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Designing the optimal conservativeness of the central bank

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Abstract

We propose an indicator of the degree of conservativeness of an independent central bank and we derive its optimal social value. We show that from a normative perspective, one can either design a central bank that cares about public spending or that it does not -but in the latter case the optimal weight on output stabilization would have to be higher and the central bank would be less conservative in the Rogoff sense.

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1. Introduction

After a series of influential articles that followed Rogoff's (1985), the ideas on central bank independence (CBI) and conservativeness soon spread to the macroeconomic sphere: 84 countries increased the formal autonomy of their central banks from the 1990s to 2008 (Rapaport *et al.* 2009). As Forder (2005) points out, so complete is the consensus on the desirability of central bank independence that it is possible to forget how quickly it emerged.

If we consider the empirical studies that look at the relationship between central bank independence and inflation, it is surprising to find out that they offer mixed results (see, among others, Klomp and De Haan 2010a, 2010b, Cukierman 2008 and Crowe and Meade 2007).[1]

Moreover, the theoretical studies on CBI do not seem to agree on what the preferences of the central bank should be. For instance, Alesina and Tabellini (1987) and Beetsma and Bovenberg (1997) consider that society's and the authorities' preferences should focus on inflation, output and public spending. Dixit and Lambertini (2003) consider that society's preferences include inflation, output and public spending but the central bank's only include the first two. Debelle and Fischer (1994) assume that both the central bank and society's preferences do not consider public spending. Therefore, if the empirical and theoretical analysis on this issue is not yet closed, the question arises as to whether we have gone too far too quickly?

In this article we will develop a complete welfare analysis following the model of Alesina and Tabellini (1987) and will introduce an indicator of the conservativeness of the central bank that relates the relative weights attributed to output and public spending with respect to inflation. We will show that from a normative perspective, one can design a central bank that cares about public spending, besides output and inflation. A central bank could equally not care about public spending, but then the optimal weight on output stabilization would have to be higher and the central bank would be less conservative, in the Rogoff sense. Moreover, since we obtain an upper value of this indicator, we conclude that when we design a central bank we should not make it too conservative.

[1] For a recent survey, see Alesina and Stella (2010).

Section 2 outlines the model and presents the formal analysis. Concluding remarks are presented in Section 3.

2. The relative degree of conservativeness and welfare analysis

Following Alesina and Tabellini's model (1987), output is given by

$$x_t = \pi_t - \pi_t^e - \tau_t - w^* + \varepsilon_t, \tag{1}$$

where π_t and π_t^e are the actual and expected inflation rates, respectively. τ_t represents taxes levied on output, w^* denotes the target real wage of workers, and ε_t is a productivity shock ($\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$).

The government budget constraint is:

$$g_t = \tau_t + \pi_t, \tag{2}$$

where g_t denotes the ratio of public expenditures over output.[2] Note that public spending will be financed by a distortionary tax (controlled by the fiscal authority) and/or by money creation (controlled by the authority responsible for monetary policy).[3] The assumptions underlying (1) and (2) imply that policymakers face the temptation to use unanticipated inflation, exploiting the trade off between inflation and output.

[2] Expression (1) is derived from the optimization problem of a competitive firm using only one input (labour). Output is produced by labour (L), subject to a productivity shock ε_t: $X_t = L^\gamma e^{\varepsilon_t/2}$, where $\varepsilon_t \sim iid(0, \sigma_\varepsilon^2)$. Workers set the nominal wage (w in logs) to achieve a target real wage w^*: $w = w^* + p^e$. Distortionary taxes are levied on production. The representative firm maximizes profit, given by: $PL^\gamma e^{\varepsilon_t/2}(1-\tau) - WL$. Solving for the firm's optimization problem (assuming it can hire the labour it demands at the given nominal wage) and taking logs, yields the output supply: $x_t = \alpha\left(\pi_t - \pi_t^e - \tau_t - w^* + \ln\gamma\right) + \frac{\varepsilon_t}{2(1-\gamma)}$. For simplicity we set $\gamma = 0.5$, so that $\alpha = \frac{\gamma}{(1-\gamma)} = 1$, and, following Alesina and Tabellini (1987), we set $\ln\gamma = 0$, so the expression for output becomes (1). See Alesina and Tabellini (1987) and Debelle and Fischer (1994) for an explanation of how expression (2) is obtained.

[3] Following Beetsma et al. (1997), we also considered a model with $g_t = \tau_t + \kappa\pi_t$, where $\kappa \in [0, 1]$, to take into account the fact that seigniorage revenues in developed economies are small. The qualitative results were not altered. Further, the hypothesis that there is no public debt can alternatively be thought of as stating that in every period policymakers wish to raise the same constant amount of total revenues g^*, in the form of either taxes or money seigniorage (Alesina and Tabellini, 1987).

The government has the following loss function:

$$L_G = \frac{1}{2}\sum_{t=0}^{T}\theta_G^t\left(\pi_t^2 + \delta_G\left(x_t - x^*\right)^2 + \gamma_G(g_t - g^*)^2\right),$$

with $0 < \theta_G < 1$, δ_G, $\gamma_G > 0$. The government wishes to minimize the deviations of inflation, output and public spending from some targets.

The model is solved under two scenarios: when monetary policy is controlled by the government, or delegated to an independent central bank. In both cases expectations and thus, wages, are set first. Afterwards, the shock ε occurs. Finally, with no delegation, the government chooses fiscal and monetary policy. With delegation, the government and the central bank will choose their policies simultaneously. In both cases, the model is solved by minimizing the loss function of the policymaker(s), holding π_t^e constant and then imposing rational expectations.

We will assume a general loss function for the independent central bank:

$$L_{CB} = \frac{1}{2}\sum_{t=0}^{T}\theta_{CB}^t\left(\pi_t^2 + \delta_{CB}\left(x_t - x^*\right)^2 + \gamma_{CB}(g_t - g^*)^2\right),$$

where $0 < \theta_{CB} < 1$, $\delta_{CB} > 0$ and $\gamma_{CB} \geq 0$. Dixit and Lambertini (2003) claim that, with discretionary policies, the monetary and fiscal authorities should be assigned identical goals.[4] Thus, we assume that both authorities have the same goals, but we allow them to differ in the relative weights attributed to output and public expenditures with respect to inflation. Notice that some authors, like Debelle and Fischer (1994), have assumed $\gamma_{CB} = 0$. This raises a question: should the central bank care about public spending? We will provide an answer in the next lines.

2.1 The relative degree of central bank conservativeness

In the related literature the term "conservativeness" represents the degree of inflation aversion of an authority. Rogoff (1985), in a model with no fiscal policy, considered that the central bank was more conservative than society when $\delta_{CB} < \delta_G$. Alesina and Tabellini (1987) considered a more conservative central bank when both δ_{CB} and γ_{CB}

[4] Following the related literature -see, among others, Alesina and Tabellini (1987), Debelle and Fischer (1994), Alesina and Stella (2010) - we assume that the inflation target (π^*) of the authorities has been normalised to zero. The results would not be qualitatively altered by assuming a positive inflation target.

were lower than δ_G and γ_G, respectively. Thus, the degree of conservativeness of the central bank should be related to the number of instruments -and policies. The more realistic a model is, and thus, the more instruments and policies are included, the higher the number of parameters that measure how conservative an authority is. We will introduce a measure of the conservativeness of the central bank that takes into account this fact and encompasses both Rogoff's and Alesina and Tabellini's notions.

Definition 1. *The relative degree of conservativeness of the central bank with respect to the conservativeness of the government (c) is given by*

$$c = \frac{1}{\frac{\frac{\delta_{CB}}{\delta_G} + \frac{\gamma_{CB}}{\gamma_G}}{2}}.$$

Remark 1. *Note that this indicator is the inverse of the average of the relative weights of the central bank with respect to the weights of the government.*

To understand this indicator, consider some particular cases:

1) When both authorities have the same preferences, $\delta_{CB} = \delta_G$ and $\gamma_{CB} = \gamma_G$, then $c = 1$, i.e., the government and the central bank have the same degree of conservativeness;

2) If $\delta_{CB} \leq \delta_G$ and $\gamma_{CB} \leq \gamma_G$ and at least one of the previous inequalities is strict, then $c > 1$. In this case, the central bank is more conservative than the government in the Alesina and Tabellini's sense.

3) If $\gamma_{CB} = \gamma_G$, then $c > 1$ is equivalent to $\delta_{CB} < \delta_G$, and in this case, the indicator of conservativeness coincides with Rogoff's.

Solving the model with and without delegation, we obtain the following result:[5]

Proposition 1. *Delegation of monetary policy to an independent and "conservative enough" authority ($c > 1$) reduces the expected inflation, the expected output and the variance of inflation, but increases the variance of output.*

Notice that $c > 1$ encompasses different combinations among the relative weights of the authorities preferences:

[5] The complete resolution of the model is available upon request.

a) when the weight on public spending placed by the monetary authority and the government coincide ($\gamma_{CB} = \gamma_G$), we reproduce Rogoff's result: an independent central bank that places a lower weight on output stabilization than the fiscal authority ($\delta_{CB} < \delta_G$) delivers lower inflation but less output stabilization.

b) when the weight placed by the monetary authority on public spending is smaller than the weight of the fiscal authority ($0 \leq \gamma_{CB} < \gamma_G$), the condition $c > 1$ would then include instances where the central bank is less conservative than the fiscal authority in the Rogoff sense (i.e., for values of δ_{CB} such that $\delta_{CB} > \delta_G$).

Proposition 1 could provide an explanation of the mixed results found between CBI and inflation in the empirical literature. The empirical evidence on the expected negative relationship between CBI and inflation is, as highlighted by Alesina and Stella (2010), not clear-cut. The measurement of CBI has focused on legal characteristics that relate to the central bank's independence from politicians (*de jure* CBI), or on *de facto* CBI, like the turnover of the central bank's governor. According to Proposition 1, delegation of monetary policy to an independent central bank is not enough to achieve lower inflation; the central bank must also be "conservative enough" in the sense that $c > 1$. This should be considered in the empirical assessment of the effects on inflation of delegating monetary policy to a central bank. However, from a practical point of view, the concept of conservativeness is hard to identify. As Berger *et al.* (2001) point out, and we demonstrate in Proposition 1, it is the combination of CBI and conservativeness that delivers lower inflation. Moreover, when considering more than one policy, what matters is the *relative degree* of conservativeness of the central bank.

2.2 Welfare analysis: designing the optimal central bank

The question that follows is, then, how conservative should the independent central bank be from society's point of view. We will consider a general loss function for the society:

$$L_S = \frac{1}{2} \sum_{t=0}^{T} \theta_S^t \left(\pi_t^2 + \delta_S \left(x_t - x^* \right)^2 + \gamma_S (g_t - g^*)^2 \right),$$

where $0 < \theta_S < 1$, $\delta_S > 0$ and $\gamma_S \geq 0$. Taking expectations, under delegation, the expected loss for society can be rewritten as a function of c, as follows:

$$E\left[L_S^D\right] = \frac{1-\theta_S^{T+1}}{2\left(1-\theta_S\right)}\left(\frac{1}{\left(\frac{\delta_G+\gamma_G}{\delta_G\gamma_G}\frac{c}{2}+1\right)^2}A^2 + \frac{1}{\left(\frac{\delta_G+\gamma_G}{\delta_G\gamma_G}\frac{c}{2}+2\right)^2}\sigma_\varepsilon^2\right)\left(1+\delta_S\left(\frac{c}{2\delta_G}\right)^2+\gamma_S\left(\frac{c}{2\gamma_G}\right)^2\right),$$

where $A = g^* + w^* + x^*$.

Notice that the parameters δ_{CB} and γ_{CB} affect the society's welfare through c. Hence, the problem of finding the optimal relative weights, i.e. δ_{CB} and γ_{CB}, that maximize the society's welfare is reduced to determine the relative degree of conservativeness of the central bank. Formally,

$$\underset{c}{min} E\left[L_S^D\right]. \tag{3}$$

Proposition 2: *There exists a unique value of c, denoted by c^*, that maximizes society's welfare. Moreover,* $c^* \in (\beta, 2\beta)$ where $\beta = \frac{\delta_G\gamma_G(\delta_G+\gamma_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2}$.

Applying the Implicit Function Theorem we derive the following comparative statics results:

Corollary 3: $\frac{\partial c^*}{\partial \varkappa} < 0$ for $\varkappa = \delta_S$, γ_S and σ_ε^2, while $\frac{\partial c^*}{\partial \varkappa} > 0$ for $\varkappa = A$.

According to Corollary 3, the higher society's weights on output stabilization and public spending, the lower will be the optimal degree of conservativeness of the central bank. This is due to the fact that a more conservative central bank would increase the deviations of output and public spending from their targets, lowering welfare. Further, the higher the volatility of supply shocks, the lower is c^* and, thus, the less conservative the central bank should be in order to try to stabilize output. Finally, the higher the target level of output, public spending or the real wage targeted by unions, the higher would be inflation and thus the more conservative the central bank would have to be.

Many articles consider that the fiscal authority incorporates the social preferences, as society would have chosen the government through elections, and thus, $\delta_S = \delta_G$ and $\gamma_S = \gamma_G$. In this case, we obtain the following corollary:

Corollary 4: *When the preferences of the government and society coincide, the optimal degree of conservativeness of the central bank satisfies that* $c^* \in (1, 2)$.

Therefore, in the optimal, the central bank is more conservative than society (and the government). This is in line with the results of Rogoff (1985), Alesina and Tabellini (1987) and Beetsma *et al.* (1997).

By solving (3) we are finding a relationship that the optimal values of δ_{CB} and γ_{CB} must satisfy. With no loss of generality, as the relevant variable in the optimization problem of society's welfare is c, we have a degree of freedom when choosing the optimal values δ_{CB} and γ_{CB}. Consequently, we can suppose that $\gamma_{CB} = 0$, which corresponds to the case studied, among others, by Debelle and Fischer (1994). Thus, the following corollary applies:

Corollary 5: *If public spending is not included in the preferences of the central bank ($\gamma_{CB} = 0$) and the preferences of society and the government coincide, the optimal relative weight of output satisfies $\delta^*_{CB} \in (\delta_G, 2\delta_G)$.*

Now the central bank would be *less* conservative than the government and society in the Rogoff sense. However, we cannot conclude that the central bank is less conservative, as $c > 1$. From a normative perspective, we could justify that public spending need not be included in the loss function of the monetary authority, however the consequence of this is that the socially optimal value of δ_{CB} is then higher.

Further, the last two corollaries indicate that the optimal degree of conservativeness of the central bank might have been overstated. When the government's and society's preferences coincide, the optimal degree of conservativeness of the central bank when there are two instruments of policy should be smaller than 2. This indicates that a central bank that is too conservative ($c > 2$) would not be optimal. In particular, if $\gamma_{CB} = 0$ and $\delta_{CB} < \delta_G$, which would be equivalent to Rogoff's model, then the central bank would be *too conservative*. Given that in the last decades a number of central banks have been extremely inflation averse, the question arises as to whether they are too conservative from society's point of view.

The possibility of accepting a central bank that is too conservative might have become a reality for countries joining the European Monetary Union (EMU). The European Central Bank (ECB) was established as a conservative central bank, more independent than the Bundesbank (see, among others, Wyplosz 1997 and De Haan 1997). However, not all countries that entered the monetary union might have had the same degree of inflation aversion. For instance, Scheve (2004) finds that Austria, Belgium, Finland, France, Greece, Italy, Ireland, the Netherlands, Portugal and Spain, have, on average, lower inflation aversion than Germany. The question that arises is whether the ECB has been too conservative from the social welfare perspective of some EMU member countries. Obviously, in joining a monetary union, a country might accept a monetary authority that is more conservative than the optimal value as a trade off for other advantages that are not included in this model and its overall welfare might not necessarily worsen. Nonetheless, the analysis in this article questions the need for central banks that are too conservative.

3. Conclusions

This article illustrates that, in the presence of more than one policy, inflation will be reduced when monetary policy is delegated to an independent authority that is also *relatively* conservative. Further, we also obtain a finite optimal degree of central bank conservativeness, which confirms Rogoff's (1985) conclusion that conservativeness should not be infinite. But, contrary to Rogoff´s results, we show that there may be instances where the optimal degree of conservativeness of the central bank is associated with a higher weight on output stabilization than the government -or than society, if the government represents society's preferences.

We have defined an indicator of the relative degree of conservativeness of the central bank, which is also useful to define the optimal relative weights in the preferences of the monetary authority from society's point of view. Further, we show that one can either design a central bank that cares about public spending or that it does not -but in the latter case the central bank would be less conservative, in the Rogoff sense.

Appendix

Proof of Proposition 2: Note that

$$\frac{\partial}{\partial c}E\left[L_S^D\right]=2\frac{(1-\theta_S^{T+1})\delta_G\gamma_G}{(1-\theta_S)}\left(\frac{c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)-2\delta_G\gamma_G(\delta_G+\gamma_G)}{\left(c(\delta_G+\gamma_G)+2\delta_G\gamma_G\right)^3}A^2+2\frac{\left(c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)-\delta_G\gamma_G(\delta_G+\gamma_G)\right)}{\left(c(\delta_G+\gamma_G)+4\delta_G\gamma_G\right)^3}\sigma_\varepsilon^2\right).$$

If $c>\frac{2\delta_G\gamma_G(\gamma_G+\delta_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2}$, $\frac{\partial}{\partial c}E\left[L_S^D\right]>0$. Moreover, if $c<\frac{\delta_G\gamma_G(\gamma_G+\delta_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2}$, $\frac{\partial}{\partial c}E\left[L_S^D\right]<0$. Hence, there exists a value of c such that $c\in\left(\frac{\delta_G\gamma_G(\gamma_G+\delta_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2},\frac{2\delta_G\gamma_G(\gamma_G+\delta_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2}\right)$ that satisfies the f.o.c. Moreover,

$$\frac{\partial^2}{\partial^2 c}E\left[L_S^D\right]=\frac{4(1-\theta_S^{T+1})\delta_G\gamma_G}{1-\theta_S}\left(\begin{array}{c}\frac{\delta_G\gamma_G\left(3(\gamma_G+\delta_G)^2+\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)\right)-\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)(\gamma_G+\delta_G)c}{\left(c(\gamma_G+\delta_G)+2\gamma_G\delta_G\right)^4}A^2\\+\frac{\delta_G\gamma_G\left(3(\gamma_G+\delta_G)^2+4\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)\right)-2\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)(\gamma_G+\delta_G)c}{\left(c(\gamma_G+\delta_G)+4\gamma_G\delta_G\right)^4}\sigma_\varepsilon^2\end{array}\right).$$

For a c that satisfies the f.o.c., $A^2=\frac{-2\frac{\left(c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)-\delta_G\gamma_G(\gamma_G+\delta_G)\right)}{\left(c(\gamma_G+\delta_G)+4\gamma_G\delta_G\right)^3}}{\frac{c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)-2\delta_G\gamma_G(\gamma_G+\delta_G)}{\left(c(\gamma_G+\delta_G)+2\gamma_G\delta_G\right)^3}}\sigma_\varepsilon^2$. Hence:

$$\frac{\partial^2}{\partial^2 c}E\left[L_S^D\right]=\frac{4(1-\theta_S^{T+1})(\gamma_G+\delta_G)\sigma_\varepsilon^2\delta_G^2\gamma_G^2\left(\gamma_G^2\delta_S+\delta_G^2\gamma_S\right)p(c)}{(1-\theta_S)\left(2\delta_G\gamma_G(\delta_G+\gamma_G)-c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)\right)(c(\delta_G+\gamma_G)+4\gamma_G\delta_G)^4(c(\delta_G+\gamma_G)+2\delta_G\gamma_G)},$$

where

$$p(c)=4\delta_G^2\gamma_G^2\left(2-3\frac{(\delta_G+\gamma_G)^2}{\left(\gamma_G^2\delta_S+\delta_G^2\gamma_S\right)}\right)+24\left(\delta_G+\gamma_G\right)\delta_G\gamma_G c+\left((\delta_G+\gamma_G)^2-6\left(\gamma_G^2\delta_S+\delta_G^2\gamma_S\right)\right)c^2.$$

$p(c)$ is increasing in the interval $\left(\frac{\delta_G\gamma_G(\delta_G+\gamma_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2},\frac{2\delta_G\gamma_G(\delta_G+\gamma_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2}\right)$ and $p(\frac{\delta_G\gamma_G(\delta_G+\gamma_G)}{\delta_S\gamma_G^2+\gamma_S\delta_G^2})>0$. Thus, for a value of c satisfying the f.o.c. $\frac{\partial^2}{\partial^2 c}E\left[L_S^D\right]>0$. This guarantees that the value c that solves the f.o.c. is unique and a minimum. ■

Proof of Corollary 3: Recall that c^* is the solution of a optimization problem. From the f.o.c., we know that c^* satisfies

$$F(c^*,\varkappa)=0,$$

where

$$F(c,\varkappa)=\frac{c\left(\delta_S\gamma_G^2+\gamma_S^2\delta_G\right)-2\delta_G\gamma_G\left(\delta_G+\gamma_G\right)}{\left(c\left(\delta_G+\gamma_G\right)+2\delta_G\gamma_G\right)^3}A^2+2\frac{\left(c\left(\delta_S\gamma_G^2+\gamma_S\delta_G^2\right)-\delta_G\gamma_G\left(\delta_G+\gamma_G\right)\right)}{\left(c\left(\delta_G+\gamma_G\right)+4\delta_G\gamma_G\right)^3}\sigma_\varepsilon^2$$

and $\varkappa$ denotes a parameter. In addition, from the s.o.c., we know $\frac{\partial F}{\partial c}(c^*,\varkappa)>0$. Applying the Implicit Function Theorem, we get

$$sign\left(\frac{\partial c^*}{\partial\varkappa}\right)=-sign\left(\frac{\partial F}{\partial\varkappa}(c^*,\varkappa)\right).$$

Direct computations yield $\frac{\partial F}{\partial \varkappa}(c^*, \varkappa) > 0$ for $\varkappa = \delta_S, \gamma_S$ and σ_ε^2, while $\frac{\partial F}{\partial \varkappa}(c^*, \varkappa) < 0$ for $\varkappa = A$. Hence, we have that $\frac{\partial c^*}{\partial \varkappa} < 0$ for $\varkappa = \delta_S, \gamma_S$ and σ_ε^2, while $\frac{\partial c^*}{\partial \varkappa} > 0$ for $\varkappa = A$. ■

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