E C O N O M I C S B U L L E T I N

Monetary policy transmission asymmetries in a heterogeneous monetary union: a simple contractual solution

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Abstract

In this paper, we show that imposing linear penalties on inflation and income divergences to a common central bank could be an interesting solution to stabilization problems in a heterogeneous monetary Union. We find an "optimal contract" for monetary policy which enforces the optimal solution for maximizing Union-wide welfare. This contract may provide a good institutional response to stabilization problems raised by monetary policy transmission asymmetries, as described in De Grauwe Senegas (2004).

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1. Introduction

How the common monetary policy design in the Euro area should take into consideration asymmetries in the transmission channel among the different member-states is a major clause of concern for the European Central Bank (ECB). Asymmetries in the Euro area are widely recognized and the ECB more and more wonders about the suitable conduct of monetary policy in such a heterogeneous environment. Thinking about the enlargement process, it is no doubt that heterogeneity will increase within the EMU, either in the transmission channel of monetary policy or in idiosyncratic shocks[1]. However, for the moment, the main objective of the ECB is to preserve price stability for the euro area as a whole, paying most of its attention to Union-wide output and (principally) inflation and neglecting, at least on the level of principles, inflation and output divergences in Union.

Yet, the optimality of such a strategy based upon Union-wide magnitudes can be questioned, especially in the presence of substantial divergences within the Euro area. A number of recent theoretical studies have analyzed the implications of Union heterogeneity on the optimal monetary policy design. De Grauwe (2000), Gros & Hefeker (2002) and De Grauwe & Senegas (2004) have shown in particular that the presence of asymmetries in the transmission channel[2] is a case for taking account of "national information" and not only "average information". More specifically, by attempting to stabilize only average inflation rate and output-gap, the common central bank reaches a lower level of social welfare than that which would be reached if she were concerned by the stabilization of national inflation rates and output-gaps. Thus, using national information in the design of the common monetary policy allows the common central bank to deal with the heterogeneity induced by asymmetry. So, if the transmission asymmetry of monetary policy increases with the enlargement of EMU, it will raise the need to consider national information in the formulation of optimal monetary policies in the Union.

Nevertheless, a central question remains *how* to take national information into consideration. Two responses to this question can be envisaged: an *institutional response*, inspired from the recent results in the literature (De Grauwe & Senegas, 2004), or a *contractual response*, inspired from the literature on the agency problem in a principal-agent relationship framework, optimally solved if the principal imposes the "good" contract to the agent.

On the one hand, De Grauwe & Senegas (2004) suggest that the common central bank should minimize a loss function defined as a weighted average of national loss functions. This suggestion corresponds, in practice, to an *institutional reform* allowing monetary policy to come from negotiations (discussions) in a *Governing Council* formed by delegates of all member states who defend national interests. In the context of the EMU, such an *institutional solution* requires a major change in the conduct of monetary policy because nowadays, *"as laid down in the Treaty, each Member of the Governing Council is therefore well aware that he or she is not a representative of a country (…) but acts (…) in deciding the appropriate conduct of monetary policy for the euro area as a whole"*.[3] Furthermore, the negotiation procedure could eventually give rise to inflation biases or conflicts conducting to non-cooperative solutions in the Union, so that the cure might become worse than the disease.

On the other hand, we propose in this paper an alternative procedure for monetary policy to capture national information. We analyze a *contractual solution* in which the Union

[1] For some empirical evidences of asymmetries of national shocks or transmission mechanisms in the new members of the European Union, see Angeloni & al. (2005).

[2] If asymmetries arise only in macroeconomic shocks, using aggregated or national data doesn't affect the Union social welfare and there is no reason to prefer the second strategy to the first one (see De Grauwe, 2000).

[3] See the declaration following the Governing Council meeting dated from March, 30 (2000).

(acting as the "principal") would delegate monetary policy to an "agent" who is the common central bank. With such an institutional arrangement, the Union still leaves monetary policy in the common central bank care, who acts as an independent agent, but the "principal" has to ensure the appropriate incentives to the "agent". We search for the optimal form of this delegation, namely an "optimal contract" for the common central bank, and we show that such an optimal contract exists. In the contract, national information is taken into consideration by the monetary policy decision-making process if penalties are imposed to the central bank in function of the weighted standard deviations of inflation and unemployment in the Union. Well-defined values for these penalties can enforce the *optimal solution* for monetary policy, allowing maximizing Union-wide social welfare. Moreover, we show that the optimal contract is very simple and is not state contingent, as in Walsh (1995).

We first summarize, in section 2, De Grauwe & Senegas (2004) framework before studying the "optimal contract" for monetary policy in a similar framework, in section 3. Section 4 proves that our solution is very general and not model-dependent, while section 5 dresses some concluding remarks.

2. De Grauwe & Senegas (2004) model

De Grauwe & Senegas (hereafter DGS) compare two main strategies for monetary policy: a strategy based on *non-aggregated national data* (NA strategy) and a strategy based on *Euro-aggregated data* (EA strategy). To prove the superiority of the NA strategy, DGS use a standard macroeconomic model in which an individual economy is described by the following Phillips curve:

$$U_i = U_i^* - a_i\left(\pi - \pi^e\right) + \varepsilon$$

with the specification of national loss function:

$$L_i = \left(\pi\right)^2 + b\left(U_i - U_i^*\right)^2.$$

Each country is indexed by *i*, for $i = 1,2,...,N$, U_i is the current unemployment rate in the country *i* and U_i^* is the related natural rate of unemployment. π is the inflation rate in the Union (there is no inflation divergence in the Union), π^e is the expected inflation rate and ε is a white-noise supply shock. The asymmetry in the transmission of monetary policy is introduced by the way of a_i coefficients.

Under the first strategy ("National Aggregation" procedure), the common central bank minimizes:

$$\Lambda^{NA} = \sum_{i=1}^{N} \mu_i L_i = \left(\pi\right)^2 + b\sum_{i=1}^{N} \mu_i \left(U_i - U_i^*\right)^2 \qquad (1)$$

where μ_i is the weight of country i in the social welfare function.

The solution of the optimisation program is (see DGS for details):

$$\begin{aligned}\pi^{NA} &= \Omega_{NA}\varepsilon \\ U_i^{NA} &= U_i^* + \left(1-\Omega_{NA}a_i\right)\varepsilon\end{aligned}, \tag{2}$$

where $\Omega_{NA} = \dfrac{ba_E}{1+b\left(a_E^2+\theta_{a_E}^2\right)}$. The term $a_E = \sum_{i=1}^{N}\mu_i a_i$ represents the mean transmission parameter while the term $\theta_{a_E}^2 = \sum_{i=1}^{N}\mu_i\left(a_i - a_E\right)^2$ is a measure of the dispersion in the national transmission parameters.

In the second strategy ("Euro-area-Aggregation" procedure), the common central bank minimizes:

$$\Lambda^{EA} = \left(\pi^E\right)^2 + b\left(U_E - U_E^*\right)^2 = \left(\pi\right)^2 + b\left[\sum_{i=1}^{N}\mu_i\left(U_i - U_i^*\right)\right]^2 \tag{3}$$

and the solutions become (see DGS for details):

$$\begin{aligned}\pi_i^{EA} &= \Omega_{EA}\varepsilon \\ U_i^{EA} &= U_i^* + \left(1-\Omega_{EA}a_i\right)\varepsilon\end{aligned}, \tag{4}$$

where $\Omega_{EA} = \dfrac{ba_E}{1+ba_E^2}$.

The Union-wide social welfare criterion is based upon the *ex ante* (i.e. before knowing the shocks) value of the average of national loss functions in the Union:

$$W = E_\varepsilon\left[\Lambda^{NA}\right] \tag{5}$$

Since $W^{EA} \equiv E\left[\Lambda^{NA}\left(\pi^{EA}\right)\right] \geq W^{NA} \equiv E\left[\Lambda^{NA}\left(\pi^{NA}\right)\right]$ if $\theta_{a_E}^2 \geq 0$, then: *if the Central Bank chooses to minimize (3) rather than (1), the more heterogeneous the Union, the higher the Union-wide social loss.*

De Grauwe & Senegas (2004) explain this difference by the fact that under the *EA strategy*, the monetary authorities are more aggressive in changing the inflation rate than in the *NA strategy* (since: $\Omega_{EA} \geq \Omega_{NA}$). More generally, the problem is rather that national magnitudes are insufficiently stabilized (which comes to the same thing in DGS framework), while Union-wide magnitudes are too much stabilized. Effectively, we can compute in DGS:

$$U_E^{NA} = U_E^* + \left(\frac{1+b\theta_{a_E}^2}{1+b\left(a_E^2+\theta_{a_E}^2\right)}\right)\varepsilon \quad \text{and} \quad U_E^{EA} = U_E^* + \left(\frac{1}{1+ba_E^2}\right)\varepsilon, \text{ with:}$$

$$Var\left(U_E^{NA}\right) = \left(\frac{1+b\theta_{a_E}^2}{1+b\left(a_E^2+\theta_{a_E}^2\right)}\right)^2\sigma_\varepsilon^2 \geq \left(\frac{1}{1+ba_E^2}\right)^2\sigma_\varepsilon^2 = Var\left(U_E^{EA}\right) \text{ if } \theta_{a_E}^2 \geq 0.$$

Thus, the Union-wide unemployment is too much stabilized if monetary policy doesn't take into account national information. In a more general model with inflation divergences in the Union, average (Union-wide) inflation would be also too much stabilized (see Gregoriadis *et al.*, 2006). Therefore, under the EA strategy, monetary authorities are too "aggressive" in stabilizing average variables (inflation and unemployment) and insufficiently aggressive in stabilizing national magnitudes.

3. The "optimal contract" for monetary policy

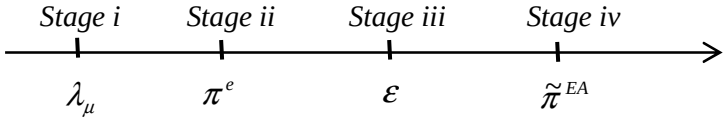
How could monetary policy become more reactive to national divergences? In this section, we are interested in a contractual solution to the issue of EA strategy. Let us suppose that the Union, acting as the "principal", decides to delegate monetary policy to an "agent", who is the common central bank. Moreover, the "principal" imposes to the "agent" linear penalties depending on inflation and unemployment divergences. These penalties represent an additional cost for the central banker and provide an incentive to fight divergences in the Union. We describe such a solution by the fact that, beyond stabilizing average variables in the Union, the central bank attempts to stabilize the euro-wide unemployment differential, measured as the weighted cross section standard error of this variable:

$$\tilde{\Lambda}^{EA} = \left(\pi^{E}\right)^{2} + b\left(U_{E} - U_{E}^{*}\right)^{2} + \lambda_{u}\left(\sigma_{u}\right)^{2} \qquad (6)$$

where $\sigma_{u} \equiv \left[\sum_{i=1}^{N} \mu_{i}\left[U_{i} - U_{i}^{*} - \left(U_{E} - U_{E}^{*}\right)\right]^{2}\right]^{1/2}$ is the weighted cross section standard error of unemployment (in deviation from its natural rate) and λ_{u} is the coefficient of aversion towards unemployment divergences.

The timing of the "delegation game" is depicted in Fig. 1:

Fig. 1 Time structure of the "delegation game"



First, (i) the agency set the optimal penalty λ_{u} on unemployment divergences that minimizes $\tilde{W}^{EA} = E\left[\Lambda^{NA}\left(\tilde{\pi}^{EA}, \tilde{U}^{EA}\right)\right]$ in (5), then ii) the public forms its expectations π^{e}, iii) shocks ε arise and iv) the common central bank chooses the inflation rate $\tilde{\pi}^{EA}$ which minimizes $\tilde{\Lambda}^{EA}$ in (6).

As usual, the resolution is backward. By minimizing (6) the common central bank sets the inflation rate and unemployment as:

$$\tilde{\pi}^{EA} = \tilde{\Omega}_{EA}\varepsilon$$
$$\tilde{U}_{i}^{EA} = U_{i}^{*} + \left(1 - \tilde{\Omega}_{EA} a_{i}\right)\varepsilon, \text{ where } \tilde{\Omega}_{EA} = \frac{b a_{E}}{1 + b a_{E}^{2} + \lambda_{u}\theta_{a_{E}}^{2}}.$$

The optimal penalty on unemployment divergences chosen by the agency at step i), namely the penalty obtained by minimizing $\tilde{W}^{EA}$, is: $\lambda_u = b$. With this value, $\tilde{\Omega}^{EA} = \Omega^{NA}$, $\tilde{\pi}^{EA} = \pi^{NA}$ and $\tilde{U}^{EA} = U^{NA}$. Thus, monetary policy provides the Union-wide first best: $\tilde{W}^{EA} \equiv E\left[\Lambda^{NA}\left(\tilde{\pi}^{EA}\right)\right] = E\left[\Lambda^{NA}\left(\pi^{NA}\right)\right] \equiv W^{NA}$. In other words, a penalty $\lambda_u = b$ on unemployment divergences imposed to the common central bank leads to the optimal solution for monetary policy, described in DGS model.

4. A generalization

The contractual solution is not model dependent. Let's consider the classical form of the national loss function:

$$L_i = b\left(U_i - U_i^*\right)^2 + c\left(\pi_i - \pi_i^*\right)^2 = b\left(\hat{U}_i\right)^2 + c\left(\hat{\pi}_i\right)^2,$$

where: $\hat{U}_i \equiv U_i - U_i^*$ and $\hat{\pi}_i \equiv \pi_i - \pi_i^*$.

In the first strategy ("National Aggregation" procedure), the common central bank minimizes:

$$\Lambda^{NA} = \sum_{i=1}^{N} \mu_i L_i = b\sum_{i=1}^{N} \mu_i \left(\hat{U}_i\right)^2 + c\sum_{i=1}^{N} \mu_i \left(\hat{\pi}_i\right)^2 \tag{7}$$

while in the second strategy ("Euro-area-Aggregation" procedure) it minimizes:

$$\Lambda^{EA} = b\left(\hat{U}_E\right)^2 + c\left(\hat{\pi}_E\right)^2 + \lambda_u \left(\sigma_u\right)^2 + \lambda_\pi \left(\sigma_\pi\right)^2 \tag{8}$$

In the expressions (7) and (8), we have still used the notations: $\hat{x}_E = x_E - x_E^*$, $x_E = \sum_{i=1}^{N} \mu_i x_i$, $\sigma_x = \left[\sum_{i=1}^{N} \mu_i \left[x_i - x_i^* - \left(x_E - x_E^*\right)\right]^2\right]^{1/2}$, for $x = \{U, \pi\}$; and λ_π, λ_u are the penalties imposed on inflation and output differentials. These penalties ensure that the common central bank feels some degree of aversion towards inflation and unemployment divergences in the Union, and look like a "quadratic" contract for central banker, corresponding to changing preferences for the stabilization of divergences relative to the stabilization of Union-wide magnitudes[4].

Suppose furthermore that the instrument of the central bank is the interest rate[5] (r). By minimizing (7) with respect to r, we obtain:

$$\frac{\partial \Lambda^{NA}}{\partial r} = b\sum_{i=1}^{N} \mu_i \frac{\partial U_i}{\partial r} \hat{U}_i + c\sum_{i=1}^{N} \mu_i \frac{\partial \pi_i}{\partial r} \hat{\pi}_i \tag{9}$$

[4] One can notice the analogy with the analysis of Rogoff (1985), in which relative preferences for the stabilization of output relative to inflation have to be changed in cases of stabilization biases.

[5] Since there are inflation divergences in this section, the monetary policy instrument can no longer be the inflation rate.

By minimizing (8) with respect to r and rearranging, we obtain:

$$\frac{\partial \Lambda^{NA}}{\partial r} = (b - \lambda_u)\frac{\partial U_E}{\partial r}\hat{U}_E + (c - \lambda_\pi)\frac{\partial \pi_E}{\partial r}\hat{\pi}_E + \lambda_u \sum_{i=1}^{N} \mu_i \frac{\partial U_i}{\partial r}\hat{U}_i + \lambda_\pi \sum_{i=1}^{N} \mu_i \frac{\partial \pi_i}{\partial r}\hat{\pi}_i \qquad (10)$$

We can easily observe that expressions (9) and (10) are identical if $\lambda_u^* = b$ and $\lambda_\pi^* = c$; the loss functions (7) and (8) are also identical in this case. Under the "optimal contract", the EA procedure with aversion to divergences is efficient and leads to the optimal regime.

Using our notations, the contractual strategy that can enforce the optimal solution is such that : i) the agency sets the optimal penalties $\lambda_\pi^* = c$ and $\lambda_u = b$ on inflation and unemployment divergences that minimizes $W = E\left[\Lambda^{NA}\right]$, ii) the public forms its expectations, iii) shocks arise and iv) the central bank minimizes Λ^{EA} in (8).

Thus, the first best solution for monetary policy can be obtained by an "optimal contract" that penalizes the common central bank for inflation and unemployment divergences in the Union. The optimal penalties imposed on inflation (respectively on unemployment) divergences correspond to the relative weight of inflation (respectively unemployment) in the welfare function of the common central bank. The interpretation of this "optimal contract" is straightforward: *monetary policy takes Union heterogeneity into account if the common central bank is forced to feel some aversion towards inflation and output divergences*.

In view of this result, the "contractual solution" seems to be a good candidate for solving the problem of monetary policy transmission asymmetries. One could argue that modifying the loss function of the central bank can be dangerous because the more complicated the loss function is, the more complicated the targeting rule is and the less transparent monetary policy will be. This could generate a loss of credibility for the central banker and make more difficult the adherence to the monetary policy rule. However, this contractual solution is not complicated and the "principal" could be interested in it, because the penalties proposed are not contingent on shocks. He can set the penalties without having any information about shocks and he doesn't need to have national information; all he has to do is to set the "good" level (λ) for penalties and to let the central bank do her job. Furthermore, the penalties imposed on the dispersion indicators are very appealing because they are a very intuitive mechanism based on public knowledge variables.

The different approaches proposed in the literature to solve the time inconsistency problem of the monetary policy could be transposed to discuss the implementation of such an "optimal contract", to solve the stabilization problem of monetary policy asymmetries.

According to the "legislative approach", mainly developed in Rogoff (1985), the solution would be to delegate monetary policy to an independent and divergence-adverse central banker. The difficulty would be to find the central banker endowed with the exact degree of aversion towards inflation and unemployment divergences[6]. Concerning the "targeting" or "contracting" approach, mainly discussed in Walsh (1995), the solution comes from an explicit or implicit contract for the common central bank, with divergence oriented

[6] Effectively, if the central banker is not endowed with the "good" degree of aversion to inflation and unemployment divergences in the Union, the contractual solution is not necessarily the best solution. This is the case, in particular, if the central banker is not interested in unemployment divergences but only in inflation divergences (Gregoriadis *et al.*, 2006).

penalties.[7] It could stem from free elections of the agents in charge of monetary policy by individual citizens, from a state-contingent wage-contract for the central banker, from a targeting rule with a reporting requirement or from a "dismissal rule" where the central banker is fired if he fails to meet divergence targets (see Walsh, 1995). Another similar solution, like in Svensson (1997), consists in an optimal reward structure based on a targeting rule, including targets in term of inflation and output divergences.[8] Thus, the central banker would be rewarded according to how close inflation and output differentials are to the given targets.

4. Conclusion

In this paper we are interested in the optimal design of monetary policies in a heterogeneous monetary Union and we highlight a simple "optimal contract" for monetary policy that enforces the optimal solution proposed by De Grauwe and Senegas (2004).

The definition of this "optimal contract" is, in some way, close to the solution proposed by Walsh (1995) in response to the inflation bias problem for monetary policy, except that we exclusively deal with a *stabilization* problem. This solution consists in linear penalties that the "principal" has to impose to the "agent". While Walsh (1995) proposes linear penalties on inflation to solve a credibility problem of monetary policy, we emphasize that linear penalties for inflation and unemployment divergences in the Union can be a solution to the stabilization problem of the monetary policy. Moreover, these penalties are not model dependent and if they are well defined, as it is the case under the "optimal contract", the common monetary policy produces the first best.

The theoretical solution of this "optimal contract" is straightforward: *the optimal penalties imposed on inflation (respectively on unemployment) divergences correspond to the relative weight of inflation (respectively unemployment) in the welfare function of the common central bank*. Nevertheless, the "optimal contract" has some limits.

In effect, our solution is open to usual criticism addressed to contractual literature in monetary policy, namely critics concerning the credibility of the "principal", the difficulty to put in practice the "optimal contract" or to find the "good" definition for penalties.

Furthermore, were these issues solved the optimal contract would remain difficult to implement, because only some Member States take advantage of this contract, while it is detrimental to the welfare of others. Effectively De Grauwe & Senegas (2004) show that some member states of the Union prefer the EA strategy, while other prefers the NA strategy. So, from the point of view of *national welfare*, the optimal contract is not beneficial to all countries of the Union, while it is optimal from the point of view of the *Union-wide welfare*, a result also established in Gregoriadis *et al.* (2006). Thus, the "optimal contract" might become an undesirable source of potential conflicts between the member states of the Union. We could however imagine that, since Union-wide benefits exist under the "optimal contract", the welfare gain for countries which take advantage of this contract exceeds the welfare loss for the others and, therefore, a compensation system for the last ones is possible. In conclusion, even if this contract is not optimal at a national level, it could become, at least, an interesting "Pareto improver" one.

[7] Penalties can be of financial or "political" (loss of credibility of the central bank, conflicts with Member States of the Union,…) nature. Different institutional arrangements corresponding in practice to contracts for central banker (like the « *Policy Target Agreement* » established in 1989 in New Zealand) are discussed in Walsh (2001).

[8] Rogoff (1985) also has suggested that targeting rules might be enforced by making the monetary authority's budget depend on adherence to the rule, while Garfinkel and Oh (1993) have proposed, for the same purpose, a punishing legislation if the monetary policy fails to achieve the target.

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