THE COST OF HETEROGENEITY IN A MONETARY UNION

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Abstract

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In this paper, we explore whether heterogeneity among union members could threaten the stability of the EMU. The types of heterogeneity we consider are (1) asymmetries in the transmission of monetary and fiscal policies, and (2) differences in national preferences for price stability, output growth, and income redistribution. Our results show that the costs of membership are cumulative and can be significant for countries whose structure and/or preferences deviate from those underlying the common monetary policy. In part, these costs arise because monetary policy imposed by an independent central bank automatically constrains the use of fiscal policy by national governments.

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EMU, currency union, central bank independence.

1. Introduction

In deciding whether or not to join the Eurpean Monetary Union (EMU), prospective members had to weigh the anticipated costs of surrendering control of their monetary policies against the expected economic and political benefits of union membership. Those who chose to join the EMU evidently expected the benefits to outweigh the costs. In this article, we do not analyze whether the decision to join or remain outside EMU was well-judged. Rather, we take the EMU as given and try to determine whether or not the loss of monetary sovereignty is likely to lead to tensions that might threaten the stability of the union. The issue of the robustess and sustainability of the EMU's institutional arrangements has previously been raised by Dixit (2001), and it clearly worries many commentators.

The European Central Bank (ECB) is charged with the task of formulating and implementing monetary policy that is in the best interest of the EMU as a whole. To this end, the EMU statutes grant the ECB full independence from the nationally elected governments of member countries. There is a fairly large body of literature documenting the sources of structural asymmetry among European countries.[1] Given the cultural differences among EMU members, it is reasonable to consider the possibility that there may also be significant differences in policy preferences. This latter source of heterogeneity has, up to now, largely been ignored. In this article, we ask whether heterogeneity in structure and preferences could be an important issue for the functioning of Europe's monetary union and, if so, what kind of compensation might be needed to sustain the union. The types of heterogeneity we consider are (1) asymmetries in the transmission of monetary and fiscal policies, and (2) differences in national preferences for price stability, output growth, and income redistribution.

[1] Econometric estimates of structural asymmetries in European and OECD economies can be found in Britton and Whitely (1997), Dale and Haldane (1995), Dornbusch et al (1998), Kieler and Saarenheimo (1998), and Ramaswany and Sloek (1998), among others. Carlino and De Fina (1999) and Cecchetti (1999) identify some of the sources of those asymmetries. None of these studies consider preference asymmetries.

Weymark's (2001) model of monetary policy delegation provides the theoretical basis for our analysis. In this model, optimal institutional design, is described in terms of central bank independence and conservatism. Weymark shows that the optimal combination of central bank independence and conservatism is determined by economic structure and policy preferences and is therefore country-specific. This result has clear implications for the EMU — if countries are sufficiently heterogenous, it is impossible for the ECB to devise a monetary policy that will be satisfactory to all members. In order to determine whether country-specific differences in transmissions and preferences pose a significant threat to the stability the EMU, we consider the constraints that a common, independent monetary policy imposes on the operation of optimal national fiscal policies, and the extent to which members may wish for a policy mix different from that provided by the common central bank. We offer this analysis as a starting point from which to evaluate, if not resolve, these issues.

2. The Theoretical Framework

Weymark (2001) shows that, for an individual country, the optimal degree of central bank independence and conservatism depends on the both the structure of the economy and on the preferences of the fiscal authority. To the extent that European countries differ significantly in one or both of these dimensions, relinquishing monetary sovereignty to a single, supranational central bank can result in significant losses. Clearly, some countries may suffer larger losses than others as a result of participating in the monetary Union. In order to assess the potential magnitude of these losses for individual countries, we compare the outcomes that could be achieved under an optimally configured national central bank with the best outcomes that could be achieved under the ECB. The theoretical framework we employ is described in this section.

2.1 Economic Structure

The model used in Weymark (2001) to study the optimal degree of central bank independence provides a useful framework for the present analysis. For purposes of exposition, we ignore potential spillover effects among countries and use the following three equations to represent the economic structure of each EU country:

$$\pi_{it} = \pi_{it}^e + \alpha_i y_{it} + u_{it} \tag{1}$$

$$y_{it} = \beta_i(m_{it} - \pi_{it}) + \gamma_i g_{it} + \epsilon_{it} \tag{2}$$

$$g_{it} = m_{it} + s_i(b_i y_{it} - \tau_{it}) \tag{3}$$

where π_{it} is the inflation rate in country i in period t, y_{it} is output growth in country i in period t, and π_{it}^e represents the rate of inflation that rational agents expect will prevail in country i in period t, conditional on the information available at the time expectations are formed. The variables m_{it}, g_{it}, and τ_{it} represent, respectively, the growth in the money supply, government expenditures, and lump-sum taxes in the ith country in period t.[2] The variables u_{it} and ϵ_{it} are random disturbances which are assumed to be independently distributed with zero mean and constant variance. The coefficients $\alpha_i, \beta_i, \gamma_i, s_i$, and b_i are all positive by assumption.

According to (1), inflation is increasing in the rate of inflation predicted by private agents and in output growth. Equation (2) indicates that monetary policy and fiscal policy have an impact on the output gap. Specifically, increases in the real money supply and in government expenditures increase output. In the interest of simplicity, the possible impact of changes in taxes on output is ignored. The microfoundations of the aggregate supply equation (1), originally derived by Lucas (1972, 1973), are well-known. McCallum (1989) shows that aggregate demand equations like (2) can be derived from a standard, multiperiod utility-maximization problem.

Equation (3) describes the government's budget constraint. In order to keep the analysis as simple as possible, we allow tax revenues to be used for redistributive purposes only. Thus, in each period, the government must finance its remaining

[2] All growth rates are defined as changes in the levels of the relevant variables expressed as a proportion of the previous period's output. For example, $m_{it} = (M_{it} - M_{it-1})/Y_{it-1}$, where M and Y represent money supply and output levels, respectively.

expenditures by selling government bonds to the central bank or to private agents. We assume that each country has two types of citizens, those who are rich and those who are poor. We also assume that only the rich save and that they do so by using after tax income to purchase government bonds. In (3), b is the proportion of pre-tax income (output) that goes to the rich and s is the proportion of after-tax income that the rich allocate to saving. The lump-sum tax, τ, is used by the government to redistribute income from the rich to the poor.[3]

Substituting (2) into (1) and taking expectations results in

$$\pi_{it}^e = m_{it}^e + \frac{\gamma_i}{\beta_i} g_{it}^e. \tag{4}$$

Using (1), (2), and (4) to solve for π_{it} and y_{it} yields the following semi-reduced form equations for inflation and output growth in the ith country:

$$\pi_{it}(g_{it}, m_{it}) = (1+\alpha_i\beta_i)^{-1}[\alpha_i\beta_i m_{it} + \alpha_i\gamma_i g_{it} + m_{it}^e + \frac{\gamma_i}{\beta_i} g_{it}^e + \alpha_i\epsilon_{it} + u_{it}] \tag{5}$$

$$y_{it}(g_{it}, m_{it}) = (1+\alpha_i\beta_i)^{-1}[\beta_i m_{it} + \gamma_i g_{it} - \beta_i m_{it}^e - \gamma_i g_{it}^e + \epsilon_{it} - \beta_i u_{it}]. \tag{6}$$

2.2 Government Objectives

Economic structure is only one dimension along which members of the European Union may differ. Because member countries have long histories of sovereignty, there will generally be cultural differences that have a signficant impact on how the various countries evaluate the costs and benefits of a common monetary policy. In using the government objective function to represent cultural differences among EU members,

[3]The budget constraint is derived as follows. In period t rich private agents buy government bonds in the amount of $s_i(b_iY_{it} - T_{it})$, where Y and T are, respectively, output and tax revenues. The purchase of government bonds by the central bank in period t reflects an increase in the money supply of $M_{it} - M_{it-1}$. The government budget in any period t can be expressed as $G_{it} = \Delta M_{it} + s_i(b_iY_{it} - T_{it})$, where $\Delta M_{it} = M_{it} - M_{it-1}$. Then $g_{it} = m_{it} - m'_{it-1} + s_i(b_iy_{it} - \tau_t)$ where $g_t = \Delta G_t/Y_{t-1}$, $m_t = \Delta M_t/Y_{t-1}$, $m'_{t-1} = \Delta M_{it-1}/Y_{it-1}$, $y_t = \Delta Y_{it}/Y_{it-1}$, and $\tau_{it} = \Delta T_{it}/Y_{it-1}$. The constraint (3) is obtained by making the simplifying assumption $m'_{it-1} = 0$.

we assume that such differences will be reflected in the types of governments that are voted into office. Formally, the objective function of country i's government is

$$L_{it}^{g} \;=\; \frac{1}{2}(\pi_{it} - \hat{\pi})^2 \;-\; \lambda_{i1}^{g} y_{it} \;+\; \frac{\lambda_{i2}^{g}}{2}[(b_i - \theta_i)y_{it} - \tau_{it}]^2 \tag{7}$$

where $\hat{\pi}$ is the government's inflation target, λ_{i1}^{g} is the relative weight that the government of country i assigns to output growth, and λ_{i2}^{g} is the relative weight assigned to income redistribution. The parameter θ_i represents the proportion of output that the government of country i would, ideally, prefer to allocate to the rich. All other variables are as previously defined.

According to (7), the preferences of EU members may differ in the relative weights assigned to output growth (λ_{i1}^{g}), income redistribution (λ_{i2}^{g}), and the tolerance for income inequality (θ_i). By assumption, all governments share a common inflation target ($\hat{\pi}$). The first two terms on the right-hand side of (7) are familiar features of the objective functions used in studies of inflation bias and require no further discussion here.[4] However, the third component in the government's loss function, which reflects the government's concern with income redistribution, merits further explanation. The parameter θ_i, as defined above, represents the ith government's ideal degree of income inequality. For example, if there are as many rich people as poor people in country i and the government is egalitarian, it would set $\theta_i = 0.5$. In this case, the government would like to redistribute output in the amount of $(b_i - 0.5)y_{it}$ from the rich to the poor. The European governments have been, and continue to be, very different in their commitments to the social market economy and market flexibility. In this simple model, λ_{i2}^{g} and θ_i are the means by which we capture the potential for fundamental (cultural) differences among the members of the EU.

2.3 Central Bank Objectives

We assume that national central banks may have objectives that are distinct from those of their national governments. We specify the objectives of the ith country's

[4]See Weymark (2001) for additional details.

national central bank to be

$$L_{it}^{cb} = \frac{1}{2}(\pi_{it} - \hat{\pi})^2 - (1-\delta_i)\lambda_i^{cb} y_{it} - \delta_i \lambda_{i1}^g y_{it} + \frac{\delta_i \lambda_{i2}^g}{2}[(b_i - \theta_i) y_{it} - \tau_{it}]^2 \quad (8)$$

where $0 \leq \delta_i \leq 1$, and λ_i^{cb} is the weight that the central bank in country i assigns to output growth relative to inflation stabilization.

The extent to which a central bank is free to establish its own policy objectives, independently of the government, depends on the degree of independence that the central bank enjoys. The parameter δ_i measures the degree to which the central bank is forced to take the government's objectives into account when formulating monetary policy. The closer δ_i is to 0, the greater is the independence of the central bank. The central bank and the government may also differ in the relative weight assigned to output growth. The central bank is said to be 'conservative' when $\lambda_i^{cb} < \lambda_{i1}^g$.[5] Note that (7) and (8) imply that not only all EU governments, but also all national central banks share the same inflation target.

3. Optimal National Policy

In this study, we use the loss associated with optimal national policy as the benchmark against which to measure the cost of relinquishing monetary sovereignty. We therefore begin this section by deriving the optimal combination of monetary policy, fiscal policy, and central bank independence and conservatism for each country.

We assume that the interaction between the each country's elected national government and its central bank can be described as a two-stage non-cooperative game in which the structure of the model and the objective functions of both players are common knowledge. In the first stage, the government chooses the institutional parameters δ_i and λ_i^{cb}. The second stage is a simultaneous-move game in which the

[5] Rogoff (1985) shows that inflation bias can be reduced by delegating monetary policy to a conservative central bank. The term 'weight conservatism' was introduced by Svensson (1997) to distinguish $\lambda_i^{cb} < \lambda_{i1}^g$ from an alternative representation of conservatism in which the central bank's inflation target is lower than the government's.

government and the monetary authority set their policy instruments, g_{it} and τ_{it} for the government, and m_{it} for the monetary authority, given the δ_i and λ_i^{cb} values determined in the previous stage. The central bank is assumed to have full instrument independence and therefore controls the money supply m_{it}. The central bank's problem is to set m_{it} so as to minimize its losses, given the degrees of economic independence (δ_i) and conservatism (λ_i^{cb}) imposed upon it by the national government in the case of a single country, or by the articles of association in the case of a currency union. Private agents understand the game that the policy authorities are playing and form rational expectations about future prices in the second stage. Private agents are assumed to form these expectations at the beginning of the second stage, before the policy authorities implement their policies but after the long term institutional parameters δ_i and λ_i^{cb} have been determined.

Substituting (6) into (3) yields τ_{it} as a function of g_{it} and m_{it}

$$\begin{aligned}\tau_{it}(g_{it}, m_{it}) \;&=\; [s_i(1+\alpha_i\beta_i)]^{-1}[(1+\alpha_i\beta_i+s_ib_i\beta_i)m_{it} \;-\; (1+\alpha_i\beta_i-s_ib_i\gamma_i)g_{it} \\ &\quad - s_ib_i\beta_i m_{it}^e \;-\; s_ib_i\gamma_i g_{it}^e \;+\; s_ib_i\epsilon_{it} \;-\; s_ib_i\beta_i u_{it}] \qquad (9)\end{aligned}$$

Formally, the two-stage policy game between the government and the central bank in country i can be described as follows:

Stage 1

The government solves the problem

$$\begin{aligned}\min_{\delta_i,\,\lambda_i^{cb}} \; \mathrm{E}\, L_i^g(g_{it}, m_{it}, \delta_i,\, \lambda_i^{cb}) \;&=\; \mathrm{E}\left\{\frac{1}{2}[\pi_{it}(g_{it}, m_{it}) - \hat{\pi}]^2 \;-\; \lambda_{i1}^g[y_{it}(g_{it}, m_{it})]\right. \\ &\quad \left. + \frac{\lambda_{i2}^g}{2}[(b_i-\theta_i)y_{it}(g_{it}, m_{it}) - \tau_{it}(g_{it}, m_{it})]^2\right\} \qquad (10)\end{aligned}$$

where $L_i^g(g_{it}, m_{it}, \delta_i,\, \lambda_i^{cb})$ is (7) evaluated at $(g_{it}, m_{it}, \delta_i,\, \lambda_i^{cb})$, and E is the expectations operator.

Stage 2

(i) Private agents form rational expectations about future prices according to (4) before the shocks u_{it} and ϵ_{it} are realized.

(ii) The shocks u_{it} and ϵ_{it} are realized and observed by the government and by the central bank.

(iii) The government chooses g_{it}, taking m_{it} as given, to minimize $L_i^g(g_{it}, m_{it}, \bar{\delta}_i,\ \bar{\lambda}_i^{cb})$ where $\bar{\delta}_i$ and $\bar{\lambda}_i^{cb}$ indicates that these variables were determined in stage 1.

(iv) The central bank chooses m_{it}, taking g_{it} as given, to minimize

$$L_i^{cb}(g_{it}, m_{it}, \bar{\delta}_i,\ \bar{\lambda}_i^{cb}) \;=\; \frac{(1-\bar{\delta}_i)}{2}[\pi_{it}(g_{it}, m_{it}) - \hat{\pi}]^2 \;-\; (1-\bar{\delta}_i)\bar{\lambda}_i^{cb}[y_{it}(g_{it}, m_{it})] \;+\; \bar{\delta}_i L_i^g(g_{it}, m_{it}, \bar{\delta}_i,\ \bar{\lambda}_i^{cb}). \qquad (11)$$

This finite-horizon policy game can be solved by first solving the second stage of the game for the optimal money supply and government expenditure policies with δ_i and λ_i^{cb} fixed, and then solving stage 1 by substituting the stage 2 results into (10) and minimizing with respect to δ_i and λ_i^{cb}. The Nash equilibrium for the stage 2 game is given by (12)—(15) below.

$$m_{it}(\delta_i, \lambda_i^{cb}) \;=\; \frac{\beta_i\hat{\pi}}{(\beta_i+\gamma_i)} + \frac{(1-\delta_i)\beta_i[\alpha_i\gamma_i^2 s_i^2 + \beta_i\phi_i\lambda_{i2}^g]\lambda_i^{cb}}{\alpha_i\lambda_{i2}^g[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i](\beta_i+\gamma_i)} + \frac{\delta_i\beta_i(1+\alpha_i\beta_i)\lambda_{i1}^g}{\alpha_i[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]} - \frac{(1-\delta_i)\gamma_i^2\beta_i s_i^2\lambda_{i1}^g}{(\beta_i+\gamma_i)[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]\lambda_{i2}^g} - \frac{\epsilon_{it}}{(\beta_i+\gamma_i)} - \frac{(1-\beta_i\gamma_i+\gamma_i\theta_i-\gamma_i\theta_i s_i)u_{it}}{\alpha_i(\beta_i+\gamma_i)} \qquad (12)$$

$$g_{it}(\delta_i, \lambda_i^{cb}) \;=\; \frac{\beta_i\hat{\pi}}{(\beta_i+\gamma_i)} + \frac{(1-\delta_i)\beta_i^2[\phi_i\lambda_{i2}^g - \alpha_i\gamma_i s_i^2\ ]\lambda_i^{cb}}{\alpha_i\lambda_{i2}^g[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i](\beta_i+\gamma_i)} + \frac{\delta_i\beta_i(1+\alpha_i\beta_i)\lambda_{i1}^g}{\alpha_i[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]} + \frac{(1-\delta_i)\beta_i^2\gamma_i s_i^2\lambda_{i1}^g}{(\beta_i+\gamma_i)[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]\lambda_{i2}^g} - \frac{\epsilon_{it}}{(\beta_i+\gamma_i)} - \frac{(1+b_i\beta_i-\beta_i\theta_i+\beta_i\theta_i s_i)u_{it}}{\alpha_i(\beta_i+\gamma_i)} \qquad (13)$$

where

$$\phi_i \;=\; 1+\alpha_i\beta_i - \gamma_i\theta_i s_i \qquad (14)$$

$$\Lambda_i \ = \ 1 + \alpha_i\beta_i + \beta_i\theta_i s_i. \tag{15}$$

From (14), it is evident that ϕ_i can be positive or negative. In the context of our model, positive values of ϕ_i imply that there is a conflict between government policies aimed at stimulating growth and those aimed at income redistribution.[6] Conversely, negative values of ϕ_i would imply — somewhat implausibly — that the impact of government expenditure on output is so large that the government can increase taxes without significantly reducing the private savings needed to finance its desired level of government expenditure. In this article, we restrict our analysis to the case in which ϕ_i is positive.

It is assumed that the government and the central bank in country i observe the white noise disturbances, u_{it} and ϵ_{it}, in the second stage before policies are chosen, but after private expectations have been formed. Although private agents cannot observe u_{it} and ϵ_{it} prior to forming expectations about future inflation rates, the characteristics of the institutions in place in the economy, characterized by δ_i and λ_i^{cb}, are known to them. Under these conditions, it can be shown that (12) and (13) characterize a rational expectations equilibrium.

Taking the mathematical expectation of both sides of (12) and (13) to obtain m_{it}^e and g_{it}^e, respectively, and substituting the result, together with (12) and (13), into (5) and (6) yields the reduced-form solutions for π_{it} and y_{it} as functions of the institutional variables δ_i and λ_i^{cb}

$$\pi_{it}(\delta_i, \lambda_i^{cb}) \ = \ \hat{\pi} \ + \ \frac{(1-\delta_i)\beta_i\phi_i\lambda_i^{cb}}{\alpha_i[\beta_i\phi_i \ + \ \delta_i\gamma_i\Lambda_i]} \ + \ \frac{\delta_i[\beta_i\phi_i \ + \ \gamma_i\Lambda_i]\lambda_{i1}^g}{\alpha_i[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]} \tag{16}$$

$$y_{it}(\delta_i, \lambda_i^{cb}) \ = \ \frac{-u_{it}}{\alpha_i}. \tag{17}$$

From (9), the reduced-form solution for τ_{it} is given by

$$\tau_{it}(\delta_i, \lambda_i^{cb}) \ = \ \frac{(1-\delta_i)\beta_i\gamma_i s_i(\lambda^{cb_i} - \lambda_{i1}^g)}{[\beta_i\phi_i + \delta_i\gamma_i\Lambda_i]\lambda_{i2}^g} \ - \ \frac{(b_i - \theta_i)u_{it}}{\alpha_i}. \tag{18}$$

[6] See Weymark (2001) for further discussion of this point.

Substituting (16) - (18) into (10), the government's stage 1 minimization problem can be expressed as

$$\min_{\delta_i,\lambda_i^{cb}} \ \mathrm{E}L_i^g(\delta_i,\lambda_i^{cb}) \ = \ \frac{1}{2}\left\{\frac{(1-\delta_i)\beta_i\phi_i\lambda_i^{cb}}{\alpha_i[\beta_i\phi_i \ + \ \delta_i\gamma_i\Lambda_i]} \ + \ \frac{\delta_i(1+\alpha_i\beta_i)(\beta_i+\gamma_i)\lambda_{i1}^g}{\alpha_i[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]}\right\}^2 + \frac{\lambda_{i2}^g}{2}\left\{\frac{(1-\delta_i)\beta_i\gamma_i s_i(\lambda_i^{cb}-\lambda_{i1}^g)}{[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]\lambda_{i2}^g}\right\}^2. \qquad (19)$$

Partial differentiation of (19) with respect λ_i^{cb} and δ_i yields the first-order conditions

$$\frac{\partial \mathrm{E}L_i^g(\delta_i,\lambda_i^{cb})}{\partial\lambda_i^{cb}} \ = \ \frac{(1-\delta_i)^2(\beta_i\phi_i)^2\lambda_i^{cb}+\delta_i(1-\delta_i)\beta_i\phi_i[\beta_i\phi_i+\gamma_i\Lambda_i]\lambda_{i1}^g}{\alpha_i^2[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]^2} + \frac{(1-\delta_i)^2(\beta_i\gamma_i)^2s^2(\lambda_i^{cb}-\lambda_{i1}^g)}{\lambda_{i2}^g[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]^2} \ = \ 0 \qquad (20)$$

$$\frac{\partial \mathrm{E}L_i^g(\delta_i,\lambda_i^{cb})}{\partial\delta_i} \ = \ -\frac{\left\{(1-\delta_i)\beta_i\phi_i\lambda_i^{cb}+\delta_i[\beta_i\phi_i+\gamma_i\Lambda_i]\lambda_{i1}^g\right\}\beta_i\phi_i[\beta_i\phi_i+\gamma_i\Lambda_i](\lambda_i^{cb}-\lambda_{i1}^g)}{\alpha_i^2[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]^3} - \left\{\frac{(1-\delta_i)(\beta_i\gamma_i)^2s_i^2[\beta_i\phi_i+\gamma_i\Lambda_i](\lambda_i^{cb}-\lambda_{i1}^g)^2}{\lambda_{i2}^g[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]^3}\right\} \ = \ 0 \qquad (21)$$

It is evident that $[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]=0$ is not a solution to the minimization problem. When $[\beta_i\phi_i+\delta_i\gamma_i\Lambda_i]\neq 0$, (20) and (21) yield, respectively, (22) and (23):

$$\lambda_{i2}^g(1-\delta_i)\phi_i\left\{(1-\delta_i)\beta_i\phi_i\lambda_i^{cb}+\delta_i[\beta_i\phi_i+\gamma_i\Lambda_i]\lambda_{i1}^g\right\} + \alpha_i^2(1-\delta_i)^2\beta_i\gamma_i^2s_i^2(\lambda_i^{cb}-\lambda_{i1}^g) \ = \ 0 \qquad (22)$$

$$\lambda_{i2}^g\phi_i\left\{(1-\delta_i)\beta_i\phi_i\lambda_i^{cb}+\delta_i[\beta_i\phi_i+\gamma_i\Lambda_i]\lambda_{i1}^g\right\}(\lambda_i^{cb}-\lambda_{i1}^g) + \alpha_i^2(1-\delta_i)\beta_i\gamma_i^2s_i^2(\lambda_i^{cb}-\lambda_{i1}^g)^2 \ = \ 0. \qquad (23)$$

There are two solutions that satisfy both of the first-order conditions given above. By inspection, it is apparent that (22) and (23) are both satisfied when $\delta_i = 1$ and $\lambda_i^{cb} = \lambda_{i1}^g$. This solution characterizes a central bank that is fully dependent. When $0 \leq \delta_i < 1$ and $\lambda_i^{cb} \neq \lambda_{i1}^g$, then (22) and (23) imply the following relationship between δ_i and λ_i^{cb}

$$\delta_i \;=\; \frac{\beta_i \phi_i^2 \lambda_i^{cb} \lambda_{i2}^g \;+\; (\alpha_i \gamma_i)^2 \beta_i s_i^2 (\lambda_i^{cb} - \lambda_{i1}^g)}{\beta_i \phi_i^2 \lambda_i^{cb} \lambda_{2i}^g \;+\; (\alpha_i \gamma_i)^2 \beta_i s^2 (\lambda_i^{cb} - \lambda_{i1}^g) \;-\; \phi_i [\beta_i \phi_i + \gamma_i \Lambda_i] \lambda_{i1}^g \lambda_{i2}^g}. \tag{24}$$

The solution that yields the minimum loss for the government, as measured by the government's loss function (7), can be identified by using (19) to compare the expected loss that would be suffered under the alternative institutional arrangements. Substituting $\delta_i = 1$ and $\lambda_i^{cb} = \lambda_{i1}^g$ into (19) results in

$$\mathrm{E}L_i^g \;=\; \frac{(\lambda_{i1}^g)^2}{2\alpha_i^2}. \tag{25}$$

Substituting (24) into the right-hand-side of (19) yields

$$\mathrm{E}L_i^g \;=\; \frac{(\lambda_{i1}^g)^2}{2\alpha_i^2} \left\{ \frac{(\alpha_i \gamma_i)^2 s_i^2}{(\alpha_i \gamma_i)^2 s_i^2 + \phi_i^2 \lambda_{i2}^g} \right\}. \tag{26}$$

The behavioural parameter λ_{i2}^g is positive by assumption. For positive values of λ_{i2}^g, the value of (25) exceeds that of (26) which establishes that (24) is the solution to the government's loss minimization problem.

4. The Cost of a Common Monetary Policy

The solution to our policy game, (24), shows that the degree of central bank conservatism that is optimal for each country depends on the degree of independence that is conferred on the central bank, the economy's structural parameters (α_i, β_i, γ_i, s_i, and b_i), and on the government's behavioural parameters (λ_{i1}^g, λ_{i2}^g, and θ_i). Consequently, for any given degree of ECB independence, differences in economic structure and government objectives among the members of the European Union may result in significant variations in the degree of ECB consevatism preferred by individual countries. No matter how the degree of ECB conservatism is determined, it cannot be optimal for all countries simultaneously unless they are all identical. Moreover, the losses associated with relinquishing monetary sovereignty are likely to vary considerably across countries. In this section we use the theoretical framework developed above to gain some insight into the potential sources and magnitudes of such losses.

The legal statutes under which the ECB operates are designed to ensure that the ECB is fully independent of the governements of participating countries. In terms of the formal representation we employ here, the independence of the ECB means that all members of the European Currency Union face the constraint $\delta_i = \delta = 0$.[7] Substituting $\delta_i = 0$ into (24) reveals that the degree of ECB conservatism that is optimal from country i's point of view is

$$\lambda_i^{cb*} = \frac{(\alpha_i \gamma_i s_i)^2 \lambda_{i1}^g}{[(\alpha_i \gamma_i s_i)^2 + \phi_i^2 \lambda_{i2}^g]}. \tag{27}$$

Given $\delta_i = \delta = 0$, participation in the currency union entails losses for those countries whose λ_i^{cb*} differs from the ECB's actual degree of conservatism. Regardless of whether the degree of ECB conservatism is an average of the λ_i^{cb} values of member countries, or simply reflects the preferences of some part of the founding membership, the implementation of a centralized monetary policy has the potential to impose costs on some participants. Some governments may have an incentive to leave the union unless they are offered some sort of compensation. One way to gain some insight into this source of pressure on the currency union is to compare the losses that a country would incur under the ECB's monetary management with those that an optimal national monetary policy would produce.

Let the deviation of country i's preferred degree of conservatism from that of the ECB be defined as

[7]Note that as a necessary condition of membership in the EMU, each central bank is required to be fully independent before they may join the monetary union, and the ECB is defined to be fully independent by statute.

$$k_i \;=\; \frac{\lambda^{cb} \;-\; \lambda_i^{cb*}}{\lambda_i^{cb*}} \tag{28}$$

where λ^{cb} is the ECB's degree of conservatism.

Substituting $\delta_i = \delta = 0$ and $\lambda_i^{cb} = \lambda^{cb} = \lambda_i^{cb*}(1 + k_i)$ into the right-hand side of (19) reveals that when monetary policy is implemented by the ECB, the government of country i perceives its loss to be

$$\mathrm{E}L_i^g \;=\; \frac{1}{2}\left\{\frac{\lambda_i^{cb*}(1+k_i)}{\alpha_i}\right\}^2 \;+\; \frac{\lambda_{i2}^g}{2}\left\{\frac{\gamma_i s_i[\lambda_i^{cb*}(1+k_i) - \lambda_{i1}^g]}{\phi_i \lambda_{i2}^g}\right\}^2. \tag{29}$$

Taking the derivative of (29) with respect to k_i and dividing by (29) evaluated at $k_i = 0$ yields

$$\frac{\frac{\partial \mathrm{E}L_i^g}{\partial k_i}}{\mathrm{E}L_i^{g*}} \;=\; \frac{2k_i(\alpha_i\gamma_i s_i)^2}{\phi_i^2 \lambda_{i2}^g}. \tag{30}$$

where $\mathrm{E}L_i^{g*}$ is given by (26).[8]

Equation (30) measures the percent welfare loss associated with EMU membership. This loss arises when the common central bank's preferred degree of conservatism deviates from the preferred policy stance of individual union members. From (30) we can see that country i's losses are increasing in k_i, the size of the deviation between its own optimal degree of conservatism and that adopted by the ECB. The losses from EMU membership are also inversely related to λ_{i2}^g (the preference for income redistribution) and to ϕ_i (the degree of conflict between the desire to stimulate growth and to generate greater income equality). Notice that λ_{i1}^g, the preference for growth, is absent from (30) except insofar as it decreases k_i (by increasing λ_i^{cb*}). The preference for growth therefore has no direct effect on the losses associated with monetary union membership. Similarly, the effectiveness of monetary policy parameter β_i, surprisingly, does not matter either except insofar as it affects ϕ_i.

Appropriate differentiation of (30) shows that the losses from EMU membership are increasing in the Phillips curve parameter α_i (and therefore decreasing in the

[8]The fact that the cost of deviating from the ECB's policy stance is measured in terms of a proportional loss takes care of the fact that (7) only defines an ordinal ranking of performance.

sacrifice ratio $1/\alpha_i$). These losses are also increasing in in the effectiveness of fiscal policy γ_i, and in the savings ratio s_i. These results are unsurprising. In general, one would expect higher sacrifice ratios to necessitate more conservative monetary policies in order to offset the government's tendency towards increased spending. On the other hand, more effective fiscal policies, and higher savings rates to fund those policies, reduce the pressure for tough monetary control.

It is evident that the impact of any divergence between the degree of conservatism preferred by ECU members and the ECB's actual degree of conservatism depends on both the structure of the economy and the preferences of the elected government. Whether the losses given in (30) are likely to be large enough to discourage some countries from joining the ECU or, alternatively, to cause some members to regret their participation, is an empirical issue to which we now turn.

5. Empirical Evidence

5.1 Data Sources

Table 1 contains the parameter values we have used in the empirical section of this article. They span the four larger EU economies, and the twelve smaller economies who either currently participate or could participate in EMU should they choose to do so. Of these sixteen economies, only five are not currently members of EMU. The UK, Denmark, and Sweden are members of the European Union (and hence the single market) but are legally allowed to opt-out of the monetary union for as long as they wish to do so; Norway and Switzerland have been offered EU and EMU membership, but have rejected both in national referenda.[9] Thus we have a sample of countries that allows us to compare small countries with large countries, EMU members with non-members, and EMU members with those who accept the single market but not the single currency.

The parameter values themselves come from different sources and are offered as

[9] Technically Sweden has no legal opt-out clause, but she has assumed opt-out status nonetheless.

TABLE 1

Country-Specific Parameter Values

i	α_i	β_i	γ_i	s_i	θ_i	ϕ_i
Germany	0.176	0.533	0.43	0.216	0.583	1.040
France	0.294	0.500	0.57	0.211	0.620	1.072
Italy	0.625	0.433	0.60	0.214	0.651	1.187
UK	0.385	0.133	0.58	0.180	0.675	0.980
Austria	0.213	0.489	0.533	0.220	0.532	1.041
Belgium	0.154	0.489	0.533	0.247	0.518	1.058
Denmark	0.270	0.489	0.533	0.209	0.530	1.074
Finland	0.263	0.489	0.533	0.249	0.588	1.051
Greece	0.400	0.489	0.533	0.237	0.445	1.126
Ireland	0.454	0.133	0.580	0.248	0.460	0.995
Norway	0.137	0.489	0.533	0.271	0.504	0.994
Netherlands	0.625	0.489	0.533	0.279	0.596	1.217
Spain	0.213	0.489	0.533	0.226	0.650	1.110
Portugal	0.417	0.489	0.533	0.226	0.350	1.126
Sweden	0.333	0.489	0.533	0.206	0.504	1.107
Switzerland	0.323	0.489	0.533	0.310	0.719	1.039

"best practice" estimates for an analysis based on stylized facts. Because our approach essentially involves a sensitivity analysis around standard estimates of these parameters, a stylized facts approach is appropriate. The advantages of further econometric refinements, or consitency constraints on the underlying econometric specifications, would be lost when we vary the parameter values to capture the effects of different preference or transmission asymmetries on performance.

The Phillips curve parameters, α_i from (1), are taken as the inverse of the annualized sacrifice ratios estimated on quarterly data from 1971–1998 by Turner and

Seghezza (1999).[10] From (2), β_i and γ_i measure the effectiveness of monetary and fiscal policy, respectively. We obtained the β_i and γ_i values reported in Table 1 from John Taylor's (1993) multicountry econometric model. These parameter values are the simulated one-year multipliers for each economy, jointly estimated in a model of interdependent economies. Thus, although our model (1)—(3) does not make spillovers between economies explicit, our numerical estimates do reflect the performance of an economy subject to such spillovers. Because Taylor's model only provides explicit estimates for the four largest European economies, we have assumed that, with the exception of Ireland, the smaller economies have β_i and γ_i values equal to the average of Germany, France, and Italy. For Ireland, we set β_i and γ_i at the UK values.

The national savings ratios s_i were obtained from OECD data wherever possible.[11] We chose to use the 1998 data because that was the year in which EMU was initiated. We also used 1998 OECD data to estimate the desired level of income equality θ_i. According to our model, θ_i measures the desired degree of income equality in terms of the desired proportion of output allocated to the rich. We therefore estimate θ_i as one minus the proportion of total fiscal expenditure allocated to social expenditures in each country.[12]

Finally, λ_{i1}^g and λ_{i2}^g represent the ith country's preference for growth and income redistribution, respectively, relative to a unit penalty for inflation aversion. For lack of

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[10]Turner and Seghezza (1999) also note that there is no significant difference between the numerical estimates obtained from single-country estimation and OECD-wide systems estimation. This justifies our use of single country estimates in (1)–(3) for economies that are subject to spillover effects.

[11]Data for Ireland and Portugal was not available. Rather than drop these countries from the sample, we used the average savings ratios of the three other cohesion countries (Spain, Portugal, and Greece) for Ireland; and set the savings ratio for Portugal equal to that of Spain.

[12]The data required to estimate θ_i were not available for Ireland, Portugal, and Norway. In order to retain these countries in the sample, we set θ_i for Ireland equal to the average value for the three other cohesion countries, θ_i for Portugal equal to our estimate for Spain, and θ_i for Norway equal to our estimate for Sweden. Plausible variations in these small parameter values would not change the rankings resulting from our calculations.

any direct evidence on these preference parameters, we have set $\lambda_{i1}^g = 1$ and $\lambda_{i2}^g = 0.5$, for each i, for our initial calculations. The performance indicators we obtain for this baseline case are reported in Table 2. However, as we do not have even stylized facts for either of the model's preference parameters, it seems prudent to consider other values for λ_{i1}^g and λ_{i2}^g as well. The effect of plausible variations in these parameters on the estimated welfare losses is given in Table 5.

5.2 EMU Counterfactuals

Given (27), (30), and the parameter values in Table 1, we can calculate the porportional losses in national welfare that arise when a common monetary policy is implemented in a currency union among heterogenous countries. Heterogenity of the union membership guarantees that the degree of central bank conservatism in monetary policy (λ^{cb}) will generally be different from the value that an individual country would have chosen for itself (λ_i^{cb*}). Implicitly, there are two benchmarks, or comparisons, to EMU that could be considered here: non-membership with an optimally chosen central bank for the individual economy, or non-membership with the central bank that the individual country actually had prior to EMU (which may or may not have been optimal). In this article, we focus on the first comparison only because there is little point in criticizing EMU from a suboptimal standpoint.

In order to be able to compare the individual country's optimal degree of conservatism with that of the ECB, we must define the ECB's choice of λ^{cb}. One of the implications of the literature on the credibility of monetary policy in the EMU is that the new central bank had to be at least as independent and at least as conservative as the Bundesbank had been before EMU. This was the only way to get Germany, which had the best inflation record in the EU area, to participate in the union.[13] For this reason, we set the ECB's degree of conservatism equal to the degree of central bank conservatism that is optimal for Germany. At the same time, we also explicitly

[13]See Giavazzi and Pagano (1988), de Grauwe (1995), and Hughes Hallett (1999) for explicit demonstrations of this point.

recognize that the ECB's new statutes make it totally independent of all national governments, government agencies, and para-statals (Kenen 1995). We therefore set $\delta = 0$ and $\lambda^{cb} = \lambda_1^{cb*}$, where δ and λ^{cb} denote, respectively, the ECB's statutory degree of independence and its chosen degree of conservatism, and λ_1^{cb*} is the German degree of conservatism, which we calculate substituting German parameter values for 1998 into (27). In this way, we capture the incentive constraints associated with getting EMU started when it did.

5.3 National Losses from a Common Central Bank

In Table 2 we report the national losses implied by our model when the ECB's degree of conservatism is suboptimal from the point of view of individual countries. For each country, the ideal degree of conservatism (inflation aversion) λ_i^{cb*} is given by (27); and the associated performance losses are implied by (30) when $\lambda^{cb} \neq \lambda_i^{cb*}$ and the parameter values from Table 1 are used.

The proportional losses in welfare units look comparatively small and are clustered in the range 0% – 2%. However, the magnitude of these losses roughly matches the gains which might have been expected from international policy coordination or exchange rate targeting (see Currie et al., 1989), and can, from that point of view, be considered to be quite large. Moreover, the losses fall into three groups:

(A) Losses $> 1\%$: Italy, Ireland, Netherlands, Switzerland

(B) $1\% >$ Losses $> 0.5\%$: UK, Greece, Spain, Portugal

(C) Losses $< 0.5\%$: France, Germany, Austria, Belgium, Denmark, Finland, Norway, Sweden.

Group A appears to contain some of the high growth or higher inflation countries. Group B comprises the real periphery; and Group C is the core of the EMU, clustered around Germany.[14] These results are consistent with the pattern of desired degrees of

[14]In other words, there is no clear pattern betwen EMU members and non-members, or betwen small or large countries in these results. However, there does appear to be a core-periphery split.

Table 2

Stylized facts Performance Indicators

(Baseline Case)

i	λ_i^{cb*}	% Loss in welfare units	Min. % Loss in growth rate equivalent units	Proportion of potential EMU gains foregone
Germany	0.00049	0.00	0.00	—
France	0.00217	0.34	0.43	0.6
Italy	0.00906	1.73	2.01	2.0
UK	0.00335	0.57	0.64	0.9
Austria	0.00115	0.13	0.21	0.15
Belgium	0.00073	0.07	0.11	0.05
Denmark	0.00157	0.22	0.24	0.15
Finland	0.00201	0.33	0.48	0.25
Greece	0.00401	0.71	0.89	0.6
Ireland	0.00854	1.64	3.40	2.0
Norway	0.00079	0.06	0.13	0.05
Netherlands	0.01153	2.23	3.29	1.9
Spain	0.00348	0.60	0.70	0.7
Portugal	0.00396	0.70	0.80	0.5
Sweden	0.00218	0.34	0.33	0.3
Switzerland	0.000525	1.03	2.59	1.75

inflation aversion λ_i^{cb*}. The country-specific values for λ_i^{cb*} show that everyone wants a very conservative central bank, but that the desired degree of conservatism varies considerably. According to our calculations, ECB (or German) conservatism exceeds that desired by some countries by factors of as much as 20.

The potential gains from participating in EMU are usually discussed and compared in terms of the predicted increases in GDP (European Commission, 1990). In order to facilitate the comparison of our results with these predictions, we convert the losses in welfare units into their "growth rate equivalents" — reported in Table 2.[15] In order to obtain these growth rate equivalent losses, we calculate the marginal rate of transformation between policy objectives around each government's indifference curve to find the change in output growth, dy_{it}, that yields the same welfare loss when all other variables are held constant at their optimized values. Formally, we use (7) together with certainty equivalence to obtain

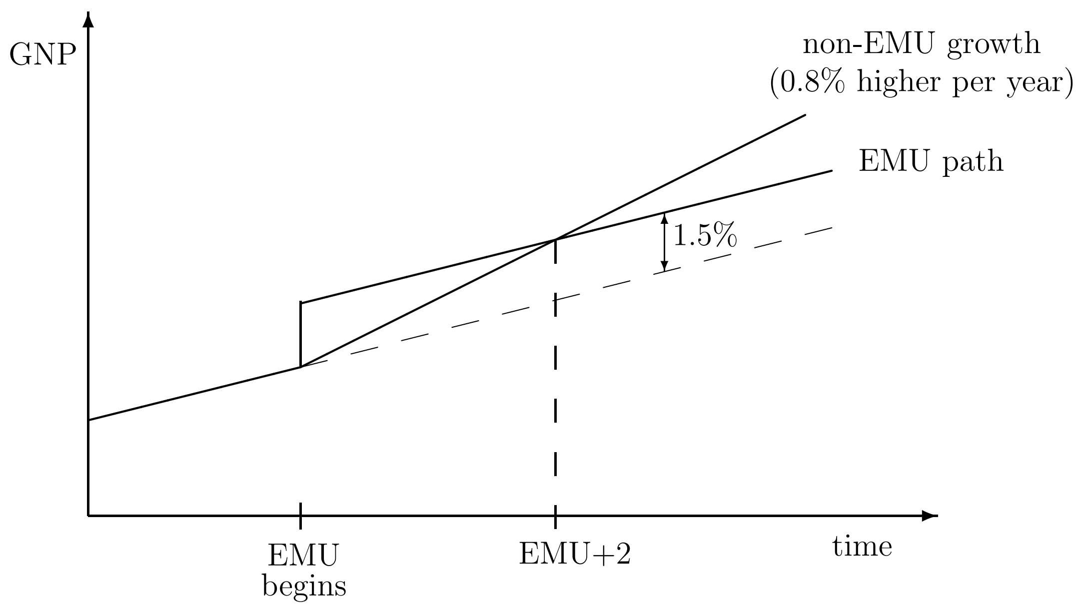
$$dy_{it} = \frac{(dEL_{it}^g)}{[\lambda_{i2}^g\{(b_i - \theta_i)y_{it} - \tau_{it}\}(b_i - \theta_i) - \lambda_{i1}^g]}. \tag{31}$$

Substituting (30) into (31) with $\partial k_i = 1$ then yields the per unit loss in growth rate equivalents.

The minimum value of dy_{it} is attained when lump sum taxes τ_i grow at the same rate as the redistribution target $(b_i - \theta_i)y_{it}$. These minimum output losses are reported in column 3 and show a similar pattern of clustering as we obtained from column 2. Note, however, that the losses in column 3 are calibrated as growth *rates*, not levels. This is important because small losses in growth rates will outweigh any gains in levels after a certain period of time. In its initial assessment of EMU, the European Commission estimated that the gains from adopting a single currency would amount to an increase in GNP of 1%–1.5% for the typical European country (European Commission 1990). These gains were expected to be lower for the larger economies, and somewhat higher for the smaller ones. The GNP gains predicted by

[15]This is the standard comparison in the coordination literature. See, for example, Oudiz and Sachs (1984) and Nolan (2002).

the European Commission therefore imply a permanent increase in national incomes, not an increase in output growth rates.



The Impact of Growth Rate Reductions
on the Gains from EMU

Figure 1

We now use the losses in column 3, and the European Commission's estimate of EMU gains, to determine which countries are likely to have experienced short term gains or losses upon joining EMU. According to our calculations, the gains from EMU membership outweigh the losses from having to accept a suboptimally conservative central bank, from a domestic viewpoint, for France, Germany, Austria, Belgium, Denmark, Finland, Greece, Norway, Portugal, and Sweden. However, the benefits predicted by the European Commission would be approximately equal to the costs of membership for the UK and Spain. For Italy, Ireland, the Netherlands, and Switzerland, the costs of EMU participation actually appear to outweigh the benefits captured in our model within one year. These results are summarized in the last column of Table 2 where we report the proportion of the anticipated gains from EMU that would be lost when the common central bank is too conservative by national standards. Note that the figures in this column are intended to give orders of magnitude; they are not accurate measures. Nevertheless, the conclusion that these welfare losses are important is inescapable. For example, a country that suffers a growth rate reduction of about 0.8% upon joining EMU loses about half of the gains predicted by the European Commission and will incur a net loss after 2–3 years.[16] The results we obtain suggest that any GNP gains from EMU will be transitory for most countries, and that the damage that a common monetary policy inflicts on output growth rates could, over time, threaten the survival of the union. The impact of growth rate reductions on the gains from EMU is illustrated in Figure 1.

5.4 The Sources of Welfare Losses

In order to identify the principal sources of the welfare losses calculated above, we need to evaluate the relative size of the partial derivatives

$$\frac{\partial \mathrm{E}L_i^g}{\partial x_i} = \frac{\partial \mathrm{E}L_i^g}{\partial \lambda_i^{cb*}} \frac{\partial \lambda_i^{cb*}}{\partial x_i} \tag{32}$$

for each i, where $x_i = \alpha_i, \beta_i, \gamma_i$, or s_i for the transmission asymmetries; and $x_i = \lambda_{i1}^g, \lambda_{i2}^g$, or θ_i for the preference asymmetries. The expressions for these partial derivatives, which are provided in the Appendix, can be used to compare the impact of preference asymmetries and transmission asymmetries on welfare losses. The sufficient conditions for preference asymmetries to have a greater impact are given in Table 3.

Using the parameter values in Table 1 to evaluate the expressions in Table 3, we reach a number of conclusions. First, the inequalities in the θ_i column will never hold. The conditions given in the α_i, γ_i, and s_i rows are also unlikely to hold for any but the most conservative governments. However, the inequalities in the λ_{i2}^g column might hold for governments which (like the UK or Ireland) have traditionally placed less em-

[16]This comparison assumed that the relevant benchmark against which to measure these losses is the output growth that could have been attained with a optimally designed national central bank.

TABLE 3

Sufficient Conditions for Preference Asymmetries
to Dominate Transmission Asymmetries

Transmission Parameters	Preference Parameters $\partial \mathrm{E}L_i^g/\partial\lambda_{i1}^g$	$\partial \mathrm{E}L_i^g/\partial\lambda_{i2}^g$	$\partial \mathrm{E}L_i^g/\partial\theta_i$
$\partial \mathrm{E}L_i^g/\partial\alpha_i$	$2\lambda_{i1}^g(1-\gamma_i\theta_i s) < \alpha_i\phi_i$	$\lambda_{i2}^g < \frac{\alpha_i}{2}$	$1 < \gamma_i s_i(\alpha_i+\theta_i)$
$\partial \mathrm{E}L_i^g/\partial\beta_i$	$\lambda_{i1}^g < \frac{\phi_i}{2\alpha_i}$	$\lambda_{i2}^g < \frac{1}{2\alpha_i}$	$\alpha_i < \gamma_i s_i$
$\partial \mathrm{E}L_i^g/\partial\gamma_i$	$2\lambda_{i1}^g(1+\alpha_i\beta_i) < \phi_i\gamma_i$	$\lambda_{i2}^g < \frac{\gamma_i\phi_i}{2(1+\alpha_i\beta_i)}$	$(1+\alpha_i\beta_i) < \gamma_i^2 s_i$
$\partial \mathrm{E}L_i^g/\partial s_i$	$2\lambda_{i1}^g(1+\alpha_i\beta_i) < \phi_i s_i$	$\lambda_{i2}^g < \frac{s_i\phi_i}{2(1+\alpha_i\beta_i)}$	$(1+\alpha_i\beta_i) < \gamma_i s_i^2$

phasis on income redistribution relative to growth. Second, the first two inequalities in the β_i row almost certainly will hold, indicating that some preference asymmetries are at least as important as some transmission asymmetries. In particular, our model indicates that monetary transmission asymmetries are less likely to cause tension in the union than other types asymmetry. This observation has obvious implications for economic governance and accountability, as well as institutional design. It also suggests that the emphasis on transmission asymmetries, which has dominated the literature up to now, is problematic and that the issue of sustaining a currency union in the presence of preference asymmetries warrants at least as much attention.

5.5 Comparing the Impact of Transmission Asymmetries

The procedures employed in the previous section can also be used to identify which of the transmission asymmetries are most important to the smooth functioning (and possibly the sustainability) of EMU. Specifically, we use the partial derivatives in

Table 4

A Comparison of Different Transmission Effects

Numerator	Denominator $\partial \mathrm{E}L_i^g/\partial\alpha_i$	$\partial \mathrm{E}L_i^g/\partial\beta_i$	$\partial \mathrm{E}L_i^g/\partial\gamma_i$	$\partial \mathrm{E}L_i^g/\partial s_i$
$\partial \mathrm{E}L_i^g/\partial\alpha_i$	—	$1 > \alpha_i^2 + \gamma_i\theta_i s_i$	$\frac{\gamma_i}{\alpha_i} < \frac{(1-\gamma_i\theta_i s_i)}{(1+\alpha_i\beta_i)}$	$\frac{s_i}{\alpha_i} < \frac{(1-\gamma_i\theta_i s_i)}{(1+\alpha_i\beta_i)}$
$\partial \mathrm{E}L_i^g/\partial\beta_i$	$1 < \alpha_i^2 + \gamma_i\theta_i s_i$	—	$\alpha_i(\gamma_i - \beta_i) > 1$	$\alpha_i(s_i - \beta_i) > 1$
$\partial \mathrm{E}L_i^g/\partial\gamma_i$	$\frac{\gamma_i}{\alpha_i} \geq 1$	$\alpha_i(\gamma_i - \beta_i) < 1$	—	$s_i > \gamma_i$
$\partial \mathrm{E}L_i^g/\partial s_i$	$\frac{s_i}{\alpha_i} \geq 1$	$\alpha_i(s_i - \beta_i) < 1$	$s_i < \gamma_i$	—

the Appendix to form ratios of the transmission parameter impact effects. Sufficient conditions for these ratios to exceed unity are given in Table 4.

It is evident from Table 4 that differences in the Phillips curve parameter α_i will almost always be more important than differences in the monetary transmission mechanism. Table 4 also indicates that asymmetries in the impact of fiscal policy (reflected by γ_i) and in savings behaviour (denoted by s_i) are more important to performance than differences in national monetary transmission mechanisms. However, it is unclear whether savings asymmetries are of greater importance than asymmetries in the response of inflation to output (as measured by α_i). Finally, our model suggests that the impact of fiscal policy is of greater importance than the response of inflation to output.

5.6 The Effect of Alternative Preference Parameters

Up to this point we have employed the same preference parameter values for each elected government in our sample. Specifically we assumed that $\lambda_{i1}^g = 1$ and $\lambda_{i2}^g = 0.5$

for all i. As a consequence, the losses associated with EMU membership reported in Table 2 arise purely as a result of transmission asymmetries. However, the results in Section 5.4 indicate that certain preference asymmetries are at least as important as transmission asymmetries. In this section, we evaluate the impact that preference asymmetries can have on welfare losses. We conduct this sensitivity analysis by considering four alternatives:

1. Each country, including Germany, puts a higher weight on output growth than before ($\lambda^g_{i1} = 1.5$ for all i), while the ECB retains its original policy position ($\lambda^{cb} = 0.0005$), believing that to reflect German preferences.

2. The ECB believes that Germany is only half as interested in output growth as before; the ECB imagines that $\lambda^g_{11} = 0.5$ and therefore sets $\lambda^{cb} = 0.001$. However, all countries, including Germany, actually remain as in Table 2.

3. Each country increases its desire for income equality ($\lambda^g_{i2} = 1.0$), while the ECB retains its original perception of the German position and sets $\lambda^{cb} = 0.00025$

4. The ECB believes that Germany is only half as interested in income equality as before; the ECB imagines that $\lambda^g_{12} = 0.25$ and therefore sets $\lambda^{cb} = 0.001$. However, all countries, including Germany, actually remain as in Table 2.

The preference variations in cases 1 and 3 are applied individually, country by country.

The percentage welfare losses (expressed in welfare units) associated with these preference configurations are reported in Table 5 in terms of their changes from column 2 of Table 2. It is evident from Table 5 that, that with only two exceptions in the last two columns (Belgium and Norway, whose losses relative to those in Table 2, column 2, exceed 100%), none of these preference variations are large enought to change the losses in Table 2 into gains. Furthermore, the ECB's misperceptions about Germany's preferences for inflation, growth, or income equality have very little impact on German losses, but potentially a large impact on many of the other countries.[17]

[17]For example, setting the ECB's value of λ^{cb} at 0.0038 (the post-Nice treaty weighted avaerage

TABLE 5

Impact of Preference Asymmetries on Welfare Losses:
Percentage Changes Relative to the Benchmark Case in Table 2

i	$\lambda^{g}_{i1} = 1.5,\ \forall i$ $\lambda^{cb} = 0.0005$	$\lambda^{g}_{i1} = 1,\ \forall i$ $\lambda^{cb} = 0.0005$	$\lambda^{g}_{i2} = 1,\ \forall i$ $\lambda^{cb} = 0.0005$	$\lambda^{g}_{i2} = 0.5,\ \forall i$ $\lambda^{cb} = 0.001$
Germany	0.03	0.02	−0.05	−0.10
France	10	14	−64	−30
Italy	2	3	−53	−6
UK	6	9	−58	−17
Austria	25	37	−43	−75
Belgium	68	101	−201	−207
Denmark	15	27	−45	−46
Finland	4	16	−26	−33
Greece	5	7	−14	−14
Ireland	2	3	−6	−6
Norway	54	81	−162	−166
Netherlands	1	2	−4	−5
Spain	5	8	−6	−17
Portugal	5	7	−14	−14
Sweden	10	15	−29	−29
Switzerland	3	5	−10	−10

6. A Common Central Bank Automatically Constrains Fiscal Policy

The results reported in Table 5 show that, as predicted by (30), welfare losses are increasing in λ_{i1}^g (the preference for growth), but decreasing in λ_{i2}^g (the preference for income redistribution). The fact that λ_{i1}^g and λ_{i2}^g affect losses in opposite directions reflects the conflict between growth and redistribution objectives in a social market economy. It is also clear that variations in λ_{i2}^g are more important than variations in λ_{i1}^g.

These results have implications for the design of economic policy and the stability of the union itself because they reflect a paradox in the way fiscal policy has to be used if national objectives are to be achieved. Ordinarily one would expect that the desire to offset the impact of excess monetary conservatism would lead liberal-minded countries (i.e., those with higher λ_{i2}^g values) to implement more expansionary fiscal policies. However, our model indicates that using fiscal policy in this way would actually lead to suboptimal outcomes.

Partial differentiation of (13) with respect to λ_{i2}^g yields

$$\frac{\partial g_{it}}{\partial \lambda_{i2}^g} = \frac{\beta_i^2 \alpha_i \gamma_i s_i^2 (\lambda^{cb} - \lambda_{i1}^g)}{\alpha_i \beta_i \phi_i (\beta_i + \gamma_i)(\lambda_{i2}^g)^2}, \tag{33}$$

which is negative for $\lambda^{cb} < \lambda_{i1}^g$.[18] But (33) is increasing in λ^{cb}. Hence, optimal government expenditures are inversely related to the priority given to income redistibution. The reason for this is that, in our model, any part of the fiscal deficit that remains after seigniorage revenue has been exhausted, must be funded by the after-tax savings of the rich. A greater emphasis on income redistribution therefore necessitates

of the national λ^{cb*} values) would mean a loss of only 0.67% in welfare units for Germany. But the losses reported in Table 2 for Italy, Ireland, and the Netherlands would be halved; and those for the UK, Spain, Portugal, and Greece fall to zero. In fact, only Belgium, Denmark, and Austria (along with Germany) suffer increases in their losses — and these are the countries with the smallest losses.

[18]Rogoff (1985) shows that the central bank should always be more conservative than society as a whole and Demertzis et al. (1995) demonstrate that such conservatism is a natural outcome of the electoral process when the central bank is indpendent.

increasing the tax burden on the rich, which reduces the funds available to finance deficit spending. This explains the apparent paradox that more liberal preferences will actually lead to less expansionary fiscal policies.[19]

In a monetary union, there is a second, and perhaps more important, constraint on fiscal policy. That is, an independent (and conservative) central bank will automatically constrain fiscal policy if the latter is being conducted optimally. No Stability Pact or any other device designed to limit the size of fiscal interventions is necessary to achieve this outcome.[20] To see this, we need only differentiate (13) and (18) with respect to λ^{cb} when $\delta_i = 0$. We get

$$\frac{\partial g_{it}}{\partial \lambda^{cb}} = \frac{\beta_i[\phi_i \lambda^g_{i2} - \alpha_i \gamma_i s_i^2]}{\alpha_i(\beta_i + \gamma_i)\phi_i \lambda^g_{i2}} \tag{34}$$

$$\frac{\partial \tau_{it}}{\partial \lambda^{cb}} = \frac{\gamma_i s_i}{\phi_i \lambda^g_{i2}} \tag{35}$$

Equation (35) is positive in all circumstances; and (34) is positive provided $\lambda^g_{i2} > (\alpha_i \gamma_i s_i^2)/\phi_i$, which is guaranteed in Table 1 as long as $\lambda^g_{i2} \geq 0.02$ (i.e., for all but the most extraordinarily socially conservative governments). In other words, the more conservative the central bank (the ECB), the less should compensating fiscal policies be used in an attempt to reach domestic objectives. This result is a consequence of the conflict between the growth and redistributional objectives.[21] In our model, a more conservative monetary policy reduces output growth. Expansionary fiscal policy aimed at counteracting this effect would require more private funding and, therefore, higher after-tax savings for the rich. Our results indicate that the increase in output will not, by itself generate sufficient new savings to finance the additional

[19] Differentiating (13) and (18) with respect to λ^g_{i1} and λ^g_{i2} makes this conflict clear: $\partial g_{it}/\partial \lambda^g_{i1} > 0$ and $\partial \tau_{it}/\partial \lambda^g_{i1} < 0$, whereas $\partial g_{it}/\partial \lambda^g_{i2} < 0$ and $\partial \tau_{it}/\partial \lambda^g_{i2} > 0$.

[20] One might conclude from this that the Stability Pact is redundant. However, the Stability Pact is useful insofar as it provides a safety barrier which prevents naive governments from introducing extreme or inappropriately signed fiscal policy when they find monetary policy unresponsive or too conservative for their circumstances.

[21] Note that this result holds independently of λ^g_{i1} (the preference for growth relative to inflation aversion) unless governments really don't care at all about income redistribution.

fiscal expenditure — a reduction in taxes would also be needed, causing the growth and redistribution objectives to be in conflict. Consequently, governments cannot use fiscal policy to reach their objectives when the ECB implements policies that are too conservative from the national point of view. A common central bank therefore automatically constrains the size of fiscal interventions, including those directed at eliminating income inequality, even if there are no other (external) constraints on fiscal policy.

If, as our model suggests, a common monetary policy ties fiscal policy down when governments have both growth and redistribution (social) objectives, governments will be forced to devise alternative policy measures to reach their domestic objectives. Recently, a number of authors have argued that the success of the EMU depends critically on the willingess of governments to undertake structural reforms to increase the degree of wage and price flexibility in their economies. The results we have obtained here provide theoretical support for this position. Futhermore, the fact that it is the inclusion of redistribution objectives in the government loss function that limits the usefulness of fiscal policy as an instrument, suggests that pressures for greater social protection or redistribution may be a natural catalyst for such reforms. At this point, there is no consensus that the necessary reforms will actually materialize.[22]

7. Conclusion

In this article, we have explored some of the costs of membership in a currency union that may arise when participating countries are heterogenous in economic structure and preferences. Because union membership is intended to be a permanent state, we have employed a model which allows us to evaluate these costs in terms of growth rates. Our model does not incorporate all of the potential costs and benefits associated with membership in a currency union, so the results we obtain are not an overall

[22]See, for example, Agell (1999), Calmfors (1998, 2001), Krueger (2000), Sibert (1999), and Sibert and Sutherland (2000).

judgement on the value of the EMU. Rather, our analysis develops new insights into the degree to which transmission and preference asymmetries could affect the robustness and sustainability of the currency union in Europe.

A number of conclusions follow from our analysis. First, because even small losses in trend growth rates accumulate over time, the cost of union membership can be quite substantial for countries whose structure and preferences deviate from those that underlie the common monetary policy. These losses can easily outweigh the permanent increase in the level of economic welfare which the European Commission argues would accrue to a country joining the EMU. Second, the losses associated with preference asymmetries may be at least as large as those caused by transmission asymmetries and should not be ignored, as they have been in much of the literature. Paradoxically, we find monetary asymmetries to be of lesser importance, in terms of the damage they cause, than asymmetries in the impact of fiscal policies, savings behaviour, or the preference for income redistribution.

Third, the common monetary policy constrains what is achievable using fiscal policy. In particular, because they conflict with a country's distributional objectives, expansionary fiscal policies cannot be used to compensate for a common monetary policy that is suboptimal, and too conservative from the national perspective. The more the common monetary policy deviates from the policy that would be considered optimal from the national point of view, the more national fiscal policy must accommodate the union's objectives. In that case, one might expect governments to reach for an alternative set of instruments. Structural reforms in the labour markets, market liberalization, and measures to increase price and wage flexibility are all obvious candidates. But that raises the issue of whether the single currency will increase the pressures for reform, or whether it will produce pressures for greater redistribution and income insurance. Clearly that is asubject for further research.

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Appendix
Impact of Structural and Behavioural Parameters on $\boldsymbol{\lambda_i^{cb*}}$

A.1 Structural Parameters

Differentiating (27) with respect to α_i, β_i, γ_i, and s_i yields:

$$\frac{\partial \lambda_i^{cb*}}{\partial \alpha_i} = \frac{2\lambda_i^{cb*}\lambda_{i2}^{g}\phi_i(1-\gamma_i\theta_i s_i)}{\alpha_i[\phi_i^2\lambda_{i2}^{g}+(\alpha_i\gamma_i s_i)^2]} > 0^{23} \tag{A.1}$$

[23] Table 1 shows $\gamma_i\theta_i s_i < 1, \forall i$.

$$\frac{\partial \lambda_i^{cb*}}{\partial \beta_i} = \frac{-2\lambda_i^{cb*}\lambda_{i2}^g \phi_i \alpha_i}{[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} < 0 \tag{A.2}$$

$$\frac{\partial \lambda_i^{cb*}}{\partial \gamma_i} = \frac{2\lambda_i^{cb*}\lambda_{i2}^g \phi_i (1 + \alpha_i \beta_i)}{\gamma_i[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} > 0 \tag{A.3}$$

$$\frac{\partial \lambda_i^{cb*}}{\partial s_i} = \frac{2\lambda_i^{cb*}\lambda_{i2}^g \phi_i (1 + \alpha_i \beta_i)}{s_i[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} > 0. \tag{A.4}$$

A.2 Behavioural Parameters

Differentiating (27) with respect to λ_{i1}^g, λ_{i2}^g, θ_i, and b_i yields:

$$\frac{\partial \lambda_i^{cb*}}{\partial \lambda_{i1}^g} = \frac{(\alpha_i \gamma_i s_i)^2}{[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} > 0 \tag{A.5}$$

$$\frac{\partial \lambda_i^{cb*}}{\partial \lambda_{i2}^g} = \frac{-(\alpha_i \gamma_i s_i)^2 \phi_i^2 \lambda_{i1}^g}{[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} < 0 \tag{A.6}$$

$$\frac{\partial \lambda_i^{cb*}}{\partial \theta_i} = \frac{2\alpha_i^2 (\gamma_i s_i)^3 \phi_i \lambda_{i1}^g \lambda_{i2}^g}{[\phi_i^2 \lambda_{i2}^g + (\alpha_i \gamma_i s_i)^2]} > 0 \tag{A.7}$$

$$\frac{\partial \lambda_i^{cb*}}{\partial b_i} = 0. \tag{A.8}$$

Note that (A.8) implies that the initial income distribution has no implications for our analysis. Changes in the *desired* income distribution are another matter, as (A.7) shows.