since the cost of living in the unstabilized economy and bearing half the tax burden would be less than the cost associated with being the "loser". That is, their  $T(\theta)$  would be infinite. The above assumption means that stabilization occurs in finite time with probability one (ignoring any feasibility issues, to be discussed below).

Equation (14) is also useful in understanding the evolution of the war of attrition from the viewpoint of one side. Consider a group with  $\theta < \bar{\theta}$ . At time zero there is some probability that its opponent has  $\theta = \bar{\theta}$  and will concede immediately. If no one concedes at time zero, both sides know their opponent is not type  $\bar{\theta}$ . At the "next" instant the next-highest type concedes, and so on, so as time elapses each side learns that its opponent does not have a cost above a certain level. When the conditional probability of an opponent's concession in the next instant (based on what the group has learned about his highest possible cost) is such that (14) just holds, its time to "throw in the towel."

Let us now consider the issue of feasibility. From equation (11b) it follows that a stabilization where one group pays a share  $\alpha$  of taxes is not feasible after  $T = \frac{1}{(1-\gamma)r} \ln(y/\alpha \bar{b})$ . Indicate this value with  $T^*$  and let  $\theta^*$  be the associated cost defined by  $T(\theta^*) = T^*$ . Suppose, therefore, that if no concession has occurred by  $T^*$  the government closes the budget deficit by a

combination of expenditure cuts and distortionary taxes which imply very large loss of utility. If the utility loss is sufficiently high, a group with  $\theta < \theta^*$  would prefer to concede at  $T^*$  than to have the distortionary solution imposed. The government's threat thus implies that the distribution of concession times will have a mass point at  $T^*$ , with concession occurring at that point with probability one if it has not occurred before. If both groups concede at  $T^*$  a tie-breaking rule is used, whereby a coin is flipped, with the loser bearing the share  $\alpha$  of non-distortionary taxes.

To close the argument, the existence of a mass point at  $T^*$  means that groups with costs close to but above  $\theta^*$  (that is who would have conceded before  $T^*$  under strategy  $T(\theta)$  if there were no mass at  $T^*$ ) will now find it preferable to wait until  $T$  to concede under the tie-breaking rule. Define  $\bar{\theta} > \theta^*$  as the cost such that a group with this cost is indifferent between being the stabilizer at  $\bar{T} = T(\bar{\theta})$  or waiting until  $T^*$  to be the stabilizer with probability one-half. The addition of the government's threat at  $T^*$  will therefore not affect optimal strategy for groups with  $\theta \geq \bar{\theta}$ . Since  $T^*$  is increasing in  $y$  and  $\bar{T}$  is increasing in  $T^*$ ,  $\bar{T}$  would be increasing in  $y$ . Thus as  $y$  increases, the fraction of the distribution of groups whose behavior is described by  $T(\theta)$  in Proposition 1 rises. Put another way, for fixed  $y$  arbitrarily high, the time until which the solution in Proposition 1 holds can also be made arbitrarily high.

If we relax the assumption that  $\theta > \alpha - 1/2$ , it is possible that no group concedes and stabilization takes place only due to intervention as above. This seems consistent with historical experience. Maier (1975) argues that inflation stabilization in Germany and France in the 1920's was possible only because the costs of living with inflation were perceived as too high by

participants in the political process. In contrast, the budget imbalances in France in the 1930's, which were not accompanied by high inflation, were not resolved until the Second World War broke out. That is, the costs of the fiscal crisis may not have been perceived as sufficiently high to induce any group to "concede."

Given concession times as a function of  $\theta$ , the expected date of stabilization is then the expected minimum  $T$ , the expectation taken over  $F(\theta)$ . With  $n$  players the probability that a given  $\theta$  is the maximum (so that  $T(\theta)$  is the minimum) is its density  $f(\theta)$  multiplied by the probability that no other  $\theta$  is higher, namely  $(F(\theta))^{n-1}$ , multiplied by  $n$ . With  $n = 2$ , the expected value of minimum  $T$ , that is, the expected time of stabilization  $T^{SE}$ , is thus

$$(16) \quad T^{SE} = 2 \int_{\underline{\theta}}^{\bar{\theta}} T(x)F(x)f(x)dx.$$

As long as all participants in the process initially believe that someone else may have a higher  $\theta$ , stabilization does not occur immediately. The cumulative distribution of stabilization times  $T$  is therefore one minus the probability that every group has a  $\theta$  lower than the value consistent with stabilization at  $T$ . With two groups this is

$$(17) \quad S(T) = 1 - (F[\theta(T)])^2$$

where  $\theta(T)$  is defined by  $T(\theta) = T$ .

Two observations are useful in helping to explain the key role of heterogeneity. Suppose, first, that all groups were identical, as in a representative agent model. If we interpret this as there being a single agent, he knows with probability one that he will be the stabilizer. Since  $u^D$  is negative, equation (8) implies that expected utility is maximized by choosing  $T_1$  equal to zero, that is, by stabilizing immediately. Intuitively, if an individual knows that he will end up bearing the cost of a stabilization, a cost to waiting implies that it is optimal to act immediately.

Heterogeneity alone is not sufficient, however, to delay stabilizations. There must also be uncertainty about the cost to waiting of other groups. If it is known to all that a group has higher costs than anyone else, optimal behavior will imply that this group concedes immediately. Intuitively, stabilization is postponed because each interest group believes in the possibility that another group will give up first.

In addition, it is interesting to compare the sense in which stabilization becomes "inevitable" in this paper with the sense used in Sargent and Wallace (1981) and Drazen and Helpman (1987,1990). In those papers a positive deficit (exclusive of debt service) implies that government debt is growing faster than the rate of interest, so that its present value is not converging to zero. The failure of this transversality condition to hold, and hence the long-run infeasibility of the path, is what makes the stabilization inevitable. Here, the war of attrition ends in finite time with a stabilization, even if debt grows less fast than the rate of interest. Hence our approach indicates why countries whose policies are technically



feasible (in the sense that the present discounted value of the debt goes to zero) will eventually stabilize if current policies involve welfare loss.

### III. Why Do Some Countries Stabilize Sooner than Others?

We can now ask how different parameter values affect the expected time of a stabilization. Our goal is to see whether observable characteristics of economies explain why some countries stabilize sooner than others. These results are presented in several propositions, and explained intuitively. The proofs are in the Appendix. We proceed under the assumption that  $\theta > \alpha - 1/2$ .

#### PROPOSITION 2: Distortionary Taxes or Monetization

When the utility loss from distortionary taxation is proportional to the level of taxes, financing a greater fraction of the pre-stabilization deficit via distortionary taxation (a higher  $\gamma$ ) implies an earlier date of stabilization.

This result may seem surprising, for it says that an attempt to control the growth of government indebtedness may actually hasten the date of stabilization. A higher  $\gamma$  on the one hand implies a greater distortion for a given deficit, inducing earlier concession. However, making more of an effort to reduce the deficit implies that government debt grows less fast and hence the distortions which induce stabilization also grow less fast. The reason why the first effect dominates is that our proportional specification in (5) implies that both the gain from being the winner and the loss from no stabilization are proportional to the size of the debt, so that a slower growth of the debt does not in itself change their relative magnitudes.<sup>17</sup> Higher monetization has the effect of raising the cost of the distortions in

the unstabilized economy relative to the gain from having another group stabilize at each point in time. This result is consistent with the idea that it is easier to stabilize hyperinflations than inflations which are "only" high.<sup>18</sup>

PROPOSITION 3: Costs of Distortions

An increase in the costs associated with living in an unstable economy, for an unchanged distribution of  $\theta$ , will move the expected date of a stabilization forward.

Countries with institutions that lessen the utility loss from distortionary financing of government expenditures (such as indexation) will, other things equal, be expected to postpone stabilization longer.<sup>19</sup>

If the utility loss is an increasing (perhaps convex) function of inflation, a sharp acceleration of inflation will lead to a stabilization. This would explain the timing of the French and German stabilizations.

PROPOSITION 4: Political Cohesion

If  $\alpha = 1/2$  stabilization occurs immediately; the larger is  $\alpha$  above  $1/2$ , the later is the expected date of stabilization.

The difference in the shares of the burden of stabilization,  $\alpha$ , could be interpreted as representing the degree of political cohesion in the society. Countries with  $\alpha$  close to  $1/2$  can be characterized as having high political cohesion since the burden of stabilization is shared relatively equally, while those where the burden is very unequal, so that  $\alpha$  is close to one, are more

polarized or less cohesive. When the relative burden of a stabilization is unequally distributed, the gain to waiting in the hope that one's opponent will concede is larger. Hence each group holds out longer.

This intuitive result suggests a relationship between measures of political stability and macroeconomic outcomes. Roubini and Sachs (1989a,b) argue that governments composed of large, short-lived, and uncohesive coalitions are associated with large budget deficits. They construct an index of political cohesion and stability in the government and show a strong correlation between that index and budget deficits after 1973 in several industrial countries. One explanation of this finding consistent with our model concerns the decisionmaking process within the coalition. Large coalitions of politically diverse parties find it particularly hard to reach agreements on how to allocate tax increases or expenditure cuts among the constituencies represented by coalition partners. In the absence of such an agreement, deficits grow. Alex Cukierman, Sebastian Edwards and Tabellini (1989) argue that the level of inflation in a cross-section of countries is inversely related to measures of political stability.

Finally, we consider the implications of dropping the assumption that all groups have the same income. Greater dispersion in the distribution of income can affect the timing of stabilization if a group's cost is a function of its income. As emphasized above, delays can only occur if relative costs are unknown to each group. If relative costs depend upon relative income levels, this implies that delays are observed only when relative positions in income distribution are unknown.

An increase in income inequality may make relative income levels more apparent, leading to an immediate stabilization. Consider, instead, a mean-

preserving spread in the distribution of income, maintaining the assumption of uncertainty about relative incomes. Intuitively, one may conclude that this should also lead to an earlier stabilization, since it means some group will have a higher cost and thus concede earlier. Such reasoning is incomplete, for it ignores the change in behavior (that is, in the function  $T(\theta)$ ) induced by the change in the distribution of costs. The fatter upper tail for costs, means that each group perceives a higher likelihood that its opponents' costs have increased. This perception would lead it to hold out longer.

PROPOSITION 5: Income Dispersion and Longer Delays in Stabilizing

If the utility loss due to distortionary taxes is a decreasing, convex function of income, and income is unobservable, a mean-preserving spread in the distribution of income  $G(y)$  that keeps the expected minimum of the  $y$ 's constant implies a later expected date of stabilization.

Note that if  $\theta'(y) < 0$ , it is the "poor" who lose the war of attrition, since the "rich" suffer less from the pre-stabilization distortions and can hold out longer.

The assumption of uncertainty about relative incomes is perhaps more realistic under the second interpretation of the costs provided in section II, namely as resources that must be devoted to the political process to avoid bearing a disproportionate share of the burden of stabilization. In this case, the level of group  $i$  income,  $y_i$ , would then be interpreted as the resources available for political purposes. With uncertainty both about the relative political skills of groups, and about what fraction of their total

income they are willing to devote to the political struggle, assuming uncertainty about relative "income" is less unrealistic.

An empirical finding consistent with Proposition 5 is presented by Andrew Berg and Sachs (1988), who find a correlation between the degree of income inequality and the frequency of debt rescheduling: countries with a more unequal income distribution have experienced more difficulties in servicing their external debt. Although this evidence is not directly related to the timing of stabilizations, it is consistent with the idea that countries with more income inequality will, at a given level of debt, find it more difficult to adopt policies necessary to insure solvency.

#### IV. Summary and Extensions

Delayed stabilizations can be explained in a model of rational heterogeneous agents: in contrast, the same model with a rational representative individual would yield immediate stabilization. Since many of the results are summarized in the introductory section, we conclude by discussing some generalizations and by touching on some issues which the model did not address but which are important in explaining stabilization.

First of all, even though we considered the example of a delayed budget adjustment, our argument is much more general. Any efficient policy change with significant distributional consequences can be delayed by a "war of attrition": trade and financial liberalizations are additional examples of this type of policy reforms.<sup>20</sup>

Second, for simplicity, no changes in external circumstances following the original shock were considered. More generally, during a war of attrition, a change in the environment (including aid or foreign intervention)

may lead to a change in agents' behavior and rapid concession by one side. Even (or especially) when this change is foreseen, the war of attrition is crucial in the delay of stabilization until the external change.

A third generalization involves a more precise formalization of the political process. In particular, this would lead to a more satisfactory characterization of the political costs involved in sheltering oneself from bearing the burden of stabilization. As in the model above, such costs may increase with the size of the outstanding debt: as the difference between payoffs of winners and losers rise, as a result of the growing level of the debt, each side should be willing to spend more time and resources in lobbying activities to induce its rivals to concede. Since different groups differ in their political influence or access to resources, such direct political costs will be central to the timing of concession.

A political model also suggests alternative interpretations of some of our results. For example, in Proposition 3, the effect of a shift in the distribution of  $\theta$  could be interpreted as follows. Countries with political institutions which make it relatively more difficult for opposing groups to "veto" stabilization programs not to their liking will stabilize sooner. In addition, we have not explicitly considered important political events such as elections, the timing of which may be related to the timing of stabilizations. An electoral victory of one side may make it more difficult for their opponents to block its program and shelter themselves from the burden of stabilization. Thus, one might expect successful stabilizations following elections with a clear winner. In the terminology of our model, an electoral landslide may be an important signal of the distribution of the relative strength of different groups.



Finally, we note some issues we did not discuss. The first is credibility. Delays in successfully stabilizing an economy are related to what determines the probability of success, where "credibility" of a program has come to be seen as a crucial ingredients of success. One notion of credibility is simply whether or not the economics of a program "make sense." For example, the Brazilian Cruzado Plan of 1986 was not seen as credible. While technical feasibility is necessary for success, it is clearly not sufficient, as the failure of apparently well designed programs indicates. This notion of credibility thus lacks predictive power, as Dornbusch (1988) argues, since successful and unsuccessful programs often appear quite similar ex ante. As an example, he refers to the great similarity of Poincare's successful 1926 program to the failed 1924 attempt, and to several unsuccessful attempts in Germany prior to the November 1923 program.

A second notion of credibility concerns the degree of commitment of a policymaker to the plan, in that he is unlikely to give in to pressure to abandon fiscal responsibility and revert to inflationary finance.<sup>21</sup> This has been formalized in terms of "strong" and "weak" policymakers with different objective functions. A weak policymaker, after a period of mimicking the strong one, abandons policies of monetary restraint. If the public is uncertain about the degree of commitment of the policymaker to fiscal responsibility, success is less likely. In these models, the policymaker's "type", which is crucial, is both exogenous and unobservable. For this reason, credibility as commitment also lacks predictive power.

Our model suggests that successful stabilizations need not be associated either with a sharp change in external circumstances, or with the program being implemented looking sharply different from what had previously been

proposed. The credibility and success of a program reflects the political support it can muster. A main message is that necessary changes in the level of political support may simply result from the passage of time, so that a program which was unsuccessful at one point in time may later be successful. In the war of attrition, passage of time and the accumulation of costs leads one group to give in and make a previously rejected program economically and politically feasible. This may come via the political consolidation of one "group" which forces its opponent to "throw the towel" in the war of attrition. The role of political consolidation as an element of "credibility" is also emphasized by Sargent in his discussion of hyperinflations and in his comparison of Poincaré and Thatcher (Sargent (1982) and (1984)).

Second, in reality successful stabilizations are not one-shot affairs. One component of success is designing how the adjustment process should be spread out over time. Our notion of timing emphasizes the beginning of a successful program, not the timing of its stages once it has begun. Theoretically, these different notions of timing can be separated, with this paper addressing the question of why significant policy changes, multistage or otherwise, are delayed. In fact, since stabilization takes time, programs often appear successful for a period of time, only to subsequently fail. Hence, the issue of delayed stabilization should ideally be considered simultaneously with issues of both partial and multistage stabilizations.

## Appendix

Proof of Lemma 1

Differentiating (8) with respect to  $T_1$  one obtains

$$(A1) \quad \frac{dEU}{dT_1} = e^{-rT_1} \left[ h(T_1)(v^W(T_1) - v^L(T_1)) + \right. \\ \left. (1 - H(T_1))(u_1^D(T_1) - rv^L(T_1) + \frac{dv^L(T_1)}{dT_1}) \right]$$

Using the definitions of  $v^W(T)$ ,  $v^L(T)$ , and  $u_1^D(t)$  (A1) becomes

$$(A2) \quad \frac{dEU}{dT_1} = e^{-rT_1} \left[ h(T_1)(2\alpha - 1)\bar{b}e^{(1-\gamma)rT_1} + \right. \\ \left. (1 - H(T_1)) \left( \gamma r \left( \alpha - \frac{1}{2} - \theta_1 \right) \bar{b}e^{(1-\gamma)rT_1} \right) \right]$$

Differentiating with respect to  $\theta_1$  we obtain

$$(A3) \quad \frac{d^2EU}{dT_1 d\theta_1} = \left[ -(1 - H(T_1))\gamma r \bar{b}e^{(1-\gamma)rT_1} \right] e^{-rT_1} < 0$$

Equation (A3) means that when others are acting optimally,  $dEU/dT$  is decreasing in  $\theta_1$ . Optimal concession time  $T_1$  is therefore monotonically decreasing in  $\theta_1$ .

Proof of Proposition 1 (This proof closely follows Bliss and Nalebuff (1984))

Suppose the other interest group is acting according to  $T(\theta)$ , the optimal concession time for a group with utility cost  $\theta$ . Choosing a time  $T_i$  as above would be equivalent to choosing a value  $\hat{\theta}_i$  and conceding at time  $T_i = T(\hat{\theta}_i)$ . Equation (8) becomes, after the change in variables

$$(A4) \quad EU(\hat{\theta}_i, \theta_i) = F(\hat{\theta}_i) \left[ \int_{\hat{\theta}_i}^{\bar{\theta}} -u^D(x) e^{-rT(x)} T'(x) dx + e^{-rT(\hat{\theta}_i)} v^L(T(\theta_i)) \right] \\ + \int_{x=\hat{\theta}_i}^{x=\bar{\theta}} \left[ \int_x^{\bar{\theta}} -u^D(z) e^{-rT(z)} T'(z) dz + e^{-rT(x)} v^W(T(x)) \right] f(x) dx.$$

Differentiating with respect to  $\hat{\theta}_i$  and setting the resulting expression equal to zero we obtain (where we drop the  $i$  subscript)

$$(A5) \quad \frac{dEU}{d\hat{\theta}} = f(\hat{\theta}) \left[ (v^W(T(\hat{\theta})) - v^L(T(\hat{\theta}))) \right] + F(\hat{\theta}) (u^D(\theta, \hat{\theta}) - r v^L + \frac{dv^L}{dT}) T'(\hat{\theta}) = 0.$$

which becomes after substitutions

$$(A6) \quad \frac{dEU}{d\hat{\theta}} = -f(\hat{\theta}) (2\alpha - 1) - F(\hat{\theta}) \gamma r (\theta + \frac{1}{2} - \alpha) T'(\hat{\theta}) = 0.$$

Now by the definition of  $T(\theta)$  as the optimal time of concession for a group with cost  $\theta$ ,  $\hat{\theta} = \theta$  when  $\hat{\theta}$  is chosen optimally. The first-order condition (A6) evaluated at  $\hat{\theta} = \theta$  implies (14). (Substituting  $T'(\theta)$  evaluated at  $\hat{\theta}$  from (14)

into (A6) one sees that the second order condition is satisfied, since (A6) then implies that  $\text{sign } dEU/d\hat{\theta} = \text{sign}(\theta - \hat{\theta})$ .

To derive the initial boundary condition note first that for any value of  $\theta \leq \bar{\theta}$ , the gain to having the opponent concede is positive. Therefore as long as  $f(\bar{\theta})$  is nonzero, groups with  $\theta < \bar{\theta}$  will not concede immediately. This in turn implies that a group with  $\theta = \bar{\theta}$  (that is, that knows it has the highest possible cost of waiting) will find it optimal to choose  $T(\bar{\theta}) = 0$ .

### Proof of Proposition 2

A higher fraction of pre-stabilization deficits financed by taxation corresponds to a higher value of  $\gamma$ . Comparing the optimal time of concession as a function of  $\theta$  for  $\bar{\gamma} > \gamma$ , we have

$$(A7) \quad T'(\theta) = \frac{f(\theta)}{F(\theta)} \frac{(2\alpha - 1)/r}{\gamma(\theta + \frac{1}{2} - \alpha)}$$

$$(A7') \quad \bar{T}'(\theta) = - \frac{f(\theta)}{F(\theta)} \frac{(2\alpha - 1)/r}{\bar{\gamma}(\theta + \frac{1}{2} - \alpha)}$$

Since  $v^W - v^L$  is the same in both cases, the initial boundary condition is the same for  $\gamma$  and  $\bar{\gamma}$ , that is,  $T(\bar{\theta}) = \bar{T}(\bar{\theta}) = 0$ . Inspection of (A7) and (A7') indicates that  $\bar{T}'(\theta) > T'(\theta)$  for all values of  $\theta$ . Combining these two results, we have that  $T(\theta) > \bar{T}(\theta)$  for  $\theta < \bar{\theta}$ . Equation (16) then implies that  $\bar{T}^{SE} < T^{SE}$ .

Proof of Proposition 3

A multiplicative shift in  $\theta$  has an identical effect to an increase in  $\gamma$  in Proposition 2. By an argument analogous to the one used in that proof,  $T(\theta)$  will shift down and hence  $T^{SE}$  will fall.

Proof of Proposition 4

When  $\alpha = 1/2$ ,  $V^W = V^L$ . Since there are costs to not conceding, it is optimal to concede immediately. To prove the second part of the proposition, the same argument as in Proposition 2 shows that  $T(\bar{\theta}) - \bar{T}(\bar{\theta}) = 0$  for  $\bar{\alpha} > \alpha$ . Since the right-hand side of (14) decreases with an increase  $\alpha$ ,  $\bar{T}'(\theta) < T'(\theta)$  for all values of  $\theta$ . Using the same reasoning as in Proposition 2, we have that  $\bar{T}(\theta) > T(\theta)$  for  $\theta < \bar{\theta}$ . Equation (16) implies  $\bar{T}^{SE} > T^{SE}$ .

Proof of Proposition 5

Suppose  $\theta_1 = \theta(y_1)$  with  $\theta' < 0$ , where a group's income  $y_1$  unobservable. Let  $G(y, \sigma)$  be the distribution of income with bounds  $y$  and  $\bar{y}$ , where increases in  $\sigma$  correspond to a more disperse income distribution. Increasing  $\sigma$  corresponds to a mean-preserving spread of income if for some  $\bar{y}$

$$G_{\sigma}(y, \sigma) \geq 0 \quad \text{for } y \leq \bar{y}$$

$$G_{\sigma}(y, \sigma) \leq 0 \quad \text{for } y > \bar{y}$$

The expected minimum value of  $y$  can be written as:

$$(A8) \quad E(y_{\min}) = 2 \int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma)) g(x, \sigma) x dx.$$

which by integration by parts equals  $\int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma))^2 dx$ . Constant expected  $y_{\min}$  implies

$$(A9) \quad \int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma)) G_{\sigma}(x, \sigma) dx = 0.$$

(A9) and (16) in the text imply

$$(A10) \quad T^{SE}(\sigma) = 2 \int_{\underline{y}}^{\bar{y}} T(x, \sigma) (1 - G(x, \sigma)) g(x, \sigma) dx.$$

Repeated integration by parts implies that (A10) can be written as

$$T^{SE}(\sigma) = \frac{2\alpha - 1}{r\gamma} \left[ \frac{-1/2}{\theta(\underline{y}) + \frac{1}{2} - \alpha} + \frac{1}{2} \int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma))^2 \left( \frac{1}{\theta(x) + \frac{1}{2} - \alpha} \right)^2 \theta'(x) dx \right]$$

If the change in  $\sigma$  does not affect the lower bound  $\underline{y}$  and if  $(d^2\theta/dy^2) \geq 0$ , we have

$$\begin{aligned} \frac{dT^{SE}(\sigma)}{d\sigma} &= - \frac{2\alpha - 1}{r\gamma} \int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma)) G_{\sigma}(x, \sigma) \left( \frac{1}{\theta(x) + \frac{1}{2} - \alpha} \right)^2 \theta'(x) dx \\ &\geq - \frac{2\alpha - 1}{r\gamma} \frac{\theta'(\bar{y})}{(\theta(\bar{y}) + \frac{1}{2} - \alpha)^2} \int_{\underline{y}}^{\bar{y}} (1 - G(x, \sigma)) G_{\sigma}(x, \sigma) dx = 0 \end{aligned}$$

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## Footnotes

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1 In Sargent and Wallace (1981) and Drazen and Helpman (1987) the timing of stabilization is deterministic and exogenous; in Drazen and Helpman (1990) the timing is stochastic, but the distribution of the time of stabilization is exogenous.

2 See Athanasios Orphanides (1989) for a model in which a rational government delays a stabilization program to take advantage of more favorable exogenous circumstances.

3 The effects of political instability on the path of government debt is studied in a different framework by Alberto Alesina and Guido Tabellini (1989,1990), Torsten Persson and Lars Svensson (1989), and Tabellini and Alesina (1990).

4 David Backus and John Driffil (1985) and Tabellini (1988) discuss war of attritions between trade unions and a Central Bank, leading to periods of inefficient outcomes. An additional application of the war of attrition model

is in the labor strike literature; for a survey see John Kennan and Robert Wilson (1988).

5 Kenneth Rogoff (1985) suggests that it may be optimal to appoint a Central Banker with preferences which do not coincide with social preferences. In this case, however, the Central Bank's preferences are known by the public, while a war of attrition requires uncertainty about an opponent's characteristics.

6 We are grateful to Barry Eichengreen for pointing out to us this example.

7 See Nouriel Roubini and Jeffrey Sachs, (1989a,b) for statistical evidence on post-1973 OECD democracies; Francesco Giavazzi and Marco Pagano (1990) on Denmark and Ireland and Giavazzi and Luigi Spaventa (1988) on Italy.

8 Since we are considering an economy with constant output, this is equivalent to a rising debt-to-GNP ratio.

9 The view that the utility loss from living in an unstabilized economy flows from the use of distortionary financing of part of the government deficit raises an obvious question: why not simply accumulate debt until an agreement can be reached on levying less distortionary taxes? We suggest there may be constraints on the rate of growth of the debt, especially if it is external, but do not model this here.

10 Elections may also give one side a clear mandate not because its opponents have conceded on their distributional objectives, but because a majority of voters see that side as more competent to handle an economic crisis. The issue of competency is not considered here.

11 This may be generalized easily to more than two groups if we keep the assumption of exogenously fixed shares: if one group agrees to pay a share  $\alpha > \frac{1}{n}$ , each other group pays  $\frac{1 - \alpha}{n - 1}$  of the burden. A more general approach

is that once one group concedes, the  $n - 1$  groups remaining engage in a "second round" war of attrition, et cetera. This may lead to similar results, but it is a much more complex problem which we have not explored.

12. We could adopt a more general specification for  $K_1$ , such as

$$K_1(t) = \theta_1(r(t))^{1+m} \text{ with } m > 0.$$

The qualitative features of our results do not change with this more general specification. The differences will be emphasized below.

13. The technical difficulty in developing an explicitly monetary model in this framework is the following. Money demand should depend on expected inflation. The latter, in turn, is a function of the perceived probability that a stabilization program is adopted in each period. While in Drazen and Helpman (1990) this probability is exogenous, in this paper it is endogenously determined, and will depend on utility and therefore, on expected inflation. Hence, equilibrium would mean a fixed point in this probability function. Thus, it appears technically infeasible to derive endogenously this probability distribution in a model in which the distribution itself affects utility via the decision about money holding.

14. We impose a condition below which insures that consumption is not negative in every period.

15. This derivation follows Christopher Bliss and Barry Nalebuff (1984).

16. Of course, if different groups' endowments are perceived to be drawn from different distributions, each group will have a different  $T_1(\theta)$ . See, for example, Drew Fudenberg and Jean Tirole (1986).

17. When the utility loss from distortionary taxation rises more than proportionally with the level of taxes (as in footnote 11), the effect of

slower growth of the deficit may dominate. It can be shown (details are available) that low  $\theta$  groups will concede later, so that if it happens that both groups have low  $\theta$ , increased  $\gamma$  will mean a later date of stabilization.

18. Drazen and Vittorio Grilli (1990) use a war of attrition model to investigate how an economic "crisis" defined as a period of high, and thus costly, inflation actually raise total welfare by inducing agreement over a policy change.

19. The caveat here is that increased indexation may induce greater monetization or higher prices for a given level of monetization.

20. Raquel Fernandez and Dani Rodrik (1990) suggest a different explanation for the postponement of the adoption of trade reform, based upon a bias in favor of the "status quo" with majority voting. Our approach and theirs are not inconsistent.

21. Rodrik (1989) studies trade reforms from this perspective. Backus and Driffil (1985a,b), Robert Barro (1986) and Tabellini (1988) study monetary policy.



