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Conference Paper

Central bank independence and conservatism under uncertainty: Substitutes or complements?

Beiträge zur Jahrestagung des Vereins für Socialpolitik 2010: Ökonomie der Familie - Session: Monetary Policy Rules and Institutions, No. B16-V3

Provided in Cooperation with:
Verein für Socialpolitik / German Economic Association

Suggested Citation: Hefeker, Carsten; Zimmer, Blandine (2010) : Central bank independence and conservatism under uncertainty: Substitutes or complements?, Beiträge zur Jahrestagung des Vereins für Socialpolitik 2010: Ökonomie der Familie - Session: Monetary Policy Rules and Institutions, No. B16-V3, Verein für Socialpolitik, Frankfurt a. M.

This Version is available at:
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January 2010

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Keywords : Central bank independence, Conservatism, Transparency of monetary policy.

JEL Classification: E 52, E 58.

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Central bank independence and conservatism under uncertainty: Substitutes or complements?

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This paper revisits the trade-off between central bank independence and conservatism using a New Keynesian model with uncertainty about the central banker's output gap target. It is shown that when this uncertainty is high, the trade-off no longer holds. In this case, the optimal combination between independence and conservatism is characterised by complementarity.

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1. Introduction

In the debate about the optimal institutional design of central banks, independence is usually considered to be the most important ingredient for a stable and successful monetary policy. Building on Rogoff (1985), it is argued that delegating monetary policy to an independent and conservative central bank will improve the central bank's credibility and deliver, on average, a lower and less variable rate of inflation, albeit at the price of higher output variability. While Rogoff (1985) did not really distinguish between independence and conservatism, Eijffinger and Hoeberichts (1998) have shown in a seminal paper that these two characteristics should be viewed as strategic substitutes. Distinguishing explicitly between central bank independence and conservatism (henceforth, respectively CBI and CBC) and studying their

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optimal combination, it is found that high conservatism can substitute for low independence from government interference in monetary policy and vice versa. There hence exists a trade-off between these institutional parameters, implying that it is in the interest of society to compensate a lack of CBI by appointing a more conservative central banker. Thus, for a given level of independence, the desired result in terms of average inflation can be achieved by adjusting the degree of conservatism of the central bank's preferences.[1]

In this paper, we add another dimension to the debate by introducing uncertainty about the central bank's preference parameters. The current debate about central bank transparency and communication suggests that the degree of predictability of central bank behavior will have a significant influence on the performance of monetary policy. Such an uncertainty plays a crucial role in practice and may therefore have important consequences for the design of monetary institutions.[2] The objective of our paper is to highlight the implications of this uncertainty for the optimal combination of independence and conservatism. By introducing the possibility that the central bank's preferences and thus its policy decisions are not fully predictable, we show that independence and conservatism are no longer necessarily substitutes.

To that end, we combine ingredients of two different strands of literature. The first strand relates to the discussion about the design of monetary institutions.[3] This literature however usually abstracts from the distinction between central bank independence and conservatism. Starting with Rogoff (1985), both institutional features are modelled by a unique parameter representing the relative weight that is attributed to inflation stabilisation in the central bank's objective function. The paper of Eijffinger and Hoeberichts (1998) is an important exception as it introduces an explicit parameter for independence in a monetary policy model with a conservative central banker. In this paper, the central bank is assumed to face pressures from the government when setting its monetary decisions. This idea is captured by the fact that the loss function that effectively governs monetary policy is a weighted average of the central bank's loss function and the government's loss function. CBI is then defined as the strength of the central bank in the negotiations with the government about monetary policy. It appears from this analysis

[1] Eijffinger and Hoeberichts (2008) argue that changes in the institutional independence of the European Central Bank (ECB) will be compensated by its more conservative behavior.

[2] Goldberg and Klein (2008) show that the initial years of the European monetary union where characterised by a significant degree of uncertainty about the ECB's preferences. Berger et al. (2008) show that there still seems to be uncertainty about the ECB's policy reactions in parts of the monetary area.

[3] This literature is much too broad to be completely referenced here. It includes seminal contributions by, for instance, Kydland and Prescott (1977), Barro and Gordon (1983), Rogoff (1985), Alesina and Tabellini (1987), Walsh (1995) and Svensson (1997). Recent surveys include Berger et al. (2001), Hayo and Hefeker (2009), Laurens et al. (2009), Siklos (2008).

that the less independence the central bank has, the more conservative it should be. Accordingly, the optimal arrangement between CBI and CBC is characterised by substitutability. A similar result is obtained by Hughes Hallett and Weymark (2005) and Weymark (2007) and, more recently, by Eijffinger and Hoeberichts (2008) within a New Keynesian framework. Thus, the result of substitutability can be considered as relatively robust across different types of models.

The second strand of literature concerns the issue of uncertain central bank preferences. Here, the assumption is made that the government and the private sector do not perfectly know the central bank's preferences.[4] A series of papers has investigated the reaction of these agents to such an uncertainty. Sorensen (1991) and Grüner et al. (2009) for instance, consider wage setters' reaction to uncertain central bank preferences, whereas Hefeker and Zimmer (2009) study the influence of uncertainty on the fiscal authorities' decisions. The focus in our paper, however, is more normative. Closest in spirit to our analysis are the papers by Beetsma and Jensen (1998) and Muscatelli (1998) who examine the implications of uncertain central bank preferences for the optimal design of monetary institutions. It is demonstrated in particular that high conservatism may be desirable in the presence of monetary uncertainty. These studies however are limited to the extreme case of full central bank independence.

To formalise the interference of the government in the central bank's monetary decisions, we make use of the New Keynesian framework developed by Eijffinger and Hoeberichts (2008). This set up is extended to allow for uncertainty about the central banker's preferences. The source of this monetary uncertainty varies across studies. Cukierman and Meltzer (1986), for instance, consider the relative weight that the central bank puts on the output gap compared to inflation. Geraats (2005), alternatively, allows for shifts in the central bank's inflation target. As in Faust and Svensson (2001, 2002), Jensen (2002) and more recently Westelius (2009), we assume that the central bank is not fully transparent about its output gap target. Besides being methodologically convenient for specifying monetary uncertainty in a New Keynesian model, such an assumption seems realistic especially when considering the case of the European Central Bank (ECB).[5]

Our result challenges the idea that CBI and CBC are necessarily strategic substitutes.[6] It turns out that when uncertainty about the central bank's

[4]Again, there is a broad literature too large to be fully and adequately referenced on the general issue of uncertainty in monetary policy, starting with Brainard (1967). An important contribution is Cukierman and Meltzer (1986). Recent surveys include Blinder et al. (2008), Crowe and Meade (2008), Dincer and Eichengreen (2009) and Geraats (2009).

[5]See Mishkin (2004) and Cukierman (2002, 2005) for a discussion of the reluctance of central banks to talk about their output target.

[6]A similar result can be found in Dehay (2009) who develops an extended version of the model of Eijffinger and Hoeberichts (1998) with uncertainty about the relative weight

output gap target is high, CBI and CBC complement each other: low independence then *reduces* the need for conservatism. Intuitively, when less authority is delegated to a central bank whose preferences are highly uncertain, the volatility of its monetary decisions is attenuated. This in turn allows to decrease the degree of central bank conservatism. By taking account of the uncertainty surrounding the central bank's preferences, our analysis eventually qualifies the result of Eijffinger and Hoeberichts (2008). The main novelty is that it identifies a condition - depending on the degree of monetary uncertainty - under which optimal CBI and CBC are characterised by either strategic substitutability or complementarity.

The remainder of the paper is organised as follows. The next section describes our formal framework. The optimal arrangement between CBI and CBC is examined in section 3, and concluding remarks are offered in section 4.

2. The New Keynesian framework with monetary uncertainty

In this section, we develop the simplest version of a New-Keynesian model (see, for instance, Clarida et al. 1999, Woodford 2003). The development of inflation is derived under the assumption of a monopolistic competition where optimizing firms adjust their prices in a staggered, overlapping way. The aggregate supply curve is thus represented by a forward-looking Phillips curve which takes the form:

$$\pi_t = \alpha x_t + \beta E_t \pi_{t+1} + e_t \tag{1}$$

where π_t is the inflation rate; x_t is the output gap defined as output relative to its equilibrium level under flexible prices and $E_t\pi_{t+1}$ is the expected future inflation rate (with E_t denoting the expectations operator). The discount factor is denoted by β and the sensitivity of inflation to the output gap is measured by α. The larger is the value of α, the greater is the firms' ability to adjust their prices in response to changes in the current output gap. Finally, e_t represents a cost push shock which exhibits some degree of persistence measured by the coefficient $0 \leq \rho < 1$:

$$e_t = \rho e_{t-1} + \mu_t \quad \text{with } \mu_t \sim N(0,1) \tag{2}$$

The government aims to minimise a loss function defined over inflation and the output gap:

$$L_t^G = \lambda^G \pi_t^2 + (x_t - x^*)^2 \tag{3}$$

where λ^G measures the government's relative concern about price stability; x^* is the government's output gap target. Since the government is elected, we can assume that it shares the society's objectives. We therefore refer to (3) as the society's loss function as well.

placed by the central bank on inflation and output.

Like the government, the central bank (CB) seeks price stability and output gap stabilisation. Its preferences are summarised as follows:

$$L_t^{CB} = \lambda^{CB}\pi_t^2 + (x_t - \tilde{x}^*)^2 \quad \text{with } \tilde{x}^* = x^* + \epsilon_t \tag{4}$$

where λ^{CB} denotes the degree of central bank conservatism and $\tilde{x}^*$ is the central bank's output gap target. The issue of monetary uncertainty arises as the central bank is not fully transparent about its output gap target *vis-à-vis* the government and society. This idea is captured by the presence of the random variable ϵ_t with $E(\epsilon_t) = 0$ and $V(\epsilon_t) = \sigma_\epsilon^2$.[7] We hence assume that its output gap target coincides on average with the government's (and society's) output gap target but that there is some degree of uncertainty around it which is measured by σ_ϵ^2. The larger is σ_ϵ^2, the greater is the uncertainty concerning the central bank's output gap target.

Following Eijffinger and Hoeberichts (1998, 2008), we assume that the central bank is not completely independent in the way it sets monetary policy. It faces pressures from the government so that the loss function that effectively governs monetary policy is a weighted average of both authorities' loss function:

$$L_t^P = \gamma L_t^{CB} + (1-\gamma) L_t^G = \left(\lambda^G + \gamma\phi\right)\pi_t^2 + \gamma\left(x_t - \tilde{x}^*\right)^2 + (1-\gamma)\left(x_t - x^*\right)^2 \tag{5}$$

where $0 \leq \gamma \leq 1$ denotes the strength of the central bank in the negotiations with the government or its political independence; $\phi = \lambda^{CB} - \lambda^G$ measures the level of central bank conservatism *vis-à-vis* the government.[8] In the remainder of the paper, the government's output gap target x^* as well as the central bank's expected output gap target are set to zero ($E(\tilde{x}^*) = x^* = 0$), indicating that there is no desire to reach an overoptimistic output level and thus no inflationary bias. Conservatism thus only impacts on the degree of stabilization of shocks but does not affect average inflation which is the focus in standard models of central bank conservatism (such as in Rogoff 1985).

Under discretionary policy, the monetary authorities minimise their loss function (5) subject to the Phillips curve (1) taking inflation expectations as given. The respective first order condition can be written:

$$x_t = \gamma\epsilon_t - \alpha\left(\lambda^G + \gamma\phi\right)\pi_t \tag{6}$$

According to this optimality condition, the central bank responds to a rise in inflation by contracting demand which reflects a "leaning against the

[7] Note that in our analysis the central bank's preference shock ϵ_t is only transitory. For a study where this shock also has a persistent component, see for instance Westelius (2009). Moreover, we assume that the preference shock ϵ_t is independent of the cost-push shock e_t, so that $E_t(\epsilon_t e_t) = 0$.

[8] In what follows, we derive the optimal ϕ. It should be stressed that this optimal degree of central bank conservatism is relative to that of the government or society. It thus does not measure an absolute value but changes according to societal preferences. As we show, it is moving upwards with the government's and society's conservatism.

wind" policy. The strength of this response positively depends on both, α, the slope of the Phillips curve and, $\left(\lambda^G + \gamma\phi\right)$, the weight attached to inflation stabilisation in the objective function (5). Monetary policy is also positively affected by ϵ_t, the central bank's unobservable output gap target. A negative realisation of ϵ_t, for example, leads to a contraction of the economy. The effect of ϵ_t is magnified by the degree of independence γ. In this respect, independence matters for monetary policy even if the central bank has the same degree of inflation aversion as the government (i.e. $\phi = \lambda^{CB} - \lambda^G = 0$). This observation is in contrast with the analysis of Eijffinger and Hoeberichts (1998, 2008). Thus, independence allows the central bank to pursue its output target to a larger degree. This possibility is obviously not given when $\gamma = 0$.

Inserting the optimality condition (6) into the New Keynesian Phillips curve and rearranging terms, we obtain:

$$x_t \left[\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1\right] = \gamma\epsilon_t + \beta E_t x_{t+1} - \alpha \left(\lambda^G + \gamma\phi\right) e_t \tag{7}$$

To determine x_t, we employ the technique of undetermined coefficients. Since the relevant state variables in (7) are ϵ_t and e_t, it is apparent that x_t will be of the form:

$$x_t = b_0\epsilon_t + b_1 e_t \tag{8}$$

Forwarding Eq. (8) and taking expectations with respect to the public's information set we get:

$$E_t x_{t+1} = b_1 \rho e_t \tag{9}$$

Substituting (9) into (7), we get:

$$x_t = \frac{\gamma\epsilon_t + \left[\beta b_1 \rho - \alpha \left(\lambda^G + \gamma\phi\right)\right] e_t}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1} \tag{10}$$

Comparing (10) and (8), we can solve for the coefficients b_0 and b:

$$b_0 = \frac{\gamma}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1} \tag{11}$$

$$b_1 = \frac{-\alpha \left(\lambda^G + \gamma\phi\right)}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1 - \beta\rho} \tag{12}$$

The equilibrium output gap can then be written:

$$x_t = \frac{\gamma}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1} \epsilon_t - \frac{\alpha \left(\lambda^G + \gamma\phi\right)}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1 - \beta\rho} e_t \tag{13}$$

The equilibrium expression for inflation is derived by inserting (13) into the optimality condition (6) and rearranging:

$$\pi_t = \frac{\alpha\gamma}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1} \epsilon_t + \frac{1}{\alpha^2 \left(\lambda^G + \gamma\phi\right) + 1 - \beta\rho} e_t \tag{14}$$

As can be seen from Eqs. (13) and (14), the equilibrium output gap and inflation rate positively depend on the central bank's (unobservable) ouptut gap target ϵ_t. Indeed, a rise in the latter induces the monetary authority to expand the economy which, in turn, generates greater inflationary pressure. Unsurprisingly, the positive impact of ϵ_t on x_t and π_t is increasing in γ, the central bank's ability to determine monetary policy independently.

The equilibrium output gap and inflation rate are also affected by e_t. A positive cost-push shock causes inflation to rise above its optimal level (which is set to zero, corresponding to price stability), inducing monetary authorities to contract demand. Moreover, it appears that an increase in the degree of the bank's conservatism λ^{CB} – and thereby in the "effective" weight for inflation stabilisation $(\lambda^G + \gamma\phi)$ – reduces the impact of cost-push shocks on inflation whereas it amplifies the impact of these shocks on the output gap. We thus have the standard result that optimal conservatism trades off price stability and output gap stabilisation.

As is clear from expressions (13) and (14), the transmission of cost-push shocks to the output gap and inflation rate is not affected by the central bank's preference shock ϵ_t. This is due to the fact that the preference shock concerns the central bank's targets and not the relative weights of its objectives.

3. The trade-off between independence and conservatism revisited

In this section, we first determine the optimal degree of central bank conservatism (vis-à-vis the government). We can study how it varies according to different economic and institutional factors such as, in particular, the degree of independence γ. We are then able to see under what circumstances the introduction of uncertainty changes the relation between independence and conservatism. We find that uncertainty qualifies the otherwise robust result of Eijffinger and Hoeberichts (1998, 2008).

Integrating the expressions for equilibrium output gap and inflation into Eq. (3) and taking expectations yields the following expected loss for society:[9]

$$E_t L_t^G = \frac{\left(\lambda^G \alpha^2 + 1\right)\gamma^2}{\left[\alpha^2\left(\lambda^G + \gamma\phi\right) + 1\right]^2}\,\sigma_\epsilon^2 + \frac{\lambda^G + \alpha^2\left(\lambda^G + \gamma\phi\right)^2}{\left[\alpha^2\left(\lambda^G + \gamma\phi\right) + 1 - \beta\rho\right]^2} \cdot \frac{1}{\left(1-\rho^2\right)} \quad (15)$$

The first term is due to the inflation and output gap volatility that arises from uncertain central bank preferences ($\sigma_\epsilon^2 > 0$). This term increases when the bank becomes more independent (higher γ). The second term corresponds to the volatility of the output gap and inflation that is related to cost-push shocks.

[9]The cost-push shock e_t is described by the AR(1) process: $e_t = \rho e_{t-1} + \mu_t$, with $0 \leq \rho < 1$ and $\mu_t \sim N(0,1)$. Hence, $E\left(e_t\right) = 0$ and $V\left(e_t\right) = E\left(e_t\right)^2 = \frac{V(\mu_t)}{1-\rho^2} = (1-\rho^2)^{-1}$.

Minimising the expected social loss with respect to ϕ, the degree of central bank conservatism (vis-à-vis the government), yields the following first order condition:

$$-\frac{\left(\lambda^G\alpha^2+1\right)\gamma^2}{\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1\right]^3}\,\sigma_\epsilon^2+\frac{\gamma\phi\left(1-\beta\rho\right)-\lambda^G\beta\rho}{\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1-\beta\rho\right]^3}\cdot\frac{1}{\left(1-\rho^2\right)}=0 \quad (16)$$

The first term is always negative and reflects the fact that greater central bank conservatism ϕ reduces the volatility arising from uncertainty about the its preferences. The second term can be positive or negative, depending on the size of ϕ. This term highlights the trade-off between inflation and output gap stabilisation: a higher ϕ means better inflation stabilisation at the cost of less output gap stabilisation. Since the first term is negative, the optimal ϕ must be sufficiently large so that the second term becomes positive. Accordingly, the optimal degree of central bank conservatism will be high enough for the marginal cost (less output gap stabilization) of an increase in ϕ to outweigh its marginal gain (better inflation stabilization). Finally, the presence of uncertain central bank preferences requires some extra conservatism that improves the inflation stabilisation at the expense of greater output gap volatility.

Rewriting the first order condition (16), we have:

$$\phi=\frac{\gamma\left(\lambda^G\alpha^2+1\right)\left(1-\rho^2\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1-\beta\rho\right]^3\sigma_\epsilon^2}{\left(1-\beta\rho\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1\right]^3}+\frac{\lambda^G\beta\rho}{\gamma\left(1-\beta\rho\right)}\equiv f\left(\phi,\gamma\right) \quad (17)$$

Expression (17) is positive, clearly showing that it is optimal for society to select a central banker that is more conservative than the government: $\phi^*>0\Rightarrow\lambda^{CB}>\lambda^G$.

To find the optimal value of ϕ and its comparative static properties, we use a graphical method as is illustrated in Figure 1.[10] As Figure 1 shows, the function $f(\phi,\gamma)$ on the right hand side of Eq. (17) is monotonically increasing in ϕ and concave.[11] Indeed, studying the properties of the function $f(\phi,\gamma)$, we observe:

$$\frac{\partial f(\phi,\gamma)}{\partial\phi}=\frac{3\alpha^2\gamma^2\beta\rho\sigma_\epsilon^2\left(\lambda^G\alpha^2+1\right)\left(1-\rho^2\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1-\beta\rho\right]^2}{\left(1-\beta\rho\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1\right]^4}>0 \quad (18)$$

$$\begin{aligned}\frac{\partial^2 f(\phi,\gamma)}{\partial^2\phi} &= \frac{6\alpha^4\gamma^3\beta\rho\sigma_\epsilon^2\left(\lambda^G\alpha^2+1\right)\left(1-\rho^2\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1-\beta\rho\right]}{\left(1-\beta\rho\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1\right]^5}\\ &\times\ \frac{\left[2\beta\rho-\alpha^2\left(\lambda^G+\gamma\phi\right)-1\right]}{\left(1-\beta\rho\right)\left[\alpha^2\left(\lambda^G+\gamma\phi\right)+1\right]^5} \quad (19)\end{aligned}$$

[10] See also Cukierman (1992) and Eijffinger and Hoeberichts (1998).

[11] Note that $\lim_{\phi=0} f(\phi,\gamma) = \frac{\gamma\left(\lambda^G\alpha^2+1\right)\left(1-\rho^2\right)\left(\alpha^2\lambda^G+1-\beta\rho\right)^3\sigma_\epsilon^2}{(1-\beta\rho)(\alpha^2\lambda^G+1)^3}+\frac{\lambda^G\beta\rho}{\gamma(1-\beta\rho)}$ and $\lim_{\phi\to+\infty} f(\phi,\gamma)=\frac{\gamma\left(\lambda^G\alpha^2+1\right)\left(1-\rho^2\right)\sigma_\epsilon^2}{(1-\beta\rho)}+\frac{\lambda^G\beta\rho}{\gamma(1-\beta\rho)}$.

Expression (19) is negative provided β and ρ are not too large and/or that λ^G and $\gamma\phi$ are sufficiently large.[12]

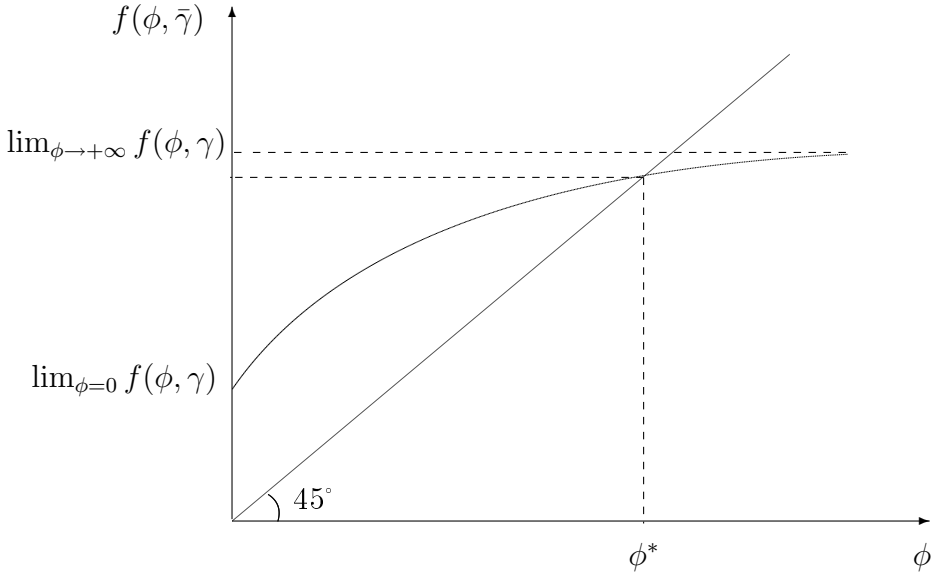

Figure 1: Determination of the optimal degree of CB conservatism

The left-hand side of Eq. (17) is a 45° line through the origin. The intersection point between the 45° line and the function f curve gives the optimal degree of central bank conservatism ϕ^*. The comparative static properties of ϕ^* can be derived from the partial derivatives of the function f. If f shifts upward, the intersection point shifts to the right, implying an increase in ϕ^*.

From this graphical analysis, we derive the following results.

Proposition 1 *Under the assumption that β and ρ are not too large*

(i) *the optimal degree of central bank conservatism increases with σ_ϵ^2, the degree of uncertainty about the central bank's output gap target*

(ii) *the optimal degree of central bank conservatism increases with the sensitivity of inflation to monetary policy α*

(iii) *central bank independence and conservatism become strategic complements when monetary uncertainty is sufficiently high*

Proof

(i) From expression (17), it is easy to see that: $\frac{\partial f}{\partial \sigma_\epsilon^2} > 0$. Hence, a rise in σ_ϵ^2 causes an upward shift of the function f and thereby raises ϕ^*.

(ii) From expression (17), we obtain the following derivative:

$$\frac{\partial f}{\partial \alpha} = \frac{\gamma \sigma_\epsilon^2 (1-\rho^2) B^2 \left[\lambda^G AB + 3\beta\rho \left(\alpha^2 \lambda^G + 1\right)\left(\lambda^G + \gamma\phi\right)\right]}{(1-\beta\rho) A^4} > 0$$

[12] In fact, to find a unique positive value of ϕ^* it is enough that $\frac{\partial f(\phi,\gamma)}{\partial \phi} < 1$.

where $A = \alpha^2 \left(\lambda^G + \gamma\phi\right) + 1$ and $B = \alpha^2 \left(\lambda^G + \gamma\phi\right) + 1 - \beta\rho$

(iii) Differentiating f with respect to γ, we can write:

$$\frac{\partial f}{\partial \gamma} = \frac{\sigma_\epsilon^2 \left(\alpha^2 \lambda^G + 1\right)\left(1 - \rho^2\right) B^2 \left[AB + 3\alpha^2 \beta\rho\gamma\phi\right]}{\left(1 - \beta\rho\right) A^4} - \frac{\lambda^G \beta\rho}{\gamma^2 \left(1 - \beta\rho\right)}$$

This derivative becomes positive – implying a positive relation between ϕ^* and γ – for sufficiently high values of σ_ϵ^2 provided β and ρ are not too large.

Thus, when the central bank has an output gap target that is not clearly defined, it is optimal for society that the central bank assigns a relatively large weight to its inflation target in order to limit the volatility of its decisions. As a result, central bankers who are relatively transparent about their output gap target can afford to be less conservative. Moreover, if the sensitivity of inflation to monetary policy is important, monetary authorities should put a high weight on their price stability objective in order to avoid excessive inflation. Finally, when monetary uncertainty is sufficiently high, limiting the central bank's independence allows to reduce the need for conservatism.

To understand the intuition underlying this result, consider first the case without monetary uncertainty. When $\sigma_\epsilon^2 = 0$, we obtain the same conventional result as Eijffinger and Hoeberichts (1998, 2008), Hughes Hallett and Weymark (2005) and Weymark (2007). Central bank independence and conservatism in this case are strategic substitutes $\left(\frac{\partial f}{\partial \gamma} < 0\right)$ because they have similar effects on the balance between inflation and output gap stabilisation. In this case, the optimal degree of central bank conservatism (vis-à-vis the government) is $\phi^* = \frac{\lambda^G \beta\rho}{\gamma(1-\beta\rho)}$. It is obvious from this expression that ϕ^* is inversely related to γ, indicating for instance that a low degree of central bank independence should be compensated by greater conservatism.[13]

However, when there is uncertainty about the central bank's output target, the strategic relationship between independence and conservatism may be reversed. A decrease in the degree of independence then has two countervailing effects on the need for conservatism. On one hand, it reduces the weight the monetary authority places on inflation stabilisation and must therefore be compensated by greater conservatism. This effect only exists when there is persistence of the cost-push shock ($\rho > 0$). On the other hand, limiting the independence of a central bank whose preferences are highly uncertain helps to attenuate the volatility of its decisions. This in turn reduces inflation and output gap variability and thus the need for conservatism. If the uncertainty surrounding central bank's preferences is high and the persistence of cost-push shocks is not too important, this second effect is likely to dominate. Consequently, the lower the central bank's independence, the

[13]Moreover, by examining ϕ^* in the case where $\sigma_\epsilon^2 = 0$, we observe that conservatism is optimal for society (i.e. $\phi^* > 0$) only if there is some persistence of cost-push shocks ($\rho > 0$) since the need for inflation stabilisation policy is more pressing in this case.

lower the optimal degree of conservatism.

4. Concluding remarks

This paper has examined the optimal arrangement between independence and conservatism in the presence of uncertainty about the central bank's output target. The main finding is that, in the presence of such uncertainty, the trade-off between CBI and CBC no longer necessarily holds. Indeed, if this uncertainty is relatively high, CBI and CBC may complement each other, implying that high (low) independence is likely to increase (decrease) the need for conservatism. Intuitively, giving greater autonomy to a central bank whose preferences are uncertain exacerbates the volatility of monetary policy decisions. It may therefore become optimal for society to appoint a more conservative central bank in order to compensate for this additional volatility. The main policy lesson of our analysis is that normative discussions about the appropriate combination of independence and conservatism should not overlook the issue of the central bank transparency and the degree of uncertainty of its policy targets.

An interesting possible application of our study could be the context of the Economic and Monetary Union (EMU), where the ECB is rather hesitant to talk about its output target. Although the ECB's priority for price stability is clearly articulated for all to understand, there is greater ambiguity concerning its output objective when the inflation rate is low. Our analysis suggests that under such circumstances the ECB's degree of independence and conservatism are likely to be strategic complements. To take the analysis one step further, we might argue that the ECB's high independence could be one of the reasons for its great conservatism. Besides being desired for historical or political considerations, this large degree of conservatism may also be needed due to the ECB's high independence. Indeed, the delegation of the monetary instrument to a supra-national authority whose output objective is not clearly defined creates additional uncertainty in the member states. Since they are not allowed to interfere in the monetary policy decisions, to make sure that priority will be given to price stability, it is in the interest of the member states to select a highly conservative central banker. Finally, our analysis suggests that allowing for greater interference of national governments in the ECB's decisions may help to attenuate the need for conservatism and thereby result in relatively lower interest rates in the eurozone.

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