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Fiscal asymmetries and the survival of the euro zone[1]

Paul R. Masson

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Abstract. A model of a dependent central bank that internalizes the government's budget constraint is used to examine the optimal composition of the euro zone. The model embodies the desire to stimulate output and to provide monetary financing to governments. Unable to pre-commit to first-best policies, the central bank produces excess inflation — a tendency partially reduced in a monetary union. On the basis of this framework, calibrated to euro zone data, the current membership is shown not to be optimal: other members would benefit from the expulsion of several countries, notably Greece, Italy, and France. A narrow monetary union centered around Germany might be able to guarantee central bank independence, but simulation results suggest that such a narrow monetary union would not be in Germany's interest relative to a return to the deutsche mark.

JEL Classification: F15; F33.
Keywords: ECB; Fiscal Asymmetries; Euro Zone; Central Bank Independence.

Résumé. Cet article propose un modèle de banque centrale dépendante qui internalise la contrainte budgétaire du gouvernement afin d'examiner la composition optimale de la zone euro. L'objectif est de stimuler le produit agrégé, mais aussi de fournir un financement monétaire aux gouvernements. Ne pouvant répondre aux politiques de premier choix, la banque centrale produit un excès d'inflation — une tendance partiellement réduite dans le cadre d'une union monétaire. Dans un tel cadre, calibré pour les données de la zone euro, la composition actuelle de la zone n'apparaît pas optimale : certains membres bénéficieraient de l'exclusion de plusieurs pays, notamment la Grèce, l'Italie et la France. Une union monétaire resserrée autour de l'Allemagne pourrait être en mesure de garantir l'indépendance de la banque centrale. Les résultats des simulations suggèrent toutefois qu'une telle union monétaire resserrée ne serait pas aussi bénéfique pour l'Allemagne qu'un retour au deutsche mark.

Classification *JEL* : F15 ; F33.
Mots-Clefs : Banque Centrale Européenne ; asymétries budgétaires ; zone euro ; indépendance de la banque centrale.

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1. Retired adjunct professor, University of Toronto, and principal, Weatherstone Consulting, Box 1866, Niagara-on-the-Lake, Ontario L0S 1J0, Canada. Email: paul.masson@rotman.utoronto.ca; telephone: 905-468-9703.
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1. Introduction

The current crisis in the euro zone has highlighted once again the strains put on a monetary union by the lack of fiscal discipline. While the interaction of fiscal and monetary policies is complex, supporters of monetary union have long argued that statutory central bank independence and credible restraints on fiscal policies would provide an adequate framework for the European Central Bank to deliver the benefits of low inflation and monetary integration[2]. The failure of the Stability and Growth Pact to enforce fiscal discipline has, according to some economists[3], led the ECB to violate the spirit, if not the letter, of the prohibition of bailouts in the Maastricht Treaty.

European public finances are in dire straits, and the rudimentary EU structural funds and the newly created European Financial Stability Fund (EFSF) and European Stability Mechanism (ESM) are inadequate to bail out all the governments with severe debt sustainability problems. Fears of default and shrinking liquidity have led to sharp increases in the interest rates prevailing on several governments' marketable debt. As a result, the ECB has purchased in secondary markets[4] large amounts of the government debt of some highly indebted euro zone countries — including Greece, Ireland, Italy, Portugal, and Spain. By lowering their borrowing costs, it hopes to make their debt more sustainable and avoid a default. Default would endanger the solvency of commercial banks in the euro zone, which hold large amounts of the debts of these countries, and the fiscal authorities of all the euro zone countries would then face further large expenditures required to recapitalize their banks. While Greece has imposed a haircut on holders of its debt, the impact on euro zone banks is manageable, given Greece's relatively modest size; default by Spain or Italy would have much more severe consequences.

The extraordinary measures taken by the ECB to purchase debt of the crisis countries have raised concerns that monetary policy may be influenced by the financing needs of highly-indebted countries[5]. While the ECB has made clear that it intends to cease the extraordinary measures it has undertaken[6], and the EFSF and ESM have been set up to take its place, there is doubt about the effectiveness of those institutions, given their limited resources. Others have pointed to imbalances in payments between the ECB and national central banks as a hidden bailout, since the ECB has accumulated large claims on banks in the weaker members of the Eurozone[7]. The size of the ECB's exposure increased considerably with the introduction of Long-Term Refinancing Operation (LTRO) three-year, low-interest-rate credits to banks.

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2. For a retrospective look at the debates on the design of the ECB and the euro zone, see Wyplosz (2006).

3. Notably, Axel Weber, then President of the Bundesbank, called for an early end to the ECB's bond purchases ("ECB's Trichet rejects Weber's call to end bond purchase program", Bloomberg, October 17, 2010.

4. Thus getting around the prohibition in Article 21 of the ECB's Statutes against purchasing debt directly from government entities. However, the distinction here is nearly meaningless, since purchasing debt in secondary markets also influences the cost of debt issuance in primary markets — which seems to be the real purpose of the ECB's actions.

5. See, for instance, Kenneth Rogoff, "A gravity test for the euro", Project Syndicate, November 2, 2011, which suggests that inflation may be needed to recapitalize the ECB if it suffers losses on its sovereign debt portfolio (http://www.project-syndicate.org/commentary/a-gravity-test-for-the-euro).

6. See, for instance, "Trichet rejects ECB role as lender of last resort", *Financial Times*, October 4, 2011.

7. Hans-Werner Sinn, "The ECB's stealth bailout", VoxEU, June 1, 2011, http://www.voxeu.org/index.php?q=node/6599.

Pressures to provide direct or indirect monetary financing to governments may undermine ECB independence in the future, especially since the banks themselves are heavily exposed to euro-zone sovereign debt. ECB executive board member Juergen Stark is reported to have resigned as a protest against the ECB's program of bond purchases of government debt, stating in an interview that "the political pressure on the ECB is enormous at the moment".[8] He went on to say "There is an open discussion about extending our mission. This not only affects our independence, it threatens it".[9]

Central bank independence requires political support to be effective, and the euro zone suffers from the lack of other aspects of integration that would provide that support-strong regional political institutions or fiscal federalism. As mentioned above, the ECB was to be insulated from financing governments by statute, and the pressures on it were in addition to be minimized by effective controls on fiscal policies, but the latter have failed[10]. As the only EU institution with the power to act swiftly and with substantial financial resources, the ECB was necessarily at the center of policy responses to recent financial turmoil. Moreover, Paul De Grauwe has argued that the very architecture of the euro zone requires the ECB to become a lender of last resort to governments (and not just banks): because countries are borrowing in "foreign" currencies (that is, they no longer can rely on liquidity provided by the national central bank if needed to redeem their debt), self-fulfilling debt crises are more likely. The central bank, by promising to provide liquidity in these cases, could prevent such debt crises from occurring — just as national central banks prevent bank runs (De Grauwe, 2011).

In this paper, we explore what the polar case of absence of central bank independence might mean for the survival of the euro zone. The intention in doing so is to highlight the dangers of ECB bailouts. Using a model (Debrun *et al.*, 2005; 2011) in which the central bank's decisions are purely the result of weighing together national objectives — objectives that include both financing government spending and stimulating output as well as keeping inflation low — we consider what would constitute a sustainable composition for the euro zone. In particular, the set of countries depends on incentives for euro zone members to remain in the monetary union — and for the others to want to keep them in. In this model, fiscal asymmetries are very important in determining the composition of a sustainable monetary union: a country with weak fiscal discipline would want to join a monetary union that is (somewhat) more disciplined than itself, because the union delivers lower inflation, but not if the disparity is too great (since in that case the country loses too much in monetary financing). Conversely, countries that exhibit a degree of fiscal discipline would not want to have as member a country whose financing needs are too great, since this would put upward pressure on the union's inflation rate. The model also includes the benefits of a common currency as well as the usual costs that result from optimum-currency-area shock asymmetries.

8. "ECB independence threatened by government pressure", Reuters, November 26, 2011.

9. Interview with the *Frankfurter Allgemeine Zeitung*, cited in http://www.creditwritedowns.com/2011/11/juergen-stark-on-ecb-inflation-monetisation.html

10. In December, 2011, euro zone countries agreed to amend the Stability and Growth Pact by applying sanctions should a country's cyclically adjusted fiscal position go into deficit, but it is as yet unclear how this would be implemented.

In evaluating the degree of fiscal discipline, two components need to be taken into account: the government's overall spending objectives, on the one hand, and an additional amount that represents both wasteful government spending (such as outright corruption) and inefficiencies in tax collection, on the other hand. The model we use calculates the overall financing need as the sum of these two components, and the composite variable provides a measure of the pressure on the central bank to increase inflation. The euro zone at present differs greatly in the extent of fiscal discipline due to both components. Greece, for instance, has high spending commitments to its public employees because of generous benefits, while at the same time suffering from inefficient tax collection. An important part of the paper will be to estimate the asymmetries in these financing needs.

The paper provides welfare calculations using a calibrated version of the model, where welfare is assumed to depend on keeping inflation and taxes low, attaining targets for productive government expenditure, and increasing output. For each country, two cases will be considered: remaining in the euro zone (whose final composition may remain to be determined), and abandoning the union and reintroducing a national currency. At the same time, countries in the euro zone would be given the choice of expulsing a country if this would increase the welfare of the remaining members. This exercise provides insights into what configuration of countries may constitute a stable core that would be sustainable, assuming that the current political framework for the euro zone remains in place, but that the ECB is unable to maintain independence from national government budget constraints.

An important issue concerns whether some countries — in particular Germany — can guarantee the independence of their central bank, or indeed, of a narrow regional central bank that is formed around Germany and shares that independence with respect to the fiscal authorities. The controversy over current ECB policies largely reflects the unhappiness of the German government with bailouts, and a smaller euro zone with more disciplined members might be able to reestablish ECB independence. We thus consider what possible configurations might be consistent with such an independent, inflation targeting central bank.

The plan of the paper is as follows. Section 2 provides a short summary of a model of a dependent central bank, which is compared to a simple model of an inflation-targeting (IT), independent central bank that does not internalize government borrowing constraints. Section 3 deals with calibration to the euro zone — which until recently has behaved much as an independent IT central bank. Section 4 focuses on fiscal asymmetries among euro zone members. Section 5 provides welfare comparisons for individual euro zone countries of remaining in the monetary union versus reintroducing their own currencies and once again having their own monetary policies — independent or not from the fiscal authorities. In addition, an assessment is made of whether the welfare of the remaining euro zone members would be increased by that country's departure. Special attention is given to Germany, given the proven track record of the Bundesbank to deliver on a commitment to low inflation, its independence, and public support for its uncompromising position. Section 6 provides some conclusions and caveats.

2. A MODEL OF A DEPENDENT REGIONAL CENTRAL BANK

Much has been written on the credibility of central banks' commitment to low inflation. It is now generally accepted that an independent central bank — with instrument independence, but not necessarily the independence to set its own goals — is best placed to achieve a rate of inflation that approaches society's optimum level (Debelle and Fischer, 1994). That level may be zero or even negative (Friedman, 1969), while central banks that are forced by fiscal dominance to finance government budgets are likely to produce sub-optimally high inflation. A further, and related, question is whether even independent central banks can pre-commit not to use monetary policy to stimulate economic activity. Such a policy is self-defeating, since a systematic attempt to do so is built into the expectations of the private sector, and the monetary stimulus therefore has little or no effect.

The interaction between monetary and fiscal policy is made even more complicated in a common currency area grouping countries with independent fiscal policies but facing a single monetary policy decided by a supra-national central bank[11]. Fears that the monetary union would create perverse externalities for fiscal policies and free-riding behavior led the European Union to institute fiscal criteria for public deficits and debt as preconditions for membership, and to require members of EMU to subscribe to the Stability and Growth Pact (SGP) with potential penalties for those that did not comply with its provisions. In practice, there have been numerous cases of countries (including Germany and France) exceeding the 3 percent of GDP fiscal deficit ceiling and the 60 percent public-debt-to-GDP ratio, but penalties were never assessed, and the SGP was weakened in 2005. At the initiative of the German government, a reinforced SGP was agreed in December, 2011, but at time of writing it had not been ratified by euro zone members and its effectiveness remained to be demonstrated.

In this paper, we study the consequences for the euro zone of the European Central Bank internalizing the budget constraints of member governments — that is, becoming a *dependent central bank* in our terminology. Such an outcome would have seemed almost inconceivable a few years ago; after all, the Maastricht Treaty explicitly ruled out monetary financing of government budgets (Article 123 of the Treaty on the Functioning of the European Union), and bailing out countries in trouble[12] (Article 125). However, recent events discussed above have shown that loss of ECB independence is now an all-too-real possibility.

While independent central banks have been extensively modeled — in particular those targeting inflation[13] — the operation of a dependent regional central bank in the European

11. For a recent survey of the extensive academic literature on this subject, most of which addresses the European context, see Beetsma and Giuliodori (2010).

12. "The Union shall not be liable for or assume the commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of any Member State, without prejudice to mutual financial guarantees for the joint execution of a specific project. A Member State shall not be liable for or assume the commitments of central governments, regional, local or other public authorities, other bodies governed by public law, or public undertakings of another Member State, without prejudice to mutual financial guarantees for the joint execution of a specific project". (Article 123.1 of the Treaty on the Functioning of the European Union)

13. See for instance Svensson (1999; 2000), Bernanke *et al.* (1999), and Clarida, Galí, and Gertler (1999).

context has not so far received attention. To date, pressures to finance government deficits have been thought mainly to be the lot of central banks in Africa or Latin America. The implications of internalizing governments' budget constraints in the context of African regional monetary integration have been studied by Debrun *et al.* (2005, 2008, 2011), and Masson and Pattillo (2005). Clear criteria emerge for the composition of monetary unions that are both desirable and feasible; that is, both the country joining should improve its welfare by doing so, and the existing members should be willing to accept it as a member. In addition to the usual OCA consideration that shocks should not be too asymmetric, fiscal discipline (*i.e.*, financing needs) should not differ too radically. Countries would like to be members of a monetary union with countries that do not require much larger financing (as a proportion of GDP) than themselves — and ideally somewhat less. Nevertheless, a monetary union may be attractive when compared to independent currencies because by internalizing trade within a common monetary area, the temptation to produce counter-productive monetary stimulus is reduced (since exchange rate depreciation can occur only with respect to countries outside the monetary union). It is assumed that neither the national nor the regional central bank can pre-commit not to provide that monetary stimulus and hence the first-best outcome cannot be attained.

Specifically, national central banks are assumed to reflect the same objectives as the government (and society), namely targeting useful government spending, keeping taxes low, minimizing the deviations of inflation around its target, and increasing output. The government (including the central bank) of country *i* is assumed to maximize utility U_i^G given by

$$U_i^G = \tfrac{1}{2}\left\{-\alpha\left(\pi_i - \tilde{\pi}(\varepsilon_i)\right)^2 - b\tau_i^2 - \gamma\left(g_i - \tilde{g}_i\right)^2\right\} + y_i \qquad (1)$$

The linear term in output is analytically convenient, and has the same effect as targeting a level of output that is greater than the "natural rate" in Barro and Gordon (1983). The central bank's policy instrument is assumed to be inflation π_i. The objective for inflation reflects a stabilization motive: a negative supply shock ε_i leads to a temporarily higher target for inflation. We parameterize this by making the inflation target inversely proportional to the output shock:

$$\tilde{\pi}(\varepsilon_i) = -\eta\varepsilon_i \qquad (2)$$

The fact that the central bank internalizes the financing needs of the government leads to higher inflation, since optimal policy involves equalizing the marginal costs of raising taxes and inflation. In addition to productive spending needs, the government also engages in wasteful spending δ, linked to corruption and rewarding of supporters, as well inefficiencies in tax collection that add to financing needs. Thus, the government's budget constraint (all terms are ratios to GDP) can be written as

$$g_i = \mu\pi_i + \tau_i - \delta_i \qquad (3)$$

where useful (*i.e.*, welfare inducing) government spending g_i is financed by seigniorage $\mu\pi_i$ (where μ is the base for the inflation tax, assumed to be a common parameter across countries) and taxes τ_i, respectively, and reduced by wasteful spending and diversion δ_i.

The model is built around a Barro-Gordon supply equation (Barro and Gordon, 1983), as modified by Alesina and Tabellini (1987) to include the negative effects of taxes, and extended to the open economy following Martin (1995). The log of output *y* depends on inflation surprises both at home and (with negative transmission) abroad, the latter depending on the strength of bilateral trade ties between the home country *i* and partner country *k:*

$$y_i = c(\pi_i - \pi_i^e - \tau_i) - \sum_{k \neq i, k=1}^{n} \theta_{i,k} c(\pi_k - \pi_k^e) + \varepsilon_i \qquad (4)$$

Monetary expansion is negatively transmitted abroad under flexible exchange rates because it leads to a fall in the real wage, making production more competitive at home relative to that abroad; the magnitude of this effect depends on the extent of trade. In justifying this effect, Martin (1995) points to the production decisions of multinational firms with operations in many European countries; they choose to increase production in their plants with the lowest real wage costs[14].

The central bank sets monetary policy to maximize (1) with respect to inflation, subject to Equations (2)-(4). It chooses inflation after observing the shock to output. Since it acts after private sector expectations are formed, it has an incentive to produce monetary surprises to moderate the effect of supply shocks. In the open economy, this has spillover effects on other countries as well, provided countries do not use the same currency and hence cannot change their bilateral exchange rate. The government maximizes (1) with respect to taxes and government spending, linked by the budget constraint (3).

The Nash equilibrium, found by solving the first order conditions together, gives an intuitive explanation of monetary and fiscal policies when the central bank is not independent. Optimal inflation π_i^* and taxes τ_i^* can be written in this context in terms of *Financing Need* ($FN_i = \tilde{g}_i + \delta_i$) which includes both legitimate spending objectives and wasteful spending/ tax diversion. Both policy variables also depend on the shock to output:

$$\pi_i^* = \frac{\gamma\mu b}{\Lambda} FN_i + \frac{(b+\gamma)+\gamma\mu}{\Lambda} c - \frac{a(b+\gamma)\eta}{\Lambda} \varepsilon_i \qquad (5)$$

$$\tau_i^* = \frac{\gamma a}{\Lambda} FN_i + \frac{\gamma\mu(1+\mu)+a}{\Lambda} c + \frac{a\gamma\mu\eta}{\Lambda} \varepsilon_i \qquad (6)$$

where all parameters are assumed to be positive and $\Lambda = a(b+\gamma) + \gamma\mu^2 b > 0$. As can be seen from the first term of Equation (5), the central bank partially accommodates the financing needs of the government. The second term also contributes to raising inflation because of the inability to pre-commit. The third term embodies the use of monetary policy to offset (partially) output shocks. The reduced form for taxes also embodies the financing motive, but given positive inflation and hence seigniorage, taxes can be lower than they

14. In the African context, a more plausible explanation may be that congestion in regional transportation networks means that domestic stimulus bids away intermediate inputs from other countries; see Debrun *et al.* (2005).

would otherwise be. The third term again allows for the effect of inflation on government financing, given monetary policy's stabilization role[15].

When used to analyze currency unions, this simple model also produces some insights that extend those of the usual OCA model. The regional central bank is also assumed not to be independent of the governments of member countries: it internalizes the budget constraints of the governments weighted together according to their relative economic size ϖ_i. It maximizes

$$U_{MU} = \sum_{i \in MU} \varpi_i U_i^G \tag{7}$$

with respect to the common rate of inflation, subject to the same constraints as before. However, the fact that there are several governments facing a single central bank affords the latter a measure of independence from countries taken individually. This in itself reduces the bias toward excessive inflation. The central bank of a grouping of countries has less of an incentive to stimulate the economy through higher inflation to the extent that it internalizes a larger proportion of the region's trade. Optimal inflation in this case is given by

$$\pi_i^* = \frac{\gamma\mu b}{\Lambda} FN_{MU} + \frac{(1-\theta_{MU})(b+\gamma)+\gamma\mu}{\Lambda} c - \frac{a(b+\gamma)\eta}{\Lambda} \varepsilon_{MU} \tag{8}$$

with the *MU* subscript indicating ϖ_i — weighted averages. This solution (which embodies the same optimization as before by governments when they set fiscal policies, taking inflation as given) has the same form as (5), with two differences: both financing needs and the shock are now averaged over all countries in the monetary union, while the bias term is reduced by the amount of trade internalized in the monetary union, θ_{MU}. The latter reflects the reduced temptation to stimulate output since the scope for beggar-thy-neighbor expansion at the expense of trading partners is reduced.

The fact that the central bank reflects the average financing need of member countries in its decision making (as well as the average shock) means that the fiscal discipline of potential members of a monetary union becomes very important. A comparison of the expected gain in welfare for a given country *i* of being a member versus having its own currency gives the following:

$$E_{-1}G_i = \frac{\theta_A(2-\theta_{MU})(b+\gamma)}{2\Lambda} c^2 + \frac{\gamma\mu b(1-\psi_i)FN_i}{\Lambda}\left[(1-\theta_{MU})c - \frac{\gamma\mu b(1-\psi_i)FN_i}{2(b+\gamma)}\right] - \frac{a^2\eta^2(b+\gamma)(1-\omega_i)^2}{2\Lambda}\left[\sigma_{\varepsilon_i}^2 + \sigma_{\bar{\varepsilon}_{-i}}^2 - 2\,\mathrm{cov}(\varepsilon_i, \bar{\varepsilon}_{-i})\right] \tag{9}$$

where $\Psi_i = FN_{MU}/FN_i$ is a measure of the fiscal asymmetry of country *i* compared to the other members. The first term measures the increase in welfare due to the reduced temptation to inflate, because some of the effects are internalized; this is referred to below as the "monetary externality" term. The second term captures the effects of fiscal asymmetries on welfare; and the last term reflects the reduction in welfare due to shock asymmetries ($\bar{\varepsilon}_{-i}$ is the average shock in the monetary union, excluding country *i*).

15. This framework, though not dynamic and hence not suitable to explain the time series evolution of inflation, provides a reasonable explanation of the cross-sectional variations in inflation rates when calibrated to African data (Debrun *et al.*, 2011).

The second term is ambiguous in sign: each country would like to import fiscal discipline, that is, be part of a monetary union with somewhat lower average financing needs than its own; however, too much fiscal discipline would reduce its share of seigniorage too greatly, so there is a tradeoff here. This feature has a certain amount of relevance to the euro zone also, as the current crisis illustrates.

The dependent central bank model can be contrasted with a simple model of an independent IT central bank. Here, we once again assume that the monetary authorities cannot pre-commit not to use monetary stimulus to raise output above its "natural rate". However, they do not internalize the government's budget constraint, so that their objective function includes only inflation and output:

$$U_i^{IT} = \frac{1}{2}\{-a(\pi_i - \tilde{\pi}(\varepsilon_i))^2\} + y_i \tag{10}$$

Optimal policy for an IT central bank is simply to target a mean inflation rate of c/a, reflecting the desire to stimulate output (the equivalent of k in the Barro-Gordon formulation, which in their model measures the attempt of the central bank to offset distortions in the economy that imply that the natural rate is too low), plus a term that involves offsetting shocks to output. Thus,

$$\pi_i^{IT} = \frac{c}{a} - \eta\varepsilon_i \tag{11}$$

A central bank in a monetary union again would maximize a GDP-weighted average of this objective function, so would target overall inflation and output of the union — and hence respond to the average shock — but would also have a reduced temptation to stimulate the economy because of the amount of trade internalized:

$$\pi_{MU}^{IT} = (1 - \theta_{MU})\frac{c}{a} - \eta\varepsilon_{MU} \tag{12}$$

Thus, the relevant criterion for joining a monetary union if central banks can commit to IT (including that of the union itself) involves weighing just two elements: the monetary externality versus the inability to respond to country-specific shocks. The fiscal asymmetry would not affect the attractiveness of potential monetary union partners, since the central bank does not internalize government budget constraints. In what follows, however, we evaluate Germany's incentive to remain in the euro zone versus having an autonomous, independent monetary policy using society's welfare function, Equation (1), not the more restricted objective Function (10) assigned to the Bundesbank. The decomposition presented above (Equation (9)) is no longer possible in this case, since the expressions for inflation rates no longer have the same form.

3. Calibration of the model to the euro zone

In this section, we describe the calibration of the model to the euro zone. In particular, the model requires estimates of output supply shocks, seigniorage, and the extent of bilateral trade among euro zone members. In addition, the weights given to deviations of inflation,

taxes, and government spending from targets are estimated such as to be consistent with the euro zone's average values for key variables and those of countries before they joined.

3.1. Shock asymmetries

In order to estimate shock asymmetries, we use a Blanchard-Quah[16] (BQ) identification of output supply shocks in a two-variable structural VAR, with dependent variables being the change in the log of real GDP and the change in the log of the GDP deflator. The long-run effect of demand shocks was constrained not to have any effect on real output; this identification restriction is consistent with our output Equation (4), which reflects only the effect of supply shocks. Estimates were obtained with four lags[17] using SVAR in Stata, on non-seasonally-adjusted quarterly data from 1999 to 2010 (or shorter period when not available). Table 1 gives the estimated standard deviations of the supply shocks, while Table 2 presents the correlations among the shocks for euro zone countries.

Table 1 – Euro zone: Standard deviation of annualized output growth, inflation and supply
Rates of growt and shocks, 2000Q1-2010Q4

	Output growth[1]	Supply shock[2]	Inflation rate[1]
Austria	2.74	1.07	0.25
Belgium	2.72	1.93	0.51
Cyprus	2.80	2.26	11.98
Estonia	9.29	6.21	3.19
Finland	5.35	4.69	0.96
France	2.23	1.57	0.40
Germany	3.62	3.30	0.49
Greece	5.48	3.83	1.22
Ireland	8.04	6.39	2.71
Italy	3.01	2.06	0.82
Luxembourg	16.16	7.51	4.52
Malta	6.88	6.33	9.66
Netherlands	2.80	2.14	0.99
Portugal	3.44	2.84	0.87
Slovakia	7.24	6.11	2.16
Slovenia	6.40	5.56	1.89
Spain	2.67	0.80	0.62
Euro zone	2.65	1.80	0.83

1. 400 times quarterly change in the log of GDP and in the log of the GDP deflator.

2. Residuals from Blanchard-Quah decompositions, multiplied by 400.

Sources: Eurostat data, and author's calculation of supply shocks.

16. Blanchard and Quah (1989), as modified by Bayoumi and Eichengreen (1992) to identify the standard deviation of the shocks.

17. Four lags were included to account for seasonality. AIC and SBIC tests indicated that there was no need to include additional lags.

As for correlations, they are typically around 0.5 or higher for core Western European countries, but are lower for some of the smaller and newer EU members. Greece stands out as having several negative correlations, as well as having only small positive correlations with a number of other euro zone participants.

Table 2 – Euro-Zone: Correlation of supply shocks (%)

	Austria	Belgium	Cyprus	Estonia	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Malta	Netherlands	Portugal	Slovakia	Slovenia	Spain
Austria	100.0																
Belgium	55.2	100.0															
Cyprus	18.6	15.1	100.0														
Estonia	23.1	33.5	34.4	100.0													
Finland	42.2	60.7	40.7	58.9	100.0												
France	37.5	41.8	38.0	43.5	60.5	100.0											
Germany	44.4	59.2	27.6	38.7	67.7	59.1	100.0										
Greece	–15.8	–6.0	20.9	23.3	11.9	17.4	7.4	100.0									
Ireland	21.9	20.1	35.8	39.7	27.2	30.8	23.5	6.7	100.0								
Italy	56.5	52.0	18.4	27.6	59.0	63.3	72.8	6.8	20.2	100.0							
Luxembourg	30.6	47.8	23.5	49.6	41.5	30.6	52.6	–13.1	14.3	48.0	100.0						
Malta	14.2	25.7	35.4	–3.5	27.0	39.3	29.9	–17.2	20.3	16.4	12.2	100.0					
Netherlands	32.1	27.0	28.3	48.3	52.1	50.7	58.0	26.4	21.2	44.6	38.6	21.7	100.0				
Portugal	36.1	33.8	17.5	37.2	52.7	36.0	52.3	–1.9	31.9	53.6	42.0	25.6	51.5	100.0			
Slovakia	18.4	21.8	25.8	29.3	29.5	5.6	36.4	13.3	26.4	10.9	22.3	6.0	40.3	32.6	100.0		
Slovenia	20.1	53.4	43.3	32.2	80.1	56.6	67.8	18.3	21.9	57.8	28.1	47.0	46.4	52.4	26.6	100.0	
Spain	52.8	36.3	28.5	40.3	39.7	30.5	32.3	–6.8	18.4	25.5	32.2	10.7	39.7	35.9	36.6	26.0	100.0

Source: author's calculations.

3.2. Base for the inflation tax

Though we refer to the direct effect of inflation on the government's budget constraint as seigniorage, in fact what we want is the total impact of higher inflation in financing the government. The tax rate τ in our model is assumed to be a proportional tax on income (and τ is constant for given *Financing Needs* and shocks to output, whatever the rate of inflation). In practice, tax revenues as a ratio to nominal GDP tend to increase with inflation for two principal reasons: with a progressive personal income tax system, bracket creep leads to higher marginal and average tax rates (Bailey, 1976); and in a corporate tax system in

which depreciation allowances are based on historical costs, effective tax rates rise with inflation (Nichols, 1968). Thus, to the extent that tax brackets and depreciation allowances are not fully indexed, the tax take will tend to increase with inflation[18].

The cost of servicing bonds with fixed nominal coupons will also decline as a ratio to GDP, but this is only true if the higher inflation was unanticipated. More complicated to estimate is the possible link between bailing out governments by buying their securities and future inflation. To the extent that bond purchases do not have a cost for the central bank, there would not be implications for its solvency. But if the ECB faced losses from defaults on the sovereign paper that it acquired, it might be led to finance them by higher inflation, increasing its seigniorage and that of the national central banks of the Eurosystem. This issue is not pursued here, however.

The European Central Bank provides estimates of seigniorage, but this is very small. The ECB's 8% share of euro zone seigniorage averaged about 400 million euro per year over 2006-2008 (ECB, 2010). Hence the total seigniorage of the Eurosystem (including both the ECB's share and the remaining 92% share divided among the national central banks) is about 5 billion euros. If we relate this to the euro zone's average annual GDP over this period (about 12,180 billion euros), seigniorage is thus only about 0.04 percent of GDP. Since actual inflation averaged 2.5 percent, if seigniorage were proportional to inflation the factor of proportionality μ would equal 0.016.

A much larger potential effect results from the non-indexation of the personal and corporate tax systems, described above. While at present we do not have detailed estimates for euro zone countries, what evidence that exists suggests that they could be sizeable. For instance, a study of the evolution of wage tax wedges over 2001-06 estimates that fiscal drag contributed to raising them by an average of about 2 percentage points in euro zone countries (OECD, 2007). Since cumulative nominal income growth[19] in the euro zone was about 10 percent over that period, the marginal effect seems to average about one fifth. As for the effect on corporate taxes, data are hard to obtain, but Feldstein (1981) estimated that the effect of an 8 percent expected inflation rate would be to raise the real net cost of an equipment investment with a 13 year tax life by 21 percent if the firm used a 4 percent real discount rate, due to a decline in the real value of depreciation allowances.

In our preliminary simulations of monetary unions in Europe we use a figure of 0.25 for the combined effect of euro zone inflation on increased financing of government budgets: that is, one percentage point increase in inflation increases the ratio of taxes to GDP by one-quarter of a percentage point.

18. This is quite separate from the Oliveira-Tanzi effect (Tanzi, 1977), which suggests that the real value of tax receipts declines with inflation, as there is a lag between the establishment of the tax liability and the actual payment of taxes. This effect is likely to be significant only at high rates of inflation, unless collection lags are very long.

19. Fiscal drag results from both inflation and real growth.

3.3. Euro zone trade

An important component of the estimated gain from a monetary union is the reduced temptation to engineer inflation surprises and thus stimulate output. In the model, this reduced temptation is related to the amount of trade internalized in the monetary union. Thus, countries will be more apt to welcome as member of the monetary union a country which trades a lot with existing members. TABLE 3 gives the fraction of each euro zone member's total exports accounted for by other euro zone countries, as well as the ratio of each country's total trade to its GDP.

Table 3 – Euro Zone Merchandise Trade, 2008

	Total Exports/GDP (% of GDP)	Exports to euro area (% of total)
Austria	43.62	53.81
Belgium	93.52	63.49
Cyprus	6.44	37.85
Estonia	52.62	31.51
Finland	35.63	32.32
France	21.71	49.69
Germany	39.69	42.76
Greece	7.62	44.17
Ireland	47.43	40.78
Italy	23.40	44.21
Luxembourg	43.76	72.07
Malta	34.25	35.62
Netherlands	73.00	62.39
Portugal	22.67	64.75
Slovak Republic	75.03	48.35
Slovenia	62.41	50.90
Spain	17.55	56.37

Sources: IMF Direction of Trade Statistics and International Financial Statistics.

Most euro zone countries are very open, with a high ratio of total exports to GDP. Notable exceptions are Greece and Cyprus, and to a lesser extent, Spain. Moreover, much of that trade is with other euro zone countries — over 40 percent except for peripheral countries such as Cyprus, Estonia, Finland, and Malta.

3.4. Behavioural parameters

The model has been adapted to the euro zone to reflect EU trade patterns and shock correlations, as well as estimated fiscal demands on the central bank (see next section). Parameters c and η were derived from the BQ decomposition to make observed variances of output and inflation relative to estimated supply shocks consistent with the responses

predicted by our output supply equation and the first order condition for optimal inflation. In addition, we chose the weights a, b, γ to reflect the average data for inflation, taxes, and government spending. We use both the experience of the euro zone, assumed to be the result of inflation targeting by an independent central bank, and the data for a dependent central bank such as Italy's in the 1980s.

In particular, an independent central bank that did not internalize the government's budget but simply targeted inflation and output would produce an average inflation rate equal to c/a for a single country's central bank and $c(1-\theta_{MU})/a$ for a regional central bank. Using a figure of 2.5 percent for average inflation in the euro zone over its first decade, and the estimate for $c=2.208$ based on the variance of the euro area's output, gives a value for a of

$$a = c(1-\theta_{MU})/2.5 = 2.208(1-0.1712)/2.5 = 0.7319$$

As for η, it is calibrated based on the variance of inflation attributed to supply shocks by the BQ decomposition relative to the variance of supply shocks. An inflation targeting independent central bank would produce a standard deviation of inflation equal to η times the standard deviation of the average euro zone supply shock. The standard deviation of euro zone annualized inflation is 0.84, and 40 percent of the long-run variance of euro zone inflation is attributed to supply shocks by the BQ estimation. Since the central bank in the model only responds to the latter, this gives

$$\eta = \sqrt{.4}\, stdev(\pi)/stdev(\varepsilon) = (0.632)(0.84)/1.80 = 0.29515$$

The experience of non-independent central banks is needed to calibrate b and γ. As a rough stylized fact, average values for inflation, tax rates, and financing need equal to 10, 50, and 52.5 — based on Italy's experience in the 1970s and 1980s — were used to calibrate their values, conditional on the other estimates given above.

The resulting parameter estimates used in the simulations are as follows:

Parameter	Value
a	0.7319
b	0.1565
c	2.2079
η	0.29515
γ	4.0089
μ	0.25
Λ	3.0880
Θ_A	0.1712

It is not being claimed that this model captures all the features that are relevant for monetary policy in Europe. The model is not dynamic, and is thus not well adapted to explain the time series variations of inflation or of government debt accumulation. It is of interest, however, to

see how such a simple framework may shed light on the possible forces at work as the euro zone faces attacks on its integrity and speculation about its disintegration or the expulsion of certain members.

4. Fiscal asymmetries

The model identifies an important structural variable, which we call *financing need* (*FN*), which measures the pressure each country exerts on the monetary union's central bank to provide monetary financing. This variable has two components: the country's fiscal target for useful government spending, and a wedge in the government's budget constraint between government spending and tax and seigniorage revenues. This wedge results from inefficiencies in tax collection and wasteful spending that does not contribute to society's welfare — *e.g.*, outright corruption by public officials and rewarding of government supporters.

The two components of FN_i for each country i consist of society's target for government spending, $\tilde{g}_i$, and a diversion wedge δ_i. We regress aggregate government revenues and expenditures on governance indicators to gauge directly what amounts of excess spending and tax losses are due to poor governance. We then set the governance indicators to their "ideal" levels: the resulting figure for ideal government spending gives the estimate for $\tilde{g}_i$, and the difference between the ideal and actual figures for the deficit provides the estimate for δ_i. Thus,

$$FN_i = \tilde{g}_i + \delta_i = g_i \big| ideal + (\tau_i - g_i) \big| ideal - (\tau_i - g_i)$$

This can be further simplified as follows:

$$F_i = \tilde{g} + \delta_i = \tau_i \big| ideal - (\tau_i - g_i) = (\tau_i \big| ideal - \tau_i) + g_i \qquad (13)$$

Thus, we use the difference between ideal and actual tax revenues plus the actual government spending to compute financing need.

The effects of poor governance were captured using International Country Risk Guide indicators for the 27 EU countries and dates for which they and the other explanatory variables were available (PRS Group, 2011). For some of the 2005 accession countries, data begin in 2000; we also wanted to exclude the data from the depth of the recent crisis with its large, and hopefully temporary, widening of deficits. Therefore, we used an eight-year average (2001-08), and assumed that this captured long-run, sustainable levels for the components of *FN*.

Some experimentation was done to find those indicators with significant effects on revenues; only governance indicators at the 5 percent level were retained. We also controlled for per capita income since revenues and expenditures seem to depend systematically on that variable. However, the relationship is not monotonic, hence we also included per capita income squared. Per capita income is assumed to affect revenues and expenditures equally, hence to have no systematic effect on the deficit. Seemingly unrelated regression (SUR)

was used to estimate equations for revenues and the fiscal position expressed as ratios to GDP. Per capita income *(YPC)* is expressed in U.S. dollars, while the governance indicators are indexes ranging from 0 to 6 — for *corruption* and democratic accountability (*dem_account*) —with in each case higher values indicating better governance. *YPCSQ* is per capita income squared. The results of estimation are given below.

Table 4 – Cross Section Estimation, Seemingly Unrelated Regressions (all EU countries, averages 2001-08)

	Equation	Observations	Parameters	RMSE	R-sq	chi2
(1)	Revenues/GDP	27	3	4.15299	0.5804	36.81
(2)	Fiscal position/GDP	27	2	1.924414	0.4169	19.99

		Coefficient	Std. Error	z	P>z
(1)	Revenues/GDP				
	YPC	0.2892	0.1786	1.62	0.105
	YPCSQ	–3.36E–03	1.82E–03	–1.85	0.064
	corruption	3.19187	1.228976	2.6	0.009
	constant	26.15679	2.931107	8.92	0
(2)	Fiscal position/GDP				
	corruption	1.558015	0.3544836	4.4	0
	dem_account	–2.4707	1.050482	–2.35	0.019
	constant	6.863744	5.664158	1.21	0.226

The system of equations does a reasonably good job in explaining the cross-country variation in general government revenues and fiscal positions. Revenues are positively related to per capita income, but the relationship flattens out with higher income levels, reaching a maximum at a per capita income equal to $43,006 before turning down. Less corruption (a higher value of the variable) increases both revenues and the fiscal position (but the latter by less). Greater democratic accountability reduces the fiscal position; this can be explained in terms of the compromises reflected in the political process and the need to attract voters in order to improve the incumbents' chances of reelection.

We use the SUR estimates of the revenue equation to estimate the "ideal" revenues in Equation (13), which determines the financing need, as follows. We first put all the countries on the same footing by adjusting revenues to what they would be if all countries had the same per capita income as the EU average and ideal values for corruption. Then we add actual government spending.

Thus, using the SUR estimates of Table 4 the financing need is calculated as

$$FN = 0.289(26.98 - YPC) - 3.36 * 10^{-3}(26.98^2 - YPCSQ) + 3.19(6.0 - corruption) + g \quad (14)$$

where *YPC* is in thousands of dollars, *YPSQ* is in millions, and $26,980 is the mean per capita income of EU countries on average over 2001-08.

TABLE 5 reports the calculated values for *FN*, as well as the values of the variables used in the calculation.

It can be seen that several countries have high values of *FN*. In particular, going in descending order, the worst performers among euro zone countries are France, Italy, Greece, and Belgium, while among the non-euro-zone members, Hungary, Poland and the Czech Republic are the highest. Among the euro-zone members, the high financing need in France is due primarily to high government spending as ratio to GDP, while in Italy and Greece, to poor values for corruption.

Table 5 – EU Countries: Fiscal Variables and Per Capita Income (averages, 2001-2008)

Country	FN	YPC	g	corruption
Austria	53.65	$35,728	50.83	4.94
Belgium	56.17	$34,472	49.81	3.84
Bulgaria	52.54	$3,752	35.58	2.00
Cyprus	48.89	$21,826	41.88	4.00
Czech Rep.	57.43	$12,092	44.65	2.71
Denmark	54.43	$45,540	53.40	5.49
Estonia	46.94	$10,291	35.26	3.18
Finland	48.49	$36,470	49.09	6.00
France	60.32	$32,652	52.95	3.55
Germany	50.52	$33,030	46.34	4.53
Greece	57.37	$21,010	45.74	2.59
Hungary	61.82	$10,189	49.65	3.02
Ireland	42.23	$45,409	34.24	3.33
Italy	58.93	$29,096	48.13	2.55
Latvia	52.06	$7,681	36.37	2.10
Lithuania	49.06	$7,706	34.31	2.39
Luxembourg	48.16	$79,009	39.64	5.00
Malta	54.68	$14,567	44.34	3.31
Netherlands	47.95	$38,022	45.73	5.10
Poland	58.47	$8,053	43.51	2.30
Portugal	49.91	$17,515	41.89	3.88
Romania	48.72	$4,693	33.44	2.45
Slovak Rep.	52.05	$11,125	38.90	2.66
Slovenia	52.60	$17,627	42.10	3.10
Spain	46.23	$24,777	39.01	3.82
Sweden	53.37	$39,675	51.62	5.24
United Kingdom	44.27	$35,955	39.82	4.40

Sources: *FN* calculation as described in text; ICRG data used for corruption; IMF International Financial Statistics and World Economic Outlook data for remaining variables.

5. Should the euro zone be shrunk or disbanded?

The model is then applied to the euro zone in order to compare the welfare to existing euro zone members of a smaller monetary union. In turn, the welfare gain or loss for the member who leaves the euro zone is calculated. In each case, as discussed above, several factors come into play: the extent of trade internalized in the monetary union, the size of a country, its financing need, and the asymmetry of its supply shocks when compared to the average for the monetary union. The welfare gains and losses are presented in the following tables, with details concerning the factors mentioned above. In each case welfare is evaluated using Equation (1), with the same parameter values for all countries. It is measured in terms of GDP equivalents: that is, a 1% welfare gain corresponds to the increase in welfare that would result from a permanent increase in GDP of 1%.

Table 6 – Welfare Gain/Loss from Euro zone Membership versus Autonomy, All Central Banks Dependent except for the Bundesbank[1] (In percent of GDP)

Country	GDP share	Shock correlation	FNmu/FN	Welfare gain	Decomposition of welfare gain		
					Monetary externality	Fiscal asymmetry	Shock asymmetry
Austria	3.1%	54.9%	1.00	0.96	1.03	0.01	–0.08
Belgium	3.7%	63.7%	0.95	1.17	1.03	0.28	–0.10
Cyprus	0.2%	37.4%	1.10	0.38	1.03	–0.55	–0.19
Estonia	0.2%	51.3%	1.14	–0.78	1.03	–0.79	–1.15
Finland	2.0%	77.6%	1.11	0.14	1.03	–0.60	–0.39
France	20.9%	76.6%	0.89	1.57	1.03	0.71	–0.05
Germany	26.8%	93.4%	1.06	–2.62	—	—	—
Greece	2.6%	17.1%	0.93	0.64	1.03	0.41	–0.72
Ireland	2.0%	36.7%	1.27	–1.53	1.03	–1.40	–1.38
Italy	17.0%	83.6%	0.91	1.45	1.03	0.57	–0.05
Luxembourg	0.4%	54.8%	1.11	–1.25	1.03	–0.64	–1.75
Malta	0.1%	32.1%	0.98	–0.17	1.03	0.12	–1.30
Netherlands	6.4%	68.0%	1.12	0.39	1.03	–0.66	–0.09
Portugal	1.9%	61.3%	1.07	0.49	1.03	–0.43	–0.19
Slovakia	0.7%	36.1%	1.03	–0.48	1.03	–0.18	–1.36
Slovenia	0.4%	73.4%	1.02	0.27	1.03	–0.11	–0.66
Spain	11.8%	44.0%	1.16	0.20	1.03	–0.88	–0.09

[1] The ECB and national central banks except Germany's are assumed to internalize the government budget constraint; the Bundesbank on its own is assumed to be able to commit to IT.

Source: author's calculations.

If the European Central Bank were not independent, but instead internalized the weighted average budget constraints of member governments, then for some current member countries the euro zone would be worse than having its own currency, even if on their own their central banks would not be independent either. This is the result of considerable differences in financing needs as well as shock asymmetries. The countries with both low shock correlations (with the average shock for the euro zone) and disciplined fiscal policies (such as Estonia, Ireland, and Luxembourg) would unambiguously do better on their own, while smaller losses are experienced by Malta and Slovakia. Both more fiscal discipline and different shocks (it is not just the correlation that matters, but also their size) can help to explain the value of retaining the ability to design their own monetary policy rather than accepting a policy that reflects average conditions in the euro zone.

The rightmost three columns give an approximate decomposition of the welfare gain into three components[20]. This decomposition is based on the formula in Equation (9) above. The first component is the result of internalizing the Barro-Gordon temptation to generate monetary stimulus by depreciation of one's own currency (no longer possible in the euro zone); the second is the effect of fiscal asymmetries (a gain for countries whose fiscal policy is laxer than the average, as indicated by a value of *FNmu/FN* less than one); and the third component is the effect of shock asymmetries. Each of the effects is important, though the third one, which is the standard OCA criterion, dominates for several countries. Perhaps not surprisingly, the largest overall net gainers are France, Italy, and Belgium. They are the only countries, with Greece, to have a significant gain from fiscal asymmetries, as the greater average fiscal discipline of the euro zone means less pressure to produce inflation relative to having their own currencies.

The case of Germany is treated differently. In particular, the historical circumstances of Germany's Bundesbank, which was at the center of the European Monetary System and the initial source of monetary policy credibility of the euro zone, as well as the constitutional protection against monetary financing in Germany, put it in a special position. Unlike other countries' central banks, the Bundesbank is assumed not to be subject to financing pressures on the part of the German government. Therefore, we compare the welfare of Germany in a euro zone having a dependent ECB to its welfare if it had its own currency, managed by an independent IT central bank. We see that under these circumstances Germany would sustain a large gain in welfare by abandoning the euro zone and reintroducing the deutsche mark. The political and administrative costs of leaving the euro zone are not considered here, however, and these would undoubtedly influence any decision to do so. Nevertheless, the welfare calculus highlights the reason why Germany has legitimate concerns about the independence of the ECB and the desirability of maintaining the euro zone in its current form.

The next exercise considers whether the welfare of the remaining countries would be improved by expelling any of the existing members individually. Table 7 summarizes these results; the

20. It is not available for Germany because of the assumption that the Bundesbank targets inflation, making the decomposition not applicable.

difference in welfare for the country leaving can be found in TABLE 6. It can be seen that the departure of France, Greece, or Italy would improve welfare of all of the remaining euro zone countries. The effect of other countries' departures would be negative on all remaining members. Effects are small, however, since each country has only a modest influence on the ECB's policies. The hypothetical departure of Germany would induce the largest welfare losses.

The final exercise revisits the assumption of a dependent central bank for the monetary union. In particular, it could be that a narrower monetary union centered around Germany could also effectively carry out an independent monetary policy, even if the larger euro zone were unable to do so. We therefore assume that the monetary union (whether it was called the euro zone or not) would be able to commit to an IT policy, and would not be subject to pressures to finance governments.

Table 7 – Welfare effects on countries in the Stub of Dropping Countries in the Heading One-bye-One[1]

	Austria	Belgium	Cyprus	Estonia	Finland	France	Germany	Greece	Ireland	Italy	Luxembourg	Malta	Netherlands	Portugal	Slovakia	Slovenia	Spain
Austria		−0.195	−0.002	−0.004	−0.015	0.026	−0.041	0.011	−0.034	0.045	−0.014	−0.001	−0.245	−0.029	−0.020	−0.011	−0.159
Belgium	−0.061		−0.002	−0.004	−0.017	0.033	−0.405	0.012	−0.032	0.047	−0.015	−0.001	−0.229	−0.027	−0.019	−0.012	−0.142
Cyprus	−0.070	−0.210		−0.004	−0.019	0.024	−0.440	0.007	−0.042	0.063	−0.016	−0.002	−0.269	−0.031	−0.023	−0.014	−0.169
Estonia	−0.066	−0.216	0.003		0.032	0.052	−0.494	0.007	−0.053	0.085	−0.022	−0.001	−0.283	−0.034	−0.026	−0.014	−0.151
Finland	−0.065	−0.213	−0.002	−0.005		0.059	−0.517	0.015	−0.039	0.061	−0.018	−0.002	−0.266	−0.033	−0.023	−0.016	−0.137
France	−0.055	−0.166	−0.002	−0.003	−0.014		−0.350	0.007	−0.030	0.042	−0.012	−0.001	−0.212	−0.024	−0.019	−0.011	−0.130
Germany	−0.063	−0.203	−0.002	−0.004	−0.021	0.063		0.016	−0.035	0.056	−0.017	−0.001	−0.255	−0.030	−0.022	−0.014	−0.134
Greece	−0.057	−0.175	−0.002	−0.004	−0.014	0.017	−0.348		−0.031	0.055	−0.011	−0.001	−0.234	−0.024	−0.019	−0.011	−0.139
Ireland	−0.075	−0.234	−0.003	−0.006	−0.023	0.049	−0.499	0.014		0.082	−0.018	−0.002	−0.296	−0.038	−0.028	−0.015	−0.167
Italy	−0.056	−0.171	−0.002	−0.003	−0.015	0.033	−0.387	0.011	−0.029		−0.014	−0.001	−0.215	−0.026	−0.017	−0.011	−0.124
Luxembourg	−0.063	−0.216	−0.002	−0.006	−0.026	0.095	−0.571	0.031	−0.037	0.048		−0.001	−0.267	−0.035	−0.024	−0.014	−0.130
Malta	−0.060	−0.190	−0.003	−0.003	−0.019	0.013	−0.440	0.023	−0.039	0.068	−0.014		−0.238	−0.030	−0.019	−0.015	−0.133
Netherlands	−0.070	−0.213	−0.002	−0.004	−0.019	0.039	−0.469	0.009	−0.037	0.062	−0.017	−0.002		−0.033	−0.023	−0.013	−0.164
Portugal	−0.067	−0.206	−0.002	−0.004	−0.020	0.049	−0.461	0.015	−0.040	0.050	−0.017	−0.002	−0.265		−0.023	−0.014	−0.154
Slovakia	−0.063	−0.197	−0.002	−0.005	−0.021	0.086	−0.486	0.008	−0.044	0.089	−0.017	−0.001	−0.261	−0.033		−0.013	−0.150
Slovenia	−0.055	−0.195	−0.002	−0.004	−0.032	0.063	−0.512	0.012	−0.035	0.055	−0.016	−0.002	−0.243	−0.031	−0.021		−0.113
Spain	−0.076	−0.223	−0.003	−0.004	−0.018	0.028	−0.455	0.011	−0.039	0.060	−0.017	−0.002	−0.283	−0.033	−0.023	−0.013	

[1] ECB assumed to internalize government budget constraints.

Source: author's calculation. Welfare measured in percentage points of GDP.

Three small "Germanic" monetary unions are considered: I) a successor to the "DM zone" composed of Germany, Belgium, the Netherlands, Luxembourg, and Austria (countries whose exchange rates were stable throughout the 1992-93 EMS crisis); II) a wider core group that includes France as well, because France played an integral part in the process of monetary integration; and III) a monetary union including all those countries in the current euro zone that have financing needs that are less than or equal to Germany's (see TABLE 5), namely Cyprus, Estonia, Finland, Germany, Ireland, Luxembourg, the Netherlands, Portugal, and Spain. We compare welfare of the hypothetical member countries of these narrower monetary unions with their welfare both as members of the present euro zone (with a dependent ECB) and as countries reverting to their own currencies — *i.e*, monetary autonomy, but without the ability to precommit to inflation targeting — except for Germany. As before, for Germany the comparison is with an independent Bundesbank. TABLE 8 summarizes those results.

Table 8 – Welfare of "Germanic" Monetary Unions Compared to Actual Euro Zone and to Independent Currencies

	gain with respect to euro zone			gain with respect to autonomy		
	I	II	III	I	II	III
Austria	1.909	1.949		2.905	2.750	
Belgium	1.639	1.650		2.817	2.661	
Cyprus			2.613			2.992
Estonia			2.925			2.146
Finland			2.730			2.875
France		1.126			2.692	
Germany	2.453	2.399	2.503	–0.165	–0.219	–0.115
Ireland			3.461			1.931
Luxembourg	2.819	2.703	2.835	1.567	1.451	1.583
Netherlands	2.660	2.682	2.750	3.047	3.068	3.136
Portugal			2.531			3.016
Spain			2.920			3.124

Source: author's calculations.

Interestingly enough, all of these core monetary unions are better than the euro zone for Germany and for each of the other potential members, and the gains of welfare are sizeable, running from 1.0 to 3.5 percent of GDP. However, none of them is better than autonomy for Germany. The reason is that such a DM-based monetary union, even if it could ensure central bank independence and hence face no fiscal pressures on monetary policy, would still respond not to Germany's shock but to the average of the shocks for the member countries. At the same time, there would be little advantage from internalizing the region's trade on monetary policy because of the narrowness of the region. The net effect would be a small loss for Germany in each case.

6. Conclusions

In sum, the basic model seems to offer considerable support for the fears that the euro zone in its current configuration is at risk, should the ECB effectively become dependent on pressures to finance its member governments. The model, of course, does not perfectly capture the complexity of the current crisis in the euro zone nor the tools at the disposal of the ECB. It could be argued, for instance, that the operations of the ECB in purchasing government bonds need not imply debt monetization and upward pressure on consumer prices, while the model assumes that ECB essentially has a single policy instrument, namely inflation. The traditional lender of last resort role for a central bank in providing liquidity to financial institutions to correct a market failure or prevent an incipient bank run need not interfere with price stability. However, the situation becomes more complicated once the ECB purchases public debt of governments that may become insolvent; if as a result the ECB makes losses and needs to be recapitalized, its independence may be put in jeopardy. The model does not analyse the complex strategic interactions between governments and the central bank that may result. Instead, it explores the consequences of assuming that the ECB might lose its independence and internalize member governments' budget constraints — with the objective of financing governments being weighed against other objectives in a way that is consistent with data for countries like Italy in the 1970s and 1980s.

Should the ECB become a dependent central bank in that sense, the departure of several of the current members with weaker regional ties, and less disciplined fiscal policies, might well be desired by the rest of the member countries. The departure of Greece — a country with fiscal problems, little trade with the rest of the euro zone, and asymmetric supply shocks, would make sense both on its own account and that of other members. The simulations reported here also suggest that two larger countries, Italy and France–both at the center of the European monetary unification project–are also a drag on their more fiscally disciplined colleagues whose welfare would be improved by their departure.

The idea of a narrower monetary union centered around Germany, if it had the ability effectively to carry out an IT policy and resist pressures to internalize government budget constraints, would seem to be an attractive alternative for the more fiscally disciplined members. However, the simulations presented here suggest that this may not be in Germany's interest. Rather than a full monetary union, therefore, a German-led monetary bloc might have the Bundesbank simply set monetary policy on the basis of Germany's needs, and the other countries following[21]. However, this return to the de facto deutsche mark zone of the 1980s and 1990s would be an enormous reverse for European integration that most European politicians as well as the general public would find difficult to accept. Thus, the likeliest outcome of the euro zone crisis may well be only a minor change in the monetary

21. As is the case in the Common Monetary Area, in which the South African Reserve Bank sets monetary policy based on conditions in that country, and Lesotho, Namibia, and Swaziland peg their currencies at a one-to-one parity with the rand and follow South Africa's monetary policy (Masson and Pattillo, 2005).

union's composition, if any, while hopefully addressing the forces that now endanger the central bank's independence.

In particular, the euro zone's institutions need to be strengthened, first, by reinforcing fiscal discipline, and second, by increasing the ability of other facilities than the ECB to provide financial assistance. In addition, creating an area-wide financial supervisor would reinforce confidence in the stability of the banking system, lessening pressures on the ECB's lender of last resort facilities. With luck, the economic and monetary union may emerge from the current crisis strengthened, not destroyed as some have feared.

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