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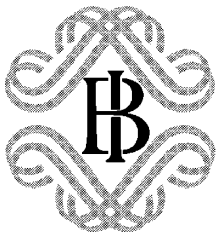
by Francesco Lippi



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MEDIAN VOTER PREFERENCES, CENTRAL BANK INDEPENDENCE AND CONSERVATISM

by Francesco Lippi*

Abstract

This paper studies how the independence and conservatism of a central bank relate to the structure and stability of the median voter preferences. This is done by means of a model of endogenous delegation in which an opportunistic policy-maker chooses the monetary regime (independence and conservatism) to maximise the welfare of the median voter. The results show that a high degree of inflation aversion of monetary policy is not necessarily associated with a high degree of central bank independence. A high degree of inflation aversion of society (i.e. of the median voter) may lead to establish a central bank which is highly inflation averse, without necessarily making it independent. This suggests that the negative correlation between inflation and central bank independence indices detected by several empirical studies may reflect a link between inflation and some deep features of social preferences.

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1. Introduction[1]

This paper studies how the independence and "conservatism" of a central bank relate to the structure and stability of the median voter preferences. The degrees of conservatism and of independence of the central bank are crucial ingredients in an inflation-reducing delegation arrangement. In broad terms, conservatism refers to the degree of inflation aversion of the monetary authorities' *objectives* in relation to those of the government, while independence refers to the institutional elements that, by serving a "gate-keeping function" between the government and the central bank, determine the extent to which policy is decided by either the government or the central bank. Both conservatism and independence contribute to the determination of the *effective* degree of inflation aversion of *policy*,[2] and several papers have treated these two variables as synonyms when interpreting the results of delegation models for monetary policy.[3]

One of the key objectives of this paper is to show why an explicit distinction between the conservatism and the independence of the central bank may yield sharper insights into the workings of delegation arrangements for monetary policy. Moreover, by modeling the choice of those regime parameters, we are able to show how monetary institutions are related to social preferences (as represented by median voter preferences). This allows us to identify the role played by central bank independence in achieving low inflation, and to distinguish it from that played by the structure of social preferences.

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[2] When independence is less than full, the effective degree of inflation aversion of policy can be thought of as a weighted average of the inflation aversion of the government and of the central bank, where the weight attached to the preferences of the central bank can be seen as a proxy of its independence. When the central bank has full independence, the effective degree of inflation aversion of policy will coincide with that of the central bank (as the government has no influence on monetary policy).

[3] Debelle and Fischer (1994) use the term "independent" to ask a question that concerns the policy targets of the central bank. Schaling (1995, p. 157) defines "central bank independence as the degree of conservativeness rather than as the political cost of overriding the central bank".

A model of endogenous delegation is developed in which an opportunistic policy-maker chooses the monetary regime (independence and conservatism) to maximize the welfare of the median voter. We focus on two features of social preferences: first, that voters differ in their desired inflation targets. Second, that there is some uncertainty concerning the exact structure of the median voter preferences when the monetary regime is established. This uncertainty, which may originate from random voter turnout, creates the following tradeoff for the policy-maker: a higher degree of central bank independence increases the credibility of monetary policy (reducing expected inflation if the central bank is conservative) but it also reduces the principal's capacity to accommodate monetary policy when large shifts in the median voter preferences occur. In equilibrium, the optimal degree of independence weighs those credibility gains and flexibility costs.

The model provides closed-form solutions for the optimal degree of conservatism and independence, which show how these features of the monetary regime relate to some "fundamental" social characteristics. In particular, a positive correlation emerges between the inflation aversion of the central bank and the median voter's inflation aversion: this may provide a formalisation of the often-mentioned relationship between the Bundesbank's high inflation aversion and the high inflation concern of the German public. The results also indicate that the degree of central bank independence is *lower* in countries where the policy-makers' temptation to inflate is smaller. Basically, this happens because a more inflation-averse society has less need of credibility and thus retains more flexibility (to adjust policy targets) without the risk of incurring higher inflation. The results imply that, although central bank independence is an effective way of reducing inflation for countries that suffer from an inflationary bias, a high degree of inflation aversion of monetary *policy* is not necessarily associated with a high degree of independence. A high inflation aversion of monetary policy may simply be the direct consequence of inflation averse social preferences.

Other papers have studied how the monetary regime relates to social features. Cukierman (1994) develops a theoretical model with partisan political parties that endogenizes the degree of independence. The model presented here instead explores the case of an office-motivated policy-maker, who caters to the preferences of the median voter. An approach related to ours is that developed by Muscatelli (1998), who studies optimal monetary policy delegation in the presence of uncertain central bank preferences. The main

difference between his approach and the one presented here is that we focus on the uncertainty pertaining to the preferences of the principal while he focuses on that pertaining to the agent's preferences. Another difference is that he studies a case of full independence, describing the choice of the optimal targets to be assigned to the central bank, while we allow the principal to select both the degree of independence and the degree of conservatism. The relationship between the monetary institution and social attitudes towards inflation has not been the subject of much empirical investigation, partly due to the difficulty of measuring these variables. An important first attempt to study this relation using survey data from several European countries was made by Hayo (1998). His conclusion that "central bank independence and public attitudes towards inflation are interconnected (p. 259)" appears consistent with the theory developed here.

The organisation of the paper is as follows. Section 2 briefly presents the elements of the analysis, which are based on a standard Barro-Gordon model extended, in a spirit similar to Waller and Walsh (1996) and Lippi (1998), to account for uncertainty in the preferences of the principal. Section 3 describes the principal's choice with regard to the institutional set-up, namely the choice of the degree of conservatism and of independence. Section 4 discusses the main implications of the results. A final section draws conclusions.

2. The model

This section presents the essential elements of a credibility model that are necessary to make our point. The simple economic structure of this model is described by the following equation:

$$y = y_n + \theta(\pi - \pi^e) + \varepsilon \tag{1}$$

where y, y_n, π and π^e denote output, natural output (subscript n), inflation and inflation expectations (superscript e), respectively. Equation (1) can be seen as a description of the supply-side of an economy in which unions sign nominal wage contracts before inflation is known (see Cukierman, 1992, chapter 3). This implies that unanticipated inflation increases output. In the absence of policy surprises, output is equal to the natural level, y_n, plus the

realisation of an i.i.d. random shock, ε, with zero mean and standard deviation equal to σ_ε. Table 1 provides a synopsis of the main variables used in this paper.

TABLE 1

LEGENDA OF THE MAIN VARIABLES

Variable	Description
y	output level
y_n	natural output level
y^*	output target
$\chi \equiv y^* - y_n$	gap between the desired and the natural output
θ	slope of the supply function
ε	supply shock
π	inflation
π^e	inflation expectations
π_i^*	inflation target of individual *i*
β	output weight in the individual loss function
$\pi_m^* \equiv \pi_a^* + s$	inflation target of the median voter
s~U[-k; k]	shock to the median voter target (uniformly distributed)
π_a^*	average inflation target of the median voter (also referred to as "social" inflation aversion)
π_b^*	central bank inflation target (also referred to as "central bank inflation aversion")
$z \equiv \pi_a^* - \pi_b^*$	central bank conservatism
ϕ	central bank independence
ϕ z	effective conservatism of monetary policy
(π_a^*, k, y^*, β)	structure of the median voter preferences
k	volatility of the median voter preferences
$v^2 \equiv k^2 / 3$	variance of the median voter inflation target

Individual *i*'s preferences over inflation and output are represented by the loss function:

$$L_i = \left(\pi - \pi_i^*\right)^2 + \beta \cdot \left(y - y^*\right)^2 . \tag{2}$$

Losses increase as inflation and output deviate from their ideal targets, π_i^* and y^*, respectively. The parameter β indicates their relative costs.

The inflation target π_i^* is indexed for each individual (subscript *i*) to allow for heterogeneity of preferences with respect to inflation, for which there is abundant evidence, e.g. Shiller (1996).[4] Under the assumption of non-strategic (i.e. "sincere") voter behavior, it can be shown that the median voter is decisive for the determination of the policy-maker's targets in such a setting (see Swank, 1995).[5] Therefore, we will refer to the policy-maker's and the median voter's targets interchangeably.

It is further assumed that due to shifts in the preferences of the median voter the inflation target of the policy-maker (π_m^*) is a random variable from the point of view of the agents who form inflation expectations. This variable is defined as:

$$\pi_m^* \equiv \pi_a^* + s \quad \text{where} \quad s \sim U[-k; k] \tag{3}$$

where the shock to the inflation target of the median voter, *s*, is assumed to be uniformly distributed over the support [*-k, k*]. Waller and Walsh (1996) and Lippi (1998) provide interpretations for the shifts in the median voter preferences.[6] Some evidence from the US concerning shifts in the median voter's preferences concerning inflation is provided by Fox (1997).[7] Higher values of π_a^* imply that the *expected* inflation target of the median voter, and

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[4] Analogous results are obtained if individuals have different output targets (see Lippi, 1999, chapter 7).

[5] The assumption of non-strategic voting eliminates the possibility that the delegation of monetary policy to a conservative agent occurs via the election (see Lippi and Swank, 1999).

[6] For instance, if policy-makers are concerned with the consequences of inflation on the income distribution, changes in the degree of indexation may result in a change of the desired rate of inflation of voters. Alternatively, movements in the distribution of the population, which change the median voter's identity, will induce an opportunistic policy-maker to revise his targets accordingly.

[7] Fox's findings that the median voter preference (parametrized by a quadratic loss function over output and inflation) shifts under different administrations is consistent with the hypothesis we formulate here.

hence of the policy-maker, is larger, representing a lower degree of social aversion to inflation. The variable *k* measures the instability of preferences about inflation. The larger is *k*, the higher is the volatility of the median voter's preferences around the average value π_a^* and therefore the higher the variance of the policy-maker's targets.

The policy process is described by the following sequence of events:

1. In the first stage nominal wage contracts are signed by rational forward-looking private agents.
2. In the second stage the desired inflation target of the median voter, and hence the target of the policy-maker (π_m^*), is revealed.
3. In the third stage, a supply shock ε occurs.
4. In the fourth stage monetary policy is implemented and economic outcomes (y, π) occur.

The game is solved by backward induction.

Before presenting the elements that characterise the monetary regime, it is useful to solve for the discretionary policy of the policy-maker. At stage four, the policy-maker minimises the loss function (subscript PM):

$$L_{PM} = \left(\pi - \pi_m^*\right)^2 + \beta \cdot \left(y - y^*\right)^2 \tag{4}$$

with respect to π, subject to (1), taking π^e as given. This yields the policy-maker's reaction function:

$$\pi_{PM} = \frac{\pi_m^* + \beta \cdot \theta\left(\chi + \theta \cdot \pi^e - \varepsilon\right)}{1 + \beta \cdot \theta^2} \tag{5}$$

where $\chi \equiv y^* - y_n$ denotes the gap between desired and natural output (identical for all members of society as the desired output level is assumed to be the same for all individuals). Different types of policy-maker will have different inflation targets π_m^* and hence a different reaction function. Before the preferences of the median voter are known, the policy-maker's inflation target is a random variable with uniform distribution, $\pi_m^* \sim U[\pi_a^* - k;\ \pi_a^* + k]$, the

expected value of which is equal to π_a^*. Applying the rational expectations hypothesis to the reaction function (5), inflation expectations and the equilibrium inflation rate turn out to be equal to:

(6) $$\pi^e = E_{\varepsilon,s}[\pi_{PM}] = \beta\theta\chi + \pi_a^*$$

and

(7) $$\pi_{PM} = \beta\theta\chi + \pi_a^* + \frac{s - \beta\theta\varepsilon}{1 + \beta \cdot \theta^2}$$

where $E_{\varepsilon,s}[\pi_{PM}]$ is the expectations operator with respect to the random variables *s* and ε. The typical Barro and Gordon (1983) inflationary bias of discretionary policy (equal to $\beta\theta\chi$) appears if the median voter preferences are such that the gap between desired and natural output is positive (χ >0).

2.1 Features of the monetary regime: conservatism and independence

The inflationary bias creates a potential role for policy *delegation*, i.e. for the assignment of policy to an agent (the central bank) with an inflation target that is smaller than the policy-makers' inflation target. Let us define the degree of "conservatism" of the central bank as the (positive) difference between the median inflation target of society and that of the central bank, namely:

(8) $$z \equiv \pi_a^* - \pi_b^* \ .$$

Ex-ante, policy delegation to a conservative central bank (*z*>0) allows the policy-maker to reduce the inflationary bias. However, after inflation expectations have been incorporated into nominal contracts, the policy-maker has an incentive to revise the delegation arrangement and to overrule the policy of the central bank. This appears from a comparison of the *ex-post* losses that the policy-maker incurs under discretion with those incurred under a central banker type π_b^* (for a generic value of inflation expectations π^e). Some algebra

shows that, *ex post*, losses under delegation exceed losses under discretion by the term:[8] $\left(\pi_a^* - \pi_b^*\right)^2 = z^2$, which implies that (*ex post*) an incentive exists for the policy-maker to readjust monetary policy, as long as the inflation target of the policy-maker is different from that of the central bank.[9] This happens since once expectations are formed (i.e. are given to the policy-maker), discretionary policy is, by construction, the best policy for the policy-maker. In order to prevent the disruptive effect of this overriding incentive by the policy-maker, a pre-commitment technology is needed to ensure that central bank policy (π_b^*) is actually adhered to. Central bank independence is thus treated here as the *commitment technology* that guarantees that the central bank targets will be adhered to.

It is now possible to define the two variables that characterise the monetary regime: (1) the conservatism of the central bank (z) and (2) the degree of central bank independence, defined as the probability that monetary policy is implemented by the central bank: ϕ. This simple way to model independence is aimed at capturing the idea that a higher level of institutional independence of the central bank from the government increases the probability that monetary policy will actually be implemented by the central bank. It is assumed that by establishing an appropriate constitutional rule the policy-maker is able to fix the probability ϕ at the desired level.[10] The fully independent central bank case and the discretionary policy case are obtained as special cases from this framework when the probability ϕ is equal to one or to zero, respectively.

Since the delegation to a "target conservative" bank does not generate costs in terms of output stabilisation, as the central bank and the policy-maker react in the same way to supply

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[8] This expression is given by the difference between the policy-maker's *ex-post* losses under discretion (his own policy) and under delegation (the central bank policy). *Ex-post l*osses under discretion are obtained by substituting into the loss function (4) the values of inflation and output (for a generic level of inflation expectations) under the reaction function (equation 5). *Ex-post l*osses under delegation are obtained by substituting into (4) the values of inflation and output obtained (for a generic level of inflation expectations) under the central bank (equation 5 with π_b^* for π_m^*).

[9] The fact that the supply shock ε does not affect the policy-maker's incentive to override the central bank shows that the delegation to a "target-conservative" bank does not generate stabilisation costs, which instead appear when policy is delegated to a "weight-conservative" bank (e.g. Rogoff, 1985, Lohmann, 1992). Hence this type of delegation does not originate the credibility versus flexibility tradeoff discussed by Rogoff (1985).

[10] A larger ϕ implies a higher likelihood that policy be implemented by the central bank. Note that independence is defined irrespectively of the degree of conservatism.

shocks (see footnote 9), we disregard these shocks in the analysis of the optimal monetary regime (ϕ and z) without loss of generality.

2.2 Inflation and the monetary regime

Let us now turn to the analysis of the effects of a given monetary policy regime on inflation expectations. Private agents form inflation expectations knowing the *structure* of the preferences of the median voter (i.e. the average inflation target π_a^*, the range of variation (k) of the inflation target, the output target y^*, the output weight β) and the regime parameters (ϕ and z), which imply that with probability ϕ monetary policy is implemented by a central bank with an inflation target π_b^* (equal to π_a^*-z) and that with probability (1- ϕ) it is set by the policy-maker in office, π_m^*. For any given monetary regime, inflation expectations can then be calculated as:

$$\pi^e \equiv E_s\left(\pi \middle| \phi, \pi_b^*\right) = \phi \cdot E_s\left[\frac{\pi_b^* + \beta \cdot \theta(\chi + \theta \cdot \pi^e - \varepsilon)}{1 + \beta \cdot \theta^2}\right] + \\ + \ (1-\phi) \cdot E_s\left[\frac{\pi_m^* + \beta \cdot \theta(\chi + \theta \cdot \pi^e - \varepsilon)}{1 + \beta \cdot \theta^2}\right] \tag{9}$$

where E_s indicates the expectations operator with respect to the target shock (s) conditional on the policy regime (recall that $\pi_m^* \equiv \pi_a^* + s$). Solving for expectations in equation (9) gives expected inflation under a partially independent ($0<\phi<1$) central bank, which is equal to:

$$\pi^e = (1-\phi)(\beta\theta\chi + \pi_a^*) + \phi(\beta\theta\chi + \pi_b^*) = \\ = \beta\theta\chi + \pi_a^* - \phi \cdot z. \tag{10}$$

Inflation expectations are a weighted average of the inflation expected under discretionary policy ($\pi_a^* + \beta\theta\chi$) and central bank policy ($\pi_b^* + \beta\theta\chi$), where the weight is given by the degree of central bank independence. Since, in the framework of our model, inflation is determined by monetary policy, in the following we will use equation (10) as a summary measure of the inflation aversion of monetary policy. It appears that this measure has three components: the first two ($\beta\theta\chi + \pi_a^*$) reflect the inflation aversion of social

preferences (as implied by the average inflation target of the median voter, the desired output target and the relative weight between those objectives). The third component ($\phi \cdot z$) measures the *effective* degree of conservatism of monetary policy.[11] Equation (10) therefore shows that in equilibrium both institutional factors (independence and conservatism) and social preferences contribute to determine the degree of inflation aversion of monetary policy.

It appears that, other things the same, a higher degree of independence reduces inflation if the central bank is conservative. But the acknowledgement of the endogenous nature of independence and conservatism wil show that the link between inflation and independence is more complicated than that.

3. The optimal degree of conservatism and independence

To describe how the features of the monetary regime (ϕ, z) relate to the structure of the median voter preferences (π_a^*, k, y^*, β), we model the establishment of the monetary regime by an *opportunistic* policy-maker. The policy-maker is opportunistic in the sense that he aims to remain in office and therefore targets the median voter's preferences. It is assumed that the regime is established before the monetary policy game is played, at a stage that is labelled the "constitutional design stage". This captures the idea that the features of the monetary regime are revised less frequently than policy and expectations. Since the median voter's preferences are uncertain at the constitutional design stage, the policy-maker objective is to minimise the *expected* welfare of the median voter. This choice criterion can also be seen as an application of the welfare principle of Rawls (1971), whereby the regime parameters are chosen from an "initial position" of ignorance of future preferences.

Formally, the policy-maker's problem amounts to minimizing the expected value of losses (4), taking into account the effects that the independence and conservatism parameters induce on the players' strategies (equations 5 and 10).

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[11] It amounts to the difference in expected inflation between a discretionary regime and the monetary regime (ϕ, z).

As is shown in the Appendix, when $\phi > 0$,[12] the first order condition for the degree of conservatism yields:

(11) $$z = \beta\theta\chi \cdot \frac{1+\beta\theta^2}{1+\beta\theta^2\phi}$$

which can be rewritten equivalently using (8) as:

(12) $$\pi_b^* = \pi_a^* - \beta\theta\chi \cdot \frac{1+\beta\theta^2}{1+\beta\theta^2\phi}.$$

Equation (11) shows that, in the case of full independence, the optimal degree of conservatism to be assigned to the central bank is equal to the size of the inflationary bias ($\beta\theta\chi$). If independence is less than full, ($0 < \phi < 1$), the optimal degree of conservatism increases in order to compensate for the inflationary effect that a lower level of independence has on inflation expectations.

Under the assumption that the degree of conservatism is positive (z>0), the first order condition for the optimal degree of independence yields (see the Appendix):[13]

(13) $$\phi = \frac{2\beta\theta\chi(1+\beta\theta^2)-z}{2\beta\theta^2 z} - \frac{\nu^2}{2\beta\theta^2 z^2} \qquad \text{where } \nu^2 \equiv \frac{k^2}{3}.$$

Equation (13) gives the optimal degree of independence as a function of the degree of central bank conservatism, the inflationary bias of discretionary policy ($\beta\theta\chi$), and the variance of the median voter's preferences ($v^2 \equiv k^2/3$). A higher value of the latter reduces the optimal degree of independence. Closed form solutions for the optimal degree of independence and conservatism are obtained from the system of equations (11) and (13). This yields:

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[12] For ϕ=0 the expected losses of the principal do not depend on the bank's degree of conservatism. This is obvious as the bank's preferences are unrelated to policy in that case.

[13] It appears from the first order condition that if conservatism is negative (z<0) the optimal degree of independence is zero.

(14) $$\phi^* = \frac{\beta\theta\chi(1+\beta\theta^2)-\nu}{\beta\theta^2\nu}$$

and

(15) $$z^* = \nu .$$

Equations (14) and (15) reveal that three types of equilibrium may arise, with nil, partial or full independence, depending on the seriousness of the inflationary bias problem relative to the variability of social preferences (measured by the expression $\beta\theta\chi / \nu$).

3.1 Corner solutions

It appears from equation (14) that when the inflationary bias problem is small in comparison with the instability of the targets, the optimal degree of independence is nil. The exact condition is:

- (16) $$\text{if} \quad \frac{\beta\theta\chi}{\nu} \leq \frac{1}{1+\beta\theta^2}, \quad \text{then } \phi^* = 0 .$$

When this condition holds credibility problems are not a major issue, and it is thus optimal to retain the flexibility to adjust to shifts in preferences. Expected inflation in the case of zero independence corresponds to the discretionary equilibrium described in equation (6).

At the other extreme, when the inflationary bias problem is large in relation to the instability of the targets, it appears from equations (11) and (14) that:

- (17) $$\text{if} \quad 1 \leq \frac{\beta\theta\chi}{\nu}, \text{ then } \phi^* = 1 \text{ and } z^* = \beta\theta\chi .$$

Hence, full independence is optimal when the inflationary bias is sufficiently large in relation to the variability of the median voter's targets. Thus, the more the median voter's preferences are stable, the more likely it is that full independence is granted. Expected inflation in this case is equal to the ideal level ($\pi^e = \pi_a^*$).

3.2 Partial independence

Intermediate cases, where the ratio $\beta\theta\chi / v$ falls within the boundaries established by (16) and (17), yield equilibria with less than full central bank independence, where the following equations hold:

(18) $$\phi^* = \frac{\beta\theta\chi(1+\beta\theta^2) - v}{\beta\theta^2 v} \in (0,1) \quad \text{and} \quad \pi_b^* = \pi_a^* - v \ .$$

Four main considerations are suggested by inspection of the above expressions. First, it appears that design of an optimal delegation arrangement involves an optimal choice of both independence and conservatism. Focusing on just one of these components, for instance on the determination of the optimal degree of conservatism assuming full independence, generally leads to suboptimal arrangements. This result is akin to that of Lohmann (1992).

Second, a country characterised by a lower target level of inflation (smaller π_a^*) will, other things being equal, assign a lower inflation target to the central bank. Note that in this particular model the optimal degree of conservatism, *z**, does not depend on the inflation target of the principal. Thus, changes in the inflation aversion of the principal are reflected point for point in the inflation aversion of the central bank. This result highlights the importance that "social" fundamentals, such as the average inflation aversion of the median voter, have for the determination of policy objectives. It may be seen as a formalisation of the common wisdom that associates the Bundesbank's success in controlling inflation with the deeply-rooted inflation concern of the German *public*.[14]

Third, the optimal degree of independence is *lower* in the countries where the median voter's temptation to inflate is small, i.e. where the gap between desired and natural output, χ, and/or the output weight β are small. A country with more inflation-averse preferences (low χ and/or β) has a smaller inflationary bias and can therefore retain the flexibility to adjust policy targets without incurring excessive inflation. Put bluntly, an inflation-averse

[14] Goldman-Sachs (1998) offers a recent example of this common wisdom: "the Bundesbank's strengths were its independent status, its determined leaders and the German population's strong social consensus for low inflation" (p. 6).

country has less need of a commitment technology. If the discretionary policy of a country is fully credible (i.e. there is no inflationary bias, $\chi = 0$, β=0), the optimal arrangement is to establish a fully dependent central bank ($\phi = 0$). Similar results are obtained by Cukierman (1994) in the context of a politico-economic model with *partisan* policy-makers.

Fourth, political instability affects both the independence and the conservatism of the central bank. In the partial-independence case, a higher level of political instability induces the principal to retain more flexibility, decreasing the optimal degree of independence. To compensate for the inflationary effect that is caused by less independence, the conservatism of the central bank increases.

4. Discussion

The above results clarify some conceptual issues which are relevant in the context of monetary policy delegation. First, they show that the distinction between the commitment-related dimension of the arrangement (i.e. the independence) and the targets of the central bank (i.e. the central bank inflation target, or its degree of conservatism) is important for a correct identification of the causes of low inflation. In fact, as was noted in the discussion of equation (10), a high degree of inflation aversion of monetary *policy* is not necessarily associated with a high degree of central bank independence, but may actually be the direct consequence of more inflation averse social preferences. Several theoretical papers, which analyse monetary policy delegation, do not explicitly distinguish between the independence and the targets of the central bank (Rogoff 1985; Cukierman 1992, chapter 18; Debelle and Fischer 1994; Schaling 1995; Waller and Walsh 1996).[15] In those papers, the inflation aversion of the central bank (usually measured by the "weight" parameter in the loss function of the monetary policy authorities) is seen as a proxy of central bank "independence". This paper has shown that this approach can be misleading: a more pronounced aversion to inflation on the part of the central bank (hence, in those papers' terminology, a higher degree of "independence") may also be the consequence of a higher degree of social inflation-aversion. It is even possible, when both independence and conservatism are endogenised, to

[15] See footnote 3.

construct examples where the correlation between the independence and the inflation aversion of the central bank is negative. Consider, for example, the effects of an increase in the instability of the median voter preferences, as shown by equation (18). In equilibrium, this increases the degree of conservatism and lowers the degree of independence. This suggests that independence and conservatism should not be used as synonyms as they may actually be negatively correlated.

Another clarification concerns the distinction between the "conservatism" and the "inflation-aversion" of the central bank. The former is a relative measure whereas the second is an absolute one. It appears from equation (18) that in a country where the median voter is highly averse to inflation (e.g. low π_a^*) and preferences are relatively stable (e.g. small v), the central bank may be highly inflation-averse without being conservative. In such a case, there is little divergence between the preferences of the central bank and those of the government and it would be wrong to attribute the low inflation performance to the conservatism of the central bank (made effective by independence).

The previous observation implies that, because of the way most indices of central bank independence are constructed, the correct measurement of the effects of independence is a more complicated empirical issue than is usually considered. Existing indices of central bank independence combine information on the legal independence of the central bank with information on the inflation-aversion of the central bank (such as the weight attributed to inflation in relation to other conflicting economic goals; see Alesina and Summers, 1993; Cukierman, 1992, chapter 19; Cukierman, Webb and Neyapti, 1992). Those indices can thus be seen as a proxy for the effective inflation aversion of monetary policy (as given by equation 10), where both the social degree of inflation-aversion and the effective conservatism of policy are combined. Therefore, a correct empirical identification of the effects of central bank independence on inflation should try to control for the social degree of inflation aversion. Despite the potential difficulties of measuring the latter variable empirically, not doing so does not allow one to identify the pure effects of central bank independence on the inflation performance.[16]

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[16] Fox (1997), Hayo (1998) and Shiller (1996) provide useful examples of how one may proceed in obtaining measures of "social inflation aversion" to be used to conduct such tests.

5. Conclusions

An important issue concerning the anti-inflationary effectiveness of an independent central bank is whether central bank independence is a prime cause of low inflation or whether it simply reflects a more general social concern with this issue. In his recent book on monetary policy Walsh (1998, p. 381) writes that "a complete understanding of the relationship between average inflation and central bank independence, even if the correlation is not causal, will require a better understanding of the factors that have, historically, lead to variations in central bank independence across countries". This paper has analysed this issue by means of a model of endogenous policy delegation, where the conservatism and independence of the central bank are determined by the structure of the median voter preferences and its (degree of) stability.

The first message that emerges from the paper is that central bank inflation-aversion is positively correlated with the inflation-aversion of the median voter. Although this may seem almost obvious, it may be a useful reminder that the "social" degree of inflation-aversion is an important component of the successful low-inflation performance of several European countries, as argued informally by Hayo (1998) and by Posen (1993). The results also indicate the existence of a negative correlation between the degree of *independence* of the central bank and the median voter temptation to inflate. Basically, this happens because a more inflation-averse society has less need of credibility and thus retains more flexibility (to adjust policy targets to shifts in the preferences of the median voter) without the risk of incurring higher inflation. Finally, it is shown that a higher level of instability in the median voter preferences regarding inflation leads to a lower level of central bank independence.[17]

The results qualify the often cited empirical correlation between inflation and central bank independence indices. They suggest that several fundamental social characteristics, including median voter inflation-aversion, are likely to be reflected by those indices. Hence, a more inflation averse monetary policy may be the consequence of a high and stable social concern with inflation, as well as of a high degree of central bank independence. Empirically this implies that in order to identify the pure effects of central bank independence one should

[17] Lippi (1998) provides some empirical evidence on the relationship between central bank independence and target instability that appears in line with this claim.

control for the different social attitudes towards inflation, which have been documented by recent empirical studies (Shiller, 1996; Hayo, 1998). This may be a fruitful avenue for future research.

Appendix

Derivation of the first order conditions for ϕ and z

The policy-maker's problem can be written as:

(A1) $$\min_{\phi,z} E_s(L) = E_s\left[\pi - \pi_m^*\right]^2 + \beta \cdot E_s\left[y - y^*\right]^2$$

which amounts to minimising the expected value of losses (4) with respect to the degree of independence (ϕ) and of conservatism (z), taking into account that policy is implemented by the central bank or the policy-maker with probability ϕ and $1-\phi$, respectively. Equilibrium inflation under each of those agents for a generic monetary regime (ϕ,z) can be calculated by substituting equation (10) into the reaction function of the policy-maker (equation 5) and of the central bank (equation 5 with π_b^* for π_m^*), respectively. Tedious but straightforward calculations show that the first expression on the r.h.s. of (A1) is equal to:

$$E_s\left[\pi - \pi_m^*\right]^2 = (\phi\pi_b^* + (1-\phi)\pi_a^*)^2 \frac{\beta\theta^2(2+\beta\theta^2)}{(1+\beta\theta^2)^2} + 2(\phi\pi_b^* + (1-\phi)\pi_a^*)(\beta\theta\chi - \pi_a^*) +$$
$$+ \frac{[\phi(\pi_b^*)^2 + (1-\phi)(\pi_a^*)^2]}{(1+\beta\theta^2)^2} + (\beta\theta\chi - \pi_a^*)^2 + v^2\left[\frac{(1+2\beta\theta^2)(\phi-1)}{(1+\beta\theta^2)^2} + 1\right]$$

where the shorthand $v^2 \equiv k^2/3$ is used for the variance of the target shock *s*. Proceeding in the same manner for the expectations of the quadratic output term, yields:

$$E_s\left[y - y^*\right]^2 = \chi^2 - (\phi\pi_b^* + (1-\phi)\pi_a^*)^2 \frac{\theta^2}{(1+\beta\theta^2)^2} + \frac{\theta^2}{(1+\beta\theta^2)^2}[\phi(\pi_b^*)^2 + (1-\phi)(\pi_a^*)^2] +$$
$$+ \frac{\theta^2(1-\phi)}{(1+\beta\theta^2)^2} v^2.$$

Taking the partial derivative of the r.h.s. of (A1) with respect to z, setting it equal to zero and rearranging the terms, yields equation (11). Similarly, taking the partial derivative with respect to ϕ, setting it to zero and rearranging the terms yields equation (13). The sign of the first order derivative reveals that the solutions in equations (11) and (13) represent a minimum.

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