

## SESSION II: THE POSITION OF THE CENTRAL BANK

### Commitment through Delegation, Political Influence and Central Bank Independence

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#### 1. INTRODUCTION

Politicians in office often delegate authority over some areas of policy to partly independent institutions within the public sector. This paper takes the view that delegation is used as a partial commitment device. By specifying the objectives of an institution more or less tightly and by giving it broader or narrower powers, politicians determine the extent of commitment to a policy rule. The wider the set of contingencies over which the rule is binding, the stronger the commitment. This set is wider and an institution more independent the more politically costly it is, for the political principals, to override the decisions of the institution. Hence a public institution with broader power in a particular area of policy corresponds to a stronger commitment to given restrictions on policy in this area.

A main objective of this paper is to identify economic and political factors that induce politicians to delegate more or less authority to semi-independent public institutions. Although some of the ideas in the paper probably have wider applicability they are illustrated by means of delegation in the area of monetary policy. More delegation of authority in this area usually means that the central bank has a stronger mandate, as well as a sufficient degree of independence from government, to conduct monetary policy so as to achieve price stability.

Besides price stability monetary policy can be directed at achieving other objectives such as a high level of economic activity and stabilization policy. In addition, inflationary finance can be used to reduce the real value of existing government debt. The temptation to use monetary policy to achieve such objectives is stronger the more depressed is the economy and the larger the size of the public debt. It is well-known that these temptations lead to equilibria in which those objectives are not achieved (or only partially achieved), and in which the rate of inflation is suboptimally high<sup>1</sup>. Politicians in office can precommit monetary policy by delegating some or all of the authority to

\* I have benefited from the comments of Eddie Dekel and Matthias Raith.

conduct monetary policy to the central bank (CB) and by directing it through law or convention to give high priority to price stability. Recent evidence reveals that there are substantial cross-country variations in the degree of CB independence<sup>2</sup>. The main objective of this paper is to develop a conceptual framework that makes it possible to formulate hypotheses that can account for at least some of this variation in CB independence.

Politicians in office obviously do not have to delegate authority. When they decide to do that it is because such delegation serves their purposes. More independence to the CB entails both a benefit and a cost. The benefit is that by reducing inflationary expectations a higher level of CB independence reduces interest charges on new government debt and moderates wage increases. This moderation ultimately makes it possible to stimulate the economy with lower inflation. The cost involves a loss in flexibility for the party in office. This foregone flexibility could have been useful since its presence would have made it possible to engage in stabilization policy and to tax away some of the national debt via inflation. There is consequently a tradeoff between the credibility of low inflation and flexibility<sup>3</sup>. In extreme situations government can override the decisions of the CB, but such a course of action entails a political cost for the party (or parties) in office.

The above considerations are complicated further when the different parties competing for office disagree about the structure of government expenditures. In the presence of such disagreements the party currently in office may grant some independence to the CB also in order to restrict the ability of the opposition (if and when it accedes to office) to spend on public goods which are in low priority for the incumbent party<sup>4</sup>. When it decides how much independence to grant to the CB, the party in office weigh these various elements, taking into consideration the likelihood that it will not be re-elected. The paper presents a precise analysis of the effect of these different factors on the tendency to delegate authority to the CB within a framework in which government is uncertain about the future state of the economy as well as about how long it will survive in office. The analysis suggests that the delegation of authority to the CB is used as a device to reduce interest charges on new government debt. The higher the importance attached by government to this objective, the larger the level of independence accorded to the CB.

The analysis also reveals that CB independence is higher the larger the average, employment motivated inflationary bias, the larger political polarization and political instability<sup>5</sup> and (under reasonable conditions) the larger the amount of funds that government plans to borrow on the capital market.

After having delegated some authority to the CB, the executive or legislative branches of government can redirect monetary policy either by overriding the bank openly or by exerting more subtle political pressure on it<sup>6</sup>. Sections 2 and 3 focus on the first channel and section 4 on the second one. The extent of

political pressure is usually private information and the public learns about it gradually, but optimally. The main lesson from the analysis of this case is that, while in office, CB governors with lower survival probabilities display less resistance to expansionary political pressures than governors with higher survival probabilities. Recent evidence supports this implication<sup>7</sup>.

Section 2 presents a model of delegation of authority and characterizes its equilibrium level. Comparative static results are presented and interpreted in section 3. Section 4 illustrates the effect of instability at the CB on the response of the latter to informal political pressures. This is followed by concluding remarks.

## 2. A MODEL OF ENDOGENOUS DELEGATION

### a. An intuitive overview

This section illustrates some of the ideas in the paper by means of a precise model. There are two parties that randomly alternate in office. Both parties like a high level of employment and dislike inflation. Due to the existence of nominal wage contracts the party in office can affect employment by creating unanticipated inflation. Natural employment is affected by real economic shocks but is always below desired employment<sup>8</sup>. Because of the fluctuations in the natural level of employment, the value of unanticipated inflation to policymakers varies depending on the realization of these shocks. In periods of low natural employment, monetary surprises are more valuable than in periods with high levels of natural employment. Although they value high employment and price stability to the same extent, the two parties have different preferences with respect to the *composition* of government expenditures<sup>9</sup>.

The government in office also wants to issue a fixed amount of bonds in order to finance the current budget deficit. All bonds are discount bonds. Hence the interest charge is paid up front. Other things the same, policymakers like to keep financing costs as low as possible. These costs depend in turn on what the public believes about the rate of inflation that will occur until the bonds are redeemed. If the public believes that inflation will be high, the nominal rate it demands is high and the finance charge is large. If the public believes that inflation will be low, the nominal rate that needs to be paid in order to place the bonds is low and the discount is small. Hence, other things the same, incumbent policymakers prefer lower inflationary expectations since they are associated with lower costs of financing the national debt.

But once bonds have been issued, nominal wage contracts concluded and real shocks to employment have realized the government in office is tempted to inflate. This temptation arises for two reasons. One is that once it is held by the public at a fixed nominal rate the real value of debt can be inflated away, thus

alleviating the fiscal burden. The other is that given fixed nominal wage contracts the divergence between actual and desired employment can be reduced by unanticipated inflation. Since the public is aware of these temptations it requires a nominal interest that would compensate it for the average value of expected inflation. Obviously this raises the cost of financing the government debt. As is well known, government can reduce these costs by credibly committing its policy to a zero or low inflation at the outset<sup>10</sup>.

I focus here on partial commitment through the delegation of authority to the CB. In the presence of delegation the bank is directed to focus first on the maintenance of price stability. But the political authorities can override its decisions at a cost. The larger the level of independence granted to the bank at the outset the larger the (political) cost of overriding its decisions and the stronger the commitment to price stability. But, given the level of independence, the price stability objective is abandoned if the realization of shocks is extreme enough to make the option to renege on it sufficiently attractive<sup>11</sup>. The stronger the commitment the lower inflationary expectations and the smaller is the discount on government bonds. This is a benefit for government objectives. But a stronger commitment also entails costs since it reduces government's ability to stabilize employment and to utilize the inflation levy on government debt. The level of CB independence is determined by weighing those opposing considerations optimally *before* nominal contracts are concluded and *before* the realization of shocks to natural employment.

To capture these elements I consider the following six-stage sequence of events. In the first stage the incumbent government decides how much authority to delegate to the CB. In the second stage it floats a fixed amount of discount bonds whose discount is determined by the real rate required by the public and by its inflationary expectation. Elections take place in the third stage and either the incumbent or the challenging party is voted into office and remains there until the end of the game. Nominal wage contracts are concluded in the fourth stage and shocks to the natural level of employment realize in the fifth stage. In the sixth and final stage the party in office decides whether or not to exert pressure on the CB to inflate and if it does – at what rate. Immediately after that bonds are redeemed. (A schematic representation of the sequence of events appears in Figure 1).

The benefit of a more independent CB is that higher independence reduces inflationary expectations. A cost of higher CB independence is that it restricts the ability of politicians to inflate the debt away making it more difficult to spend on the type of public good that they like. But, from the perspective of the incumbent party in stage 1, this cost differs depending on whether it is re-elected or not. If not re-elected, the incumbent party does not value the ability to inflate the debt away as much as it values this ability when it is reelected. The reason is that in the second case, this ability enables it to spend more on the public

goods it likes, whereas in the first case this enables the other party to spend more on public goods which the incumbent party does not particularly care about. In different words, the incumbent party prefers a stronger level of commitment and therefore a more independent CB when it is certain of not being re-elected than when it is certain of being elected.

### b. The formal structure

Viewed from the perspective of the first period, the incumbent party's objective is to maximize

$$as(1 - n) + \beta E[x(\pi - \pi^e) + \lambda Bs\pi + (1 - \lambda)bs\pi - \frac{d}{2}\pi^2 - \lambda c(x)], \quad (1)$$

$$B > b \geq 0, 1 \geq \beta, \lambda \geq 0, x > 0$$

where

$$c(x) = \begin{cases} 0 & \text{if the political authorities respect the CB authority in stage 6} \\ c & \text{if the political authorities override the CB decisions in stage 6} \end{cases}$$

$s$  is the (exogenous) amount of bonds that the incumbent government desires to sell (in stage 2),  $n$  is the nominal rate of interest necessary to induce the public to buy this quantity of bonds. Since government debt takes the form of discount bonds the government actually raises funds of size  $s(1 - n)$  when it places an amount with a face value of  $s$  on the market. The parameter  $a$  measures how much the incumbent government values the ability to raise funds and  $n$  is the nominal rate of interest.

The remaining costs and benefits all materialize in the last period. They are therefore discounted by the political discount factor of the incumbent –  $\beta$ .  $\pi$  and  $\pi^e$  are actual and expected inflation respectively. The difference  $\pi - \pi^e$  measures the amount of period 6's inflation which was not anticipated by individuals when nominal contracts that are based on  $\pi^e$  were concluded. It is well-known that unanticipated inflation has positive effects on employment and output<sup>12</sup>. The stochastic parameter  $x$  measures how valuable are the effects of stimulatory inflationary surprises to the incumbent government. It can be thought of as an index of the natural level of employment. The lower natural employment, the more valuable are positive surprises and the larger, therefore,  $x$ <sup>13</sup>. The important feature of  $x$  is that it is not known with certainty prior to its realization in the fifth stage. Thus, from the perspective of the first stage, in which the level of CBI is chosen,  $x$  is a stochastic variable. This is the reason for the appearance of the expected value operator,  $E$ , in equation (1).

$\lambda$  is the probability that the incumbent party is re-elected,  $\pi s$  measures the inflation-induced reduction in the real value of the debt. The terms  $Bs\pi$  and

$b_s\pi$  respectively measure the benefit to period one's incumbent of this reduction when he remains and when he does not remain in office. The constraint  $B > b$  reflects the view that the reduction in the real value of debt is more valuable to either party when it is in office. This presumption originates from the notion that when it is not in office, either party prefers a more independent CB since such a bank makes it more difficult for the other party to spend on a public good that is not desired by the first party. The term  $(d/2)\pi^2$  measures the costs of inflation and  $d$  is a positive parameter which determines how seriously these costs are taken by either party.

Finally  $c$  is the political cost incurred by policymakers if they decide to override the commitment of the CB to price stability in period 6. The size of this (fixed) cost is larger the higher the degree of independence that was conferred on the bank in the first period. This cost is multiplied by  $\lambda$  (the probability of remaining in office) since the political blame for overriding the CB is directed only at the party in office at the time.

The following figure summarizes the sequence of events and moves.

1	2	3	4	5	6
CB independence is chosen by incumbent party	An amount $s$ of bonds is sold to public	Elections take place	Nominal wage contracts (based on $\pi^e$ ) are concluded	$x$ realizes	Incumbent party decides whether to override the CB. If it does it also picks inflation, $\pi$

Figure 1 Sequence of events and timing of moves

The figure is largely self-explanatory, but the following additional facts are worth noting:

1. The extent of delegation of authority as embodied in  $c$ , is chosen before the results of the elections, and the state of the economy as proxied by  $x$  are known. As a consequence, in choosing CB independence, the incumbent government has to weigh the benefits of commitment against the loss in flexibility associated with more independence to the CB.
2. Although they are influenced by events from all stages, the components of the objective function in equation (1) (or payoffs) are located in only two of the six stages. The component  $\alpha(1 - n)$  is located in stage 2 and all the other components in stage 6. Correspondingly  $\beta$  should be thought of as the discount factor between stage 2 and stage 6.
3. The incumbent government makes decisions in stages 1 and 6. The public makes decisions in stages 3 and 4, and nature moves in stage 5.
4. Government bonds are redeemed in stage 6 *after* the realization of inflation.

### c. When does government override the CB?

I now turn to the derivation of equilibrium strategies. It is natural and convenient to start from the last period and to go backwards. In the last stage, uncertainty about the election result and the state of the economy ( $x$ ) has been resolved and CB independence ( $c$ ) and government debt ( $s$ ) are taken as given. Hence the incumbent's party problem is given by

$$\text{Max}_{\pi} x(\pi - \pi^e) + B_s\pi - \frac{d}{2}\pi^2 \equiv \text{Max}_{\pi} V(\pi, x) \quad (2)$$

if it decides to override the authority of the CB. In the other case the CB is free to focus on price stability and  $\pi = 0$ . The solution to the problem in equation (2) is

$$\pi_D(x) = \frac{1}{d}(x + B_s) \quad (3)$$

where the index D that is attached to  $\pi$  stands for "discretionary" since when it overrides the CB, government acts in a discretionary manner.

When does government override the CB? To answer this question we calculate the value of government's objectives when  $\pi_D$  is chosen by using (3) in (2). This yields

$$V(\pi_D, x) = -x\pi^e + \frac{1}{2d}(x + B_s)^2 \quad (4)$$

Government decides to override the CB and to inflate at rate  $\pi_D$  if and only if<sup>4</sup>

$$V(\pi_D, x) - V(0, x) > c \quad (5)$$

where, from (2),  $V(0, x) = -x\pi^e$ . Using this and (4) in (5) and rearranging, government overrides the CB if and only if

$$x > \sqrt{2dc} - B_s \equiv x_c \quad (6)$$

Equation (6) states that, given  $x_c$ , government overrides the CB when the level of employment is sufficiently depressed  $-x$  is sufficiently high. But the larger CB independence (the larger  $c$ ), the larger the value of  $x$  above which government overrides the CB. I assume  $x_c > 0$  since otherwise there is no commitment at all and the problem becomes trivial.

### d. Equilibrium expectations and wage contracts

Nominal wage contracts are agreed upon in stage 4 and are in effect until the end of the game. The level of the contract wage is higher the higher are inflationary expectations  $\pi^e$ . For simplicity and without loss of generality we proxy the contract nominal wage by  $\pi^e$ . In stage 4 individuals do not know  $x$

with certainty. But since they understand government's decision rule contingent on  $x$  they can use it to calculate the (statistical) expected value of inflation. This expected value is

$$\begin{aligned}\pi^e &\equiv E_x [\pi x_c] = \int_0^{x_c} 0 \cdot dF(x) + \int_{x_c}^{\infty} \pi_D(x) dF(x) = \\ &= \frac{1}{d} \left\{ \int_{x_c}^{\infty} x dF(x) + B_s \int_{x_c}^{\infty} dF(x) \right\}\end{aligned}\quad (7)$$

where  $F(x)$  is the distribution function of  $x$ .

Since, from equation (6),  $x_c$  is an increasing function of CB independence, equation (7) implies that inflationary expectations are lower the higher is CB independence.

#### e. Determination of the discount on government bonds

Let

$$s^d(r) = K + \alpha r, \quad \alpha > 0 \quad (8)$$

be the demand for government bonds in period 2 where  $r$  is the ex-ante real rate of interest. Since government insists on selling a quantity  $s$  of (in terms of face value) bonds, the real rate of interest is determined from

$$r = \frac{1}{\alpha} (s - K). \quad (9)$$

When elected, both parties use the same decision rule in period 6. As a consequence, inflationary expectations are the same before and after elections. To obtain the real rate in equation (9), individuals have to be compensated for the expected rate of inflation  $\pi^e$ . Hence, the nominal rate,  $n$ , is

$$n = r + \pi^e = \frac{1}{\alpha} (s - K) + \pi^e. \quad (10)$$

Since bonds are of the discount type, a higher nominal rate implies that government raises less funds for the budget given the size of  $s$ .

#### f. Determination of CB independence

CB independence ( $c$ ) is chosen by the party in office in period 1 before it knows whether it will be re-elected and before it knows what will be the state of the economy ( $x$ ) after the elections. A higher level of CB independence reduces  $\pi^e$ . Such a reduction is beneficial for two reasons as can be seen from equations (1) and (10). First, it reduces the discount on government bonds. Second, a lower

$\pi^e$  implies lower nominal wages and therefore, given  $x$  and  $\pi$ , a higher level of economic activity in period 6. But a higher level of CB independence also has costs since in some states of nature it prevents government from conducting anticyclical monetary policy and in the remaining states a political cost has to be paid for engaging in such policy. In addition, a higher level of CB independence reduces the scope for inflating away the national debt. Thus, by delegating more authority to the CB, government gains credibility, but loses flexibility. The level of CB independence is determined by optimally trading off these two elements in period 1.

Formally the government in office in period 1 chooses  $c$  so as to maximize the objective function in equation (1) subject to the relations given in equations (3), (6), (7) and (10). Substituting equations (7) and (10) into equation (1), rearranging, and dropping terms which do not depend on  $c$  the government's problem in period 1 can be expressed as

$$\begin{aligned}\text{Max}_c J(\cdot) &\equiv \text{Max}_c \frac{as + \beta Ex}{d} \left[ \int_{x_c}^{\infty} x dF(x) + B_s \int_{x_c}^{\infty} dF(x) \right] \\ &+ \beta \int_{x_c}^{\infty} \left[ \frac{1}{d} (x + B_s) \left\{ \frac{x}{2} + [(1-\lambda)b + (\lambda - \frac{1}{2})B]s \right\} - \lambda c(x) \right] dF(x)\end{aligned}\quad (11)$$

where  $x_c$  is given in equation (6). After some rearrangement, the first-order condition for an internal maximization of this problem is

$$\begin{aligned}J_c(\cdot) &= [as + \beta \{ Ex + (1-\lambda) [(B-b)s - \sqrt{\frac{dc}{2}}] \}] f(x_c) \\ &- \beta \lambda \int_{x_c}^{\infty} dF(x) = 0\end{aligned}\quad (12)$$

where  $f(x)$  is the probability density of  $x$ . Equation (12) determines the level of CB independence,  $c$ , as a function of various parameters. The second-order condition for an internal maximum is

$$\begin{aligned}J_{cc}(\cdot) &= \sqrt{\frac{d}{2c}} \left\{ [as + \beta \{ Ex + (1-\lambda) [(B-b)s - \sqrt{\frac{dc}{2}}] \}] f'(x_c) \right. \\ &\left. + \frac{\beta}{2} (3\lambda - 1) f(x_c) \right\} < 0\end{aligned}\quad (13)$$

where  $f'(\cdot)$  is the derivative of  $f(\cdot)$  with respect to  $x$ . Jointly sufficient, but not necessary conditions for the fulfillment of the second-order condition are  $(B-b)s > \sqrt{dc}/2$ ,  $f'(x_c) < 0$  and  $\lambda < 1/3$ . The second condition states that the probability density is decreasing at the critical value  $x_c$  and the third requires that the probability of re-election is smaller than  $1/3$ . When  $\lambda \geq 1/3$ , the second-order condition implies that if  $(B-b)s > \sqrt{dc}/2$ , then  $f'(x_c)$  must be negative.

### 3. POLITICAL AND ECONOMIC DETERMINANTS OF THE LEVEL OF CENTRAL BANK INDEPENDENCE

This section uses the results of the previous section in order to characterize the political and economic factors that induce political authorities to delegate more authority to the CB. The results are derived by performing comparative static experiments with respect to various parameters on the first-order condition in equation (12). Derivations appear in the appendix. The section summarizes the main results in a series of propositions and discusses the intuition that underlies them. In all the propositions "other factors" that are not mentioned explicitly are held fixed.

**PROPOSITION 1:** The CB is granted more independence ( $c$  is larger) the larger  $Ex$  and " $a$ ".

The intuition underlying the proposition can be understood by noting from equation (3), that the average inflationary bias in the absence of any form of commitment by political authorities is

$$E\pi_D(x) = \frac{1}{d}(Ex + Bs).$$

Hence, given  $s$ , the average inflationary bias is larger the larger  $Ex$  and the benefits of a partial commitment are therefore larger. As a consequence  $c$  is larger the larger is  $Ex$  as stated in the first part of the proposition.

A larger " $a$ " means that the importance attached by political authorities to the reduction of the discount on government debt is larger. With a higher level of CB independence, expectations are lower, the nominal rate is lower and the discount on new government debt therefore lower. Hence the larger the importance attributed to decreasing the discount on bonds the larger the level of CB independence. I turn next to political factors.

**LEMMA 2:** The CB is granted more independence the smaller is  $b$ .

The meaning of the lemma can be understood by recalling that the term  $B - b$  measures the difference in the value of the option to inflate the debt away between a state in which a party is in office and a state in which it is not in office. The more polarized are the parties with respect to the structure of public expenditures, the larger the (positive) difference  $B - b$ . Hence a smaller  $b$  means that the level of polarization is larger. The lemma implies therefore

**PROPOSITION 2:** The CB is granted more independence the larger the degree of polarization about the structure of government expenditures.

The intuition is that the party in office likes a stronger constraint on the other party's ability to spend the larger the disagreement about the structure of public spending. This is achieved by imposing a stronger limit on the other party's ability to inflate the debt away through a higher level of CB independence.

**PROPOSITION 3:** The higher the level of political instability (the lower  $\lambda$ ) the larger the level of independence that is granted to the CB provided political polarization is sufficiently large.

The precise meaning of "sufficiently large" is elaborated in the appendix. In any case the condition is only sufficient and not necessary. There are many other configurations of parameters, some of which are discussed in the appendix, for which proposition 3 holds. The intuition underlying the proposition is similar to the intuition underlying proposition 2. Given the level of polarization the party in office prefers a more independent CB the smaller are its re-election prospects. The party in office in period 1 obviously likes to have more flexibility for itself than for the other party. The smaller its chances of re-election the larger the benefits of CB independence in terms of restricting the other party's ability to spend in comparison to the cost of being similarly constrained. In addition the smaller the chances of re-election the smaller the likelihood that the incumbent party will incur the political blame for overriding the CB if future circumstances make such a course of action optimal.

The effect of the amount of bonds that government wishes to sell on CB independence is generally ambiguous. But there is a presumption that this effect is positive. Alternative sufficient conditions for a positive effect are summarized in the following proposition.

**PROPOSITION 4:** If either of the following conditions holds:

- (i)  $\lambda \geq 1/3$  and  $\beta$  is relatively small, or
- (ii)  $\lambda$  is near to either 0 or 1
- (iii)  $f(x_c)$  is very small,

then CB independence is higher the larger is the amount of funds  $s$ , that government wishes to borrow from the public.

A larger  $s$  triggers two opposing effects on the tendency to delegate authority to the CB. On the one hand the reduction in the up-front discount on government bonds induced by higher independence is more valuable when government needs to raise more funds. But, by the same token, the value of ultimately retaining the option to inflate the debt away is also more valuable when  $s$  is larger. This tends to reduce the attractiveness of CB independence and operates, therefore, in the opposite direction. The proposition presents conditions under which the first effect dominates.

The effect of the parameter  $d$  on CB independence is unambiguous. Proposition 5 summarizes the result.

**PROPOSITION 5:** The CB is granted less independence the larger the relative concern of political authorities for price stability (the higher  $d$ ).

The intuition underlying proposition 5 follows. When  $d$  is high, the discretionary rate of inflation is lower for any given values of  $x$  and of  $s$  (see equation (3)) even in the absence of a commitment. As a result the benefits of any commitment level are smaller. This induces the executive and legislative branches of government to delegate less authority to the CB. An illustration of such a case is the U.K. In comparison to other central banks within industrial countries, the Bank of England is relatively dependent. But there is concurrently an anti-inflationary stance within the British civil service. Proposition 5 suggests that the conjunction of those facts may not be accidental.

#### 4. INSTABILITY AT THE CENTRAL BANK AND INFLATION

Recent evidence shows that (within the group of less developed countries (LDC's)) there is a positive association between the turnover rate of central bank governors and average inflation across countries<sup>15</sup>. This section briefly describes a conceptual framework in which the policy chosen by the CB governor is influenced by the probability of his removal even when he remains in office and the CB is not formally overridden.

To this point the analysis has presumed that, if not officially overridden, the CB always sticks to a zero inflation policy. But governments often manage to influence CB policy through more subtle channels and pressures<sup>16</sup>. This section uses a framework in which the timing and extent of these pressures is the private information of the governor to show that the higher the probability that the governor will be removed from office, the higher inflation even when the governor remains in office.

The formal model is an extension of the model of a policymaker with an (extended) information advantage as presented in chapter 10 of Cukierman (1992). As long as he is in office the governor possesses an objective function with a *changing* but persistent relative emphasis on the creation of surprises versus price stability. In the present context this shifting weight can be thought of as originating in changes in the extent of political pressures on the CB. The public never gets to observe these pressures directly but can draw noisy inferences about their current and future state from past inflation rates. These inferences are noisy because the CB does not have perfect control over the rate of inflation.

Let  $s$  be the probability of survival of the governor in office in period  $t$  given that he has remained in office until period  $t - 1$ <sup>17</sup>. In states of nature in which he is not in office the governor does not care about either price stability or surprise creation<sup>18</sup>. The relevant part of the governor's objective function is

$$E_0 \left\{ \left[ \pi_0 - \pi_0^e \right] x_0 - \frac{\pi_0^2}{2} + \sum_{i=1}^{\infty} (s\beta)^i \left[ \left[ \pi_i - \pi_i^e \right] x_i - \frac{\pi_i^2}{2} \right] \right\} \quad (14)$$

$$+ \sum_{i=1}^{\infty} s^{i-1} (1-s) K$$

where  $x_i = A + p_i$ ,  $p_i = \rho p_{i-1} + v_i$ ,  $A > 0$  and  $0 < \rho < 1$ .  $v_i$  is a normal variate with zero mean and variance  $\sigma_v^2$ . Here  $\pi_i$  is actual inflation in period  $i$  and  $\pi_i^e$  the rate of inflation expected for that period at the beginning of the period.  $\beta$  is the discount factor and  $x_i$  is a stochastic variable whose realizations are restricted to the positive orthant<sup>19</sup>. It reflects the potency of political pressures on the CB. The larger  $x_i$  the stronger are the pressures of the political establishment on the governor to expand the money supply.  $x_i$  is private information. Its positive serial correlation reflects the presumption that when pressures are above their mean level they tend to remain above it for some time.  $K$  is the *constant* level of utility experienced by the governor when not in office.  $s^i$  is the probability that the governor survives in office until the end of period  $i$  and  $s^{i-1}(1-s)$  is the probability that he terminates at the beginning of that period after having survived until the end of the previous period. Equilibrium is of the Nash variety; taking the (rational) process of expectation formation by the public as given, the governor plans rates of monetary expansion and inflation so as to maximize the objective function in equation (14); taking the behavioral rule of the governor as given, the public forms expectations so as to minimize the mean (square) forecast error.

Application of the results in chapter 10 of Cukierman (1992) to this case reveals that equilibrium inflation is given by

$$\pi_i = \frac{1 - s\beta\rho}{1 - s\beta\lambda} A + \frac{1 - s\beta\rho^2}{1 - s\beta\rho\lambda} p_i + \psi_i \quad (15)$$

where  $\psi_i$  is a normal variate with zero mean and variance  $\sigma_\psi^2$ .  $\psi_i$  characterizes the (lack of) precision of monetary policy in controlling inflation.  $\lambda$  is a known function of  $\rho$ ,  $\sigma_v^2$  and  $\sigma_\psi^2$  and satisfies the following inequality

$$\lambda \leq \rho. \quad (16)$$

Note that since  $s$ ,  $\beta$ ,  $\rho$  and  $\lambda$  are all smaller than one, the coefficients of  $A$  and of  $p_i$  are positive. How does an increase in the governor's survival probability affect equilibrium inflation? The following proposition provides an answer to this question.

**PROPOSITION 6:** For any given realization of the political pressure shock ( $p_t$ ) and of the control error ( $\psi_t$ ) the rate of inflation is higher the lower is the survival probability,  $s$ , of the central bank governor.

**PROOF:** In part 2 of the Appendix.

Proposition 6 provides precise underpinning for the intuitively plausible notion that a governor with a low probability of survival in office will inflate at a higher rate than a governor with a higher probability of survival. The reason is that part of the cost of *currently* more expansionary monetary policy takes the form of higher *future* inflationary expectations. A governor who is less sure of being in office in the future is obviously less sensitive to this cost. He therefore inflates at a higher rate.

Two facts are worth noting. First, due to the dynamic nature of his optimization problem, the governor's policy while in office is influenced by what he perceives to be his future survival probability. Second, a lower survival probability raises the CB inflationary response to any given level of political pressure.

For LDC's proposition 6 is supported by evidence presented in chapter 20 of Cukierman (1992) and in Cukierman and Webb (1993).

## 5. CONCLUDING REMARKS

Preliminary empirical evidence suggests that legal CB independence is larger when party instability is larger and lower when regime instability is higher<sup>20</sup>. The first type of instability is usually relevant for constitutional democracies while the second is characteristic of non-democratic regimes in which changes in government occur through coups or other non-constitutional means. Part of this evidence is consistent with the implications of this paper. In particular the implication that a higher level of political instability is conducive to more independence for the CB is supported by the finding that legal CB independence is higher when party political instability is larger. The reason is that party instability occurs mainly in democratic countries and that in such countries legal independence is an important determinant of actual CB independence<sup>21</sup>. Hence in such countries legal independence is a reasonable proxy for the *actual* level of independence that political authorities *meant* to confer on the CB. This observation, in conjunction with the positive empirical relationship found between legal independence and party political instability are consistent with proposition 3.

Since the framework of the paper is appropriate mostly for constitutional regimes, the observed negative relationship between regime instability and legal independence is not directly explainable by it. It is possible, however, that it arises because in non-democratic regimes the structure of the regime makes it unlikely that a serious commitment can be upheld by constitutional means.

This reduces the effect of legal CB independence on expectations and with it the tendency of the regime to use legal CB as a commitment device. This effect is stronger the more unstable the regime since it is widely known that a new regime does not necessarily respect the institutions erected by the previous one. Those remarks should be viewed as conjectures to be tested in future work.

Some of the lessons to be learned from this paper are that:

1. A certain degree of CB independence is granted in order to reduce interest charges on government debt.
2. In many cases the tendency to delegate authority to the CB is stronger the larger the national debt. The 1986 "divorce" between the Italian CB and the Italian Treasury can be understood in these terms<sup>22</sup>.
3. When capital markets are wide ( $\alpha$  in equation (8) is small) it is likely that government will try to raise more funds through the capital market. In conjunction with the second conclusion this implies that, other things the same, governments of countries with wider capital markets will delegate more authority to the CB. This conclusion is supported by the observation that some of the most independent central banks are found in countries with well developed capital markets. Germany and the U.S. are examples.

But, on the other hand, proposition 5 suggests that if there is a strong preference for price stability within the executive branch of government, the tendency to delegate authority to the CB is likely to be lower. An example is the U.K. in which the traditional anti-inflation stance of the British civil service reduces the need for a highly independent CB.

The paper suggests that the need to rely on CB independence is greater the stronger is the inflationary bias under discretion. Furthermore this statement is independent of whether this bias arises because of employment considerations or because of a strong desire to reduce the real value of government debt. More generally, any factor that increases the tendency to inflate under discretion, such as a higher degree of polarization, also raises the tendency to delegate authority to the CB.

In order to influence monetary policy after having delegated some authority to the CB, political authorities do not always have to override the Bank openly. Instead they can exert more subtle political pressure (Havrilesky, 1992). The paper shows that CB governors who are less likely to survive in office find it more difficult to resist inflationary pressures. This conclusion is particularly relevant for LDC's.

What are the insights from the discussion of commitment through delegation in the area of monetary policy to other areas of policy? This is a largely open question. My feeling is that, at least for democracies with a certain minimal level of consensus, higher levels of political instability are likely to lead to more delegation of authority to semi-independent public institutions.

## APPENDIX

## 1. Proof of the propositions in section 3

By the implicit function theorem

$$\frac{dc}{dD} = -\frac{1}{J_{cc}} \frac{\partial J_c}{\partial D} \quad (A1)$$

where  $D$  is a dummy parameter. Since  $J_{cc}$  is negative by the second-order condition in equation (13) the signs of  $dc/dD$  and of  $\partial J_c/\partial D$  are identical. It is therefore enough to find the sign of the second term in order to determine that of the first one.

PROPOSITION 1: From equation (12)

$$\frac{\partial J_c(\cdot)}{\partial Ex} = \beta f(x_c); \quad \frac{\partial J_c(\cdot)}{\partial a} = sf(x_c). \quad (A2)$$

The proof is completed by noting that both expressions are positive and by letting  $D = Ex, a$ .

LEMMA 2: From equation (12)

$$\frac{\partial J_c(\cdot)}{\partial b} = -\beta(1-\lambda)sf(x_c). \quad (A3)$$

The proof is completed by letting  $D = b$  and by noting that (A3) is negative.

PROPOSITION 3: From equation (12)

$$\frac{\partial J_c(\cdot)}{\partial \lambda} = -\beta[f(x_c) \{ (B-b)s - \sqrt{\frac{dc}{2}} \} + \int_{x_c}^{\infty} dF(x)]. \quad (A4)$$

This expression is negative if

$$B-b \geq \frac{1}{s} \sqrt{\frac{dc}{2}} \quad (A5)$$

or, equivalently, if the level of political polarization is sufficiently high. Letting  $D = \lambda$  it follows that if (A5) is satisfied

$$\frac{dc}{d\lambda} < 0. \quad (A6)$$

For a given level of polarization the result in (A6) is more likely to obtain the higher  $s$  and the lower  $d$ .

PROPOSITION 4: From equation (12)

$$\frac{\partial J_c(\cdot)}{\partial s} = \beta(1-\lambda)(B-b)f(x_c) - [Hf'(x_c) + \beta\lambda f(x_c)]B \quad (A7)$$

where  $H$  is the coefficient of  $f(x_c)$  in equation (12). This equation implies that  $H$  is positive. Note that  $H$  is also the coefficient of  $f'(x_c)$  in equation (13). When  $\lambda \geq 1/3$  the second-order condition in equation (13) implies that  $Hf'(x_c) < 0$ . Hence, if in addition  $\beta$  is sufficiently small the expression in (A7) is positive. This establishes part (i).

The second-order condition is equivalent to the condition

$$Hf'(x_c) + \beta\lambda f(x_c) - \frac{1}{2}\beta(1-\lambda)f(x_c) < 0. \quad (A8)$$

When  $\lambda \rightarrow 1$  this condition reduces to

$$Hf'(x_c) + \beta f(x_c) < 0$$

which implies that the expression in (A7) is positive. When  $\lambda \rightarrow 0$  the first-order condition in equation (12) implies that

$$c = \frac{2}{d} \left[ \left[ \frac{1}{\beta} + B-b \right] s + Ex \right]^2$$

from which it follows that  $c$  is an increasing function of  $s$ . This establishes part (ii).

If  $f(x_c)$  is very small the second-order condition implies again  $Hf'(x_c) < 0$ . Since  $f(x_c)$  is small, this implies that the expression in (17) is positive which establishes part (iii).

PROPOSITION 5: From equation (12)

$$\begin{aligned} \frac{\partial J_c(\cdot)}{\partial d} &= \frac{1}{2} \left[ -\beta(1-\lambda)f(x_c)\sqrt{\frac{c}{2d}} + \{Hf'(x_c) + \beta\lambda f(x_c)\}\sqrt{\frac{2c}{d}} \right] \\ &= \left[ Hf'(x_c) + \beta\lambda f(x_c) - \frac{1}{2}\beta(1-\lambda)f(x_c) \right] \sqrt{\frac{c}{2d}}. \end{aligned} \quad (A9)$$

The modified form of the second-order condition in (A8) implies that the expression in (A9) is negative. Hence, higher values of  $d$  are associated with lower levels of central bank independence.

## 2. Proof of proposition 6

Totally differentiating equation (15) with respect to  $s$  and rearranging

$$\frac{d\pi_i}{ds} = -K[(1 - s\beta\lambda\rho)^2 A + (1 - s\beta\lambda)^2 \rho p_i] \quad (\text{A10})$$

where

$$K = \frac{\beta(\rho - \lambda)}{(1 - s\beta\lambda)^2 (1 - s\beta\lambda\rho)^2} \quad (\text{A11})$$

Since  $\rho - \lambda > 0$ ,  $K$  is positive. Since  $A \geq p_i$  and  $(1 - s\beta\lambda\rho)^2 > (1 - s\beta\lambda)^2 \rho$  it follows that the expression in square brackets on the right-hand side of (A10) is positive. Hence

$$\frac{d\pi_i}{ds} < 0$$

which establishes proposition 6.

## NOTES

1. See, for example, chapters 3 and 4 of Cukierman (1992).
2. Evidence for developed economies appears in Grilli, Masciandaro and Tabellini (1991) and for both developed and less developed economies in chapters 19 and 21 of Cukierman (1992) or in Cukierman, Webb and Neyapti (1992). The evidence in the first reference is based on CB charters and in the last two on CB charters as well as on the rate of turnover of CB governors.
3. Recent discussions of this tradeoff in the context of the employment motive for monetary expansion appear in Lohmann (1992) and in Cukierman, Kiguel and Liviatan (1992).
4. Alesina and Tabellini (1990) and Tabellini and Alesina (1990) have shown that such a conflict induces the incumbent to use public debt as a device for restricting the ability of the opposition to spend. In their framework the debt cannot be inflated away. Implicitly they assume therefore a fully independent CB. Here the degree of independence of the CB and therefore the extent to which government debt is inflated away are determined endogenously for a given level of debt. Hence this paper and theirs complement each other.
5. For reasons that are elaborated in the conclusion these results are restricted to democratic regimes.
6. Recent evidence on this kind of political pressure in the U.S. appears in Havrilesky (1992).
7. Details appear in chapter 20 of Cukierman (1992) and in Cukierman, Webb and Neyapti (1992).
8. Natural employment is the level of employment that prevails in the economy in the absence of monetary surprises. The assumption that it is below desired employment reflects the view that due to union power or minimum wage legislation the natural real wage is above its market clearing level. This point of view is developed explicitly in chapter 3, section 3.6 of Cukierman (1992).
9. Alesina and Tabellini (1990) and Tabellini and Alesina (1990) investigate the consequence of this conflict for the level of government debt. Cukierman, Edwards and Tabellini (1992) analyze its consequences for the efficiency of the tax system.

10. See chapter 6, section 6.4 of Persson and Tabellini (1990) or chapter 4, section 4.4 of Cukierman (1992).
11. A similar conception of CB independence appears in Lohmann (1992).
12. A precise mechanism that produces this relation is discussed in chapter 3, section 3.6 of Cukierman (1992). It is based on the interaction of nominal wage contracts with a natural real wage that is higher than that which would clear the market.
13. The positivity of  $x$  reflects the presumption that due to market power in the labor market, there always is an inflationary bias. Details appear in chapter 3 of Cukierman (1992). Variations in  $x$  may also reflect changes in the relative strength of price stability and of pro stimulation advocates within a given party.
14. I assume that when indifferent government respects the independence of the CB.
15. See chapter 20 of Cukierman (1992) or Cukierman, Webb and Neyapti (1992).
16. A recent documentation of some of these channels for the U.S. Fed appears in Havrilesky (1992).
17. I assume for simplicity that this probability is constant and independent from events in other periods.
18. This somewhat extreme assumption is used for simplicity. The main result would go through even if he cared but less than in periods in which he is in office.
19. More precisely the probability that  $p_i$  is negative and exceeds  $A$  in absolute value is negligible. Details appear in appendix A to chapter 9 of Cukierman (1992).
20. Details appear in chapter 23 of Cukierman (1992).
21. Evidence and a discussion appear in Cukierman, Webb and Neyapti (1992) and in chapters 20 and 23 of Cukierman (1992).
22. For details see Epstein and Schor (1986).

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