Relinquishing Monetary Policy Independence

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Abstract

I study the macroeconomic costs (both in terms of stabilization and welfare) of the relinquishment of monetary policy independence associated with the membership of a currency area. The analysis is framed within a general equilibrium model of the world economy, composed by a large closed Union and a small (either independent or integrated) open economy. In terms of business cycle stabilization, I find that an economy relinquishing its monetary independence may face a potential trade-off between higher instability in real activity and lower instability in inflation. The tightness of this trade-off is found to be inversely related to the degree of cross-country symmetry of the shocks. In terms of welfare, maintaining the monetary stabilization tool proves to be always welfare improving. Finally, a higher degree of openness does not necessarily make a country a better candidate for participating in a currency area.

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1 Introduction

With the launch of the Euro in January 1999 twelve European countries have decided to relinquish the power of setting their own independent monetary policy. Besides its obvious political implications such a revolutionary arrangement has major consequences on the ability of each member country to stabilize the domestic business cycle in response to asymmetric disturbances. In the traditional literature on Optimum Currency Areas (Mundell(1961), McKinnon (1963)) the degree of (a)symmetry of macroeconomic disturbances with respect to the rest of the area is typically considered critical for the evaluation of the costs of participation to a monetary union. To the extent that shocks tend to hit the members of the union in a symmetric way, giving up the flexibility in the exchange rate has a relatively low cost in terms of stabilization purposes. However, if a member country experiences an idiosyncratic rise in inflation due to an unexpected boom in real activity the constraint imposed by the centralized conduct of monetary policy may represent a major cost both in terms of stabilization and of welfare.

In *Figure 1a* some evidence to illustrate this potential problem is displayed. Ireland is a specific example of a small open economy that experienced a large asymmetric boom in real activity since 1996 along with an upward pressure on inflation. Despite this, in early 1998 nominal interest rates have started to decrease to satisfy the converge process towards the EMU standards. Since late 1999 interest rates have taken an upturn again (due to the overall tightening brought about by the ECB) but evidently not sufficient to induce a cooling in domestic inflation, which has continued to rise until current days. In *Figure 1b* the actual pattern of the interest rates is compared with the one that would have been generated if monetary policy in Ireland could have followed a simple independent Taylor rule. The differential is quite striking starting with late 1999. Clearly a much tighter policy would have been required if Ireland had been able to set its own autonomous policy based on the domestic conditions of the business cycle.

Motivated by this evidence the present paper takes on the simple question: what are the macroeconomic costs of such a policy misalignment in the face of idiosyncratic disturbances?

Recently a large body of empirical literature has tried to assess the extent to which the likelihood of asymmetric shocks is a potential destabilizing factor for the take-off of the Monetary Union in Europe. Bayoumi-Eichengreen (1993, 1996) find that shocks are more idisyncratic across European countries than U.S. regions. Helg et al. (1995), by looking at the decomposition of output at the industry level, find that, on average, more variance of output innovations is explained at the country rather at the industry level, again an indicator of asymmetry in the distribution of shocks. According to Krugman (1993) currency unions, by inducing regional specialization in production, should tend to exacerbate the likelihood of asymmetric shocks. Frankel-Rose (1996), however, argue that the conditions for qualifying as an OCA might rather be endogenous to the evolution of the currency area per se, given the higher degree of policy coordination and trade intensity that the union itself is likely to bring about. Artis-Zhang(1997) and Angeloni-Dedola (1999), in fact, find that cross-correlation of real cycles and inflation have risen in recent years among EMU participants. Yet the case of Ireland discussed above is still an example of the kind of macroeconomic costs a member of a currency area might incur upon relinquishing its monetary policy independence.

In this work I evaluate, in a theoretical model, the costs of relinquishing monetary policy independence from both a stabilization and a welfare standpoint. The latter dimension is typically absent from the traditional OCA literature. In that literature, in fact, it is implicitly assumed that the impossibility of fine tuning the economy in response to asymmetric shocks is a cost almost by definition. But what could be desirable in terms of stabilization purposes (e.g., low volatility of output and inflation) might well not satisfy a simple welfare criterion. My analysis is framed within a general equilibrium model of the world economy, composed by a small open country and by a closed large Monetary Union. The small economy can be either integrated in the Union or being independent. In the first case the leverage on the conduct of monetary policy is abandoned, whereas in the second case the domestic authority can respond to local shocks for stabilization goals. In this latter case, therefore, the nominal exchange rate is free to float in order to facilitate the equilibrium adjustment in relative prices. Key ingredients of the model are a certain degree of rigidity in the adjustment of nominal prices (a necessary condition for the nominal exchange rate to matter for the adjustment of real *relative* prices) and a description of monetary policy in terms of endogenous feed-back rule.

The analysis suggests several interesting results. First, in terms of business cycle stabilization, I find that upon relinquishing its monetary independence an economy may face a potential trade-off between higher instability in real activity (due to the loss of a stabilization tool) and lower instability in inflation, thanks to the gains of resorting to a permanently fixed exchange rate as a nominal anchor. This holds independently of the type of shocks (supply or demand) hitting the economy. The key reason lies in the fact that a regime of permanently *fixed* exchange rates under *asymmetric* shocks displays the particular property of allowing a stabilization of the price level, a feature that the recent literature on monetary policy in closed economy has emphasized as typical of the optimal policy design[1]. This trade-off between real activity and inflation instability turns out to be looser the higher is the symmetry in the distribution of shocks between the home economy and the Union. When shocks are correlated between the small economy and the currency area, in fact, this price level stabilization property of fixed nominal exchange rates disappears.

Second, maintaining an independent monetary stabilization tool proves to be always welfare improving, independently of the type of disturbance hitting the economy and of the correlation of shocks between the home economy and the Union. In the presence of nominal price rigidities, the intuition for this result relies in the importance of variations in the nominal exchange rate to facilitate the dynamic adjustment of the terms of trade in response to shocks.

Third, a higher degree of openness does not necessarily make a country a better candidate for participating in a currency area. If, on the one hand, higher openness reduces the volatility in the terms of trade, it also boosts output instability. Therefore the welfare differential between relinquishing and maintaining monetary independence is minimized only for an intermediate degree of openness.

The plan of the paper is as follows. Section 2 presents the theoretical framework. Section 3 analyses the different stabilization performances of an independent versus an integrated economy. In Section 4 an evaluation of the welfare cost of relinquishing monetary independence is conducted. Section 5 concludes.

2 The Model

The world is composed by two asymmetric economies: a Monetary Union (i.e., a large closed economy) and a small economy, either with *independent* monetary policy *(id)* or *integrated* in the Union *(ig)*. These two economies are going to feature identical structures (preferences, technology and distribution of shocks), with the exception of the monetary policy rule adopted by

[1] See Woodford (1999)

the domestic authority. In the case of the independent economy the monetary authority is allowed to respond to domestic and foreign disturbances by adjusting the short-term nominal interest rate according to a simple feedback rule. On the contrary, the authorities of the integrated economy cannot set their interest rate independently to respond to domestic economic developments, as an asymmetric sudden rise in inflation or a slump in real activity.

2.1 The Independent Economy

The independent economy is a small economy where monetary policy can be conducted without constraints in a regime of purely floating exchange rates. The domestic market is populated by infinitely-lived households, consuming Dixit-Stiglitz aggregates of domestic (C^H) and imported (C^F) goods, and by domestic firms producing a differentiated good. All goods are tradeable.

The log-linear equilibrium equations of this economy can be described in terms of aggregate demand and supply blocks. Appendix A contains a more detailed description of the underlying structural model. In what follows let $\widehat{H}_t \equiv \log(\frac{H_t}{H})$ for a generic variable H.

2.1.1 Aggregate Demand

Total consumption is given by:

$$\widehat{C}_t = (1-\gamma)\widehat{C}_t^H + \gamma\widehat{C}_t^F \tag{1}$$

where γ is the share of imported goods, a natural index of openness.

The Euler equation for the representative consumer can be written :

$$\widehat{C}_t = E_t\{\widehat{C}_{t+1}\} - \frac{1}{\sigma}E_t\{i_t^{id} - E_t\widehat{\pi}_{t+1}\} - \frac{1}{\sigma}E_t\{\Delta\widehat{\omega}_{t+1}\} \tag{2}$$

where

$$\widehat{\pi}_t \equiv \widehat{P}_t - \widehat{P}_{t-1} = (1-\gamma)\widehat{\pi}_t^H + \gamma\widehat{\pi}_t^F \tag{3}$$

is CPI inflation, π_t^H, π_t^F are domestic and foreign goods inflation respectively, i_t^{id} is the nominal interest rate independently set by the domestic authority, and ω_t is a real demand (preference) shifter. Notice that :

$$\widehat{\pi}_t = \widehat{\pi}_t^H + \gamma(\widehat{S}_t^{id} - \widehat{S}_{t-1}^{id}) \tag{4}$$

where $\widehat{S}_t^{id} \equiv \widehat{e}_t + \widehat{P}_t^* - \widehat{P}_t^H$ denotes the (log) terms of trade. Demands for domestic and foreign goods can be written respectively:

$$\widehat{C}_t^H = \rho\gamma \widehat{S}_t^{id} + \widehat{C}_t \tag{5}$$

$$\widehat{C}_t^F = -\rho(1-\gamma)\widehat{S}_t^{id} + \widehat{C}_t \tag{6}$$

where $\rho \geq 1$ is the elasticity of substitution between home and foreign goods.

Under the assumption that the share of domestic goods consumed by the Union is negligible (i.e., $\gamma^* \rightarrow 0$) the export demand reads:

$$\widehat{C}_t^{H^*} = \rho \widehat{S}_t^{id} + \widehat{C}_t^* \tag{7}$$

where $\widehat{C}_t^* = \widehat{Y}_t^*$denotes total consumption in the Union.

2.1.2 The Open Economy IS Equation

By substituting (3) in (2), an expression for a forward-looking IS equation can be obtained:

$$\widehat{C}_t = E_t\{\widehat{C}_{t+1}\} + \frac{\gamma}{\sigma}E_t\{\Delta\widehat{S}_{t+1}^{id}\} - \frac{1}{\sigma}(\widehat{i}_t^{id} - E_t\widehat{\pi}_{t+1}^H) - \frac{1}{\sigma}E_t\{\Delta\widehat{\omega}_{t+1}\} \tag{8}$$

where $\widehat{i} \equiv \log(\frac{1+i_t}{1+\bar{i}})$. Notice that current consumption depends, among other things, on current and future changes of the terms of trade. Therefore the presence of inertia in the adjustment of the terms of trade is crucial for the short-run behavior of both consumption and output. This effect disappears as $\gamma \rightarrow 0$, i.e., if the economy becomes closed.

In the following I assume that the demand-preference shock follows a simple autoregressive process:

$$\widehat{\omega}_{t+1} = \rho^{\omega}\widehat{\omega}_t + u_t^{\omega}$$

where $u_t^{\omega}\tilde{\ } iid$.

2.1.3 Labor Supply

The consumer's intratemporal trade-off between consumption and leisure is expressed by:

$$V_n(N_t) = U_c(C_t)\frac{W_t}{P_t} \tag{9}$$

where W is the nominal wage, $U_c(C)$ is the marginal utility of consumption and $V_n(N)$ is the marginal disutility of work effort.

2.2 Aggregate Supply

2.2.1 Labor demand

In the market of the domestic goods, there is a continuum of monopolistically competitive firms (owned by consumers), indexed by $i \in [0, 1]$. They operate a CRS technology: $Y_t(i) = Z_t N_t(i)$, where Z is a total factor productivity shifter. Each firm can be imagined as composed by two units: a production unit and a pricing unit.

Cost minimization leads to the following efficiency condition for the choice of labor input :

$$\frac{MC_t(i)}{P_t^H} = \frac{1}{Z_t}\frac{W_t}{P_t^H} \tag{10}$$

where MC indicates nominal marginal costs. The productivity process is assumed to follow:

$$\widehat{Z}_{t+1} = \rho^z \widehat{Z}_t + u_t^z$$

$u_t^z \tilde{} iid$

2.2.2 The Open Economy Phillips Curve

Domestic firms are allowed to reset their price according to a stochastic time-dependent rule, which implies receiving a price signal at a constant random rate ϕ,as in Calvo (1983). In Appendix A, it is shown how to derive an open-economy equivalent of a Phillips curve, in which movements in the terms of trade feed back onto inflation. The aggregate supply equation reads:

$$\widehat{\pi}_t^H = \beta\ E_t \widehat{\pi}_{t+1}^H + \lambda\kappa_y\ \widehat{Y}_t + \lambda\kappa_s\ \widehat{S}_t^{id} - \lambda\xi_t \tag{11}$$

where $\kappa_y \equiv (\tau + \frac{\sigma}{(1-\gamma)})$ is the elasticity of real marginal costs to output, $\kappa_s \equiv \gamma[1 - \frac{(2-\gamma)\sigma\rho}{1-\gamma}]$ is the elasticity of real marginal costs to the terms of trade, and $\xi_t \equiv [\kappa_{y^*} \widehat{Y}_t^* + (1+\tau)\widehat{Z}_t]$ is a term that depends only on exogenous factors, i.e., foreign output and domestic productivity, with $\kappa_{y^*} \equiv \frac{\sigma\gamma}{1-\gamma}$. Notice that as $\gamma = 0$ equation (11) reduces to a standard closed-economy Phillips curve, where the output elasticity of real marginal costs is $\kappa_y \equiv (\tau + \sigma)$, and $\kappa_s = \kappa_{y^*} = 0$. The channel that translates movements of the terms of trade into changes in inflation derives from the exchange rate affecting the consumer's purchasing parity. This affects her supply of labor and, in equilibrium, real marginal costs.

2.3 Monetary Policy, the Interest Rate and the Exchange Rate.

I assume that the independent small economy conducts monetary policy according to a simple linear feed-back rule of the Taylor type:

$$\widehat{i}_t^{id} = b_\pi \widehat{\pi}_t^H + b_y \widehat{Y}_t$$

Besides its obvious simplicity, this specification serves very well the duty of capturing both the output and inflation stabilization goals of monetary policy. Furthermore, in the case of the independent economy, it does not feature any feedback from the nominal exchange rate, so that the monetary authorities in the small economy conduct policy in a regime of purely floating exchange rates, without any external constraint[2].

Changes in the domestic short-term interest rate will affect movements of the nominal exchange rate via a an uncovered interest parity:

$$\widehat{i}_t = \widehat{i}_t^* + E\{\widehat{e}_{t+1} - \widehat{e}_t\} \tag{12}$$

Appendix A shows how to derive this as a certainty equivalence approximation of an arbitrage condition on the ex-post returns of two types of

[2] To what extent this represents an ideal approximation of the conduct of monetary policy in small open economies like Canada or other European countries might be a matter of debate. Clarida-Gali-Gertler (1999) estimate policy reaction functions for several European countries and find that the role of the exchange rate in the interest rate rule has been relevant. In this paper I focus, for simplicity, on the two extreme cases of, on the one hand, complete absence of external constraints on monetary policy and, on the other, of total relinquishment of monetary independence.

nominal bonds, expressed in units of domestic and foreign currency respectively.

2.4 The Integrated Economy

The Integrated economy is a small economy that belongs to the Monetary Union, so that the nominal exchange rate is irrevocably fixed. The interest parity condition reduces in this case to:

$$\widehat{i}_t^{ig} = \widehat{i}_t^* \ \forall t$$

and

$$\widehat{S}_t^{ig} = \widehat{P}_t^* - \widehat{P}_t^H$$

The identifying feature of this economy lies therefore in the external constraint on monetary policy imposed by the participation in the currency area. The equations describing the equilibrium in this economy are identical to those of the independent economy, including the same asymmetric disturbances to technology Z and demand ω.

2.5 The Union

We can think of the Union economy as a simple closed economy with sticky prices, subject to supply and demand shocks:

$$\widehat{Y}_t^* = E_t\{\widehat{Y}_{t+1}^*\} - \frac{1}{\sigma}(\widehat{i}_t^* - E_t\pi_{t+1}^*) - \frac{1}{\sigma}E_t\{\Delta\widehat{\omega}_{t+1}^*\} \tag{13}$$

$$\widehat{\pi}_t^* = \beta \ E_t\widehat{\pi}_{t+1}^* + \lambda(\tau + \sigma) \ \widehat{Y}_t^* - \lambda(1 + \tau) \ \widehat{Z}_t^* \tag{14}$$

$$\widehat{i}_t^* = b_{\pi^*}\widehat{\pi}_t^* + b_{y^*}\widehat{Y}_t^* \tag{15}$$

Equation (13) is simply the closed-economy version of equation (8). Equation (14) is a typical forward-looking closed-economy Phillips curve, and equation (15) describes the conduct of monetary policy by the Union's central bank. Again here the Taylor specification is mainly meant to capture the inflation-output stabilization goal of policy in the simplest possible way. Demand and supply shocks in the Union, ω_t^* and Z_t^*, are assumed to follow autoregressive processes:

$$\widehat{\omega}^*_{t+1} = \rho^{\omega^*} \widehat{\omega}^*_t + u^{\omega^*}_t$$
$$\widehat{Z}^*_{t+1} = \rho^{z^*} \widehat{Z}^*_t + u^{z^*}_t$$

where both u^{ω}_t *and* u^{z}_t are iid.

3 Stabilization: Independent vs. Constrained Monetary Policy.

In this section I describe how the relinquishment of an autonomous monetary policy can affect the short-run adjustment process of the domestic small economy in response to both supply and demand shocks. Let's first briefly describe the parametrization of the model.

3.1 Parametrization

The model is parametrized as follows. The period utility is $U(C_t, N_t) = U(C_t) - V(N_t) = \frac{1}{1-\sigma} C_t^{1-\sigma} - \frac{1}{1+\tau} N_t^{1+\tau}$. I set the discount rate $\beta = 0.99$ and the elasticity of labor supply $\tau = 1$. The share of imported goods γ is chosen such that the steady-state sum of exports and imports is roughly 40% of output. The elasticity of substitution between home and foreign consumption is set $\rho = 1.5$. As it is now common in the literature on the Calvo pricing technology, I let the probability of price non-adjustment ϕ be equal to 0.75, which implies that the average frequency of price adjustment is four quarters. As to the monetary policy rule parameters, I set, as benchmark values, $b_\pi = b_{\pi^*} = 1.5$, $b_y = b_{y^*} = 0.5$, reflecting a larger weight assigned to the stabilization of inflation relative to output. The standard deviation of each shock is normalized to 1. The persistence of each stochastic process is set to $\rho^\omega = \rho^z = 0.9$. Finally I assume throughout that demand and supply shocks are uncorrelated *within* country but can be correlated *between* the small economy and the Union, so that $E_t\{u^\omega_t u^z_t\} = 0$ and $E_t\{u^\omega_t u^{\omega^*}_t\} = E_t\{u^z_t u^{z^*}_t\} = \theta \geq 0$.

3.2 Short-Run Dynamics and Distribution of Shocks

To what extent does the presence of asymmetric shocks render the membership of a monetary union less desirable ? To start with, let's concentrate on the potential effects of relinquishing monetary independence on the variability of output.

Supply Shocks: is monetary *independence* destabilizing ? In principle, a positive supply shock should move output and inflation in opposite directions. The equilibrium adjustment requires a real depreciation, i.e., a fall in the relative price of domestic goods. When monetary policy is free to react interest rates will fall thereby boosting the expansion of output even more through the exchange rate channel. Therefore a regime of independent monetary policy (i.e., floating exchange rates) could be in principle more destabilizing.

Figure 2 displays impulse responses to a domestic productivity shock. The solid line denotes the response of domestic variables when the economy can conduct an independent monetary policy, whereas a dashed line denotes the response of the same variable when the economy is integrated in the Union . The dynamic adjustment is strikingly different in the two cases. In response to the fall in inflation (due to the increase in productivity and the fall in real marginal costs) the central bank in the independent economy reduces interest rates sharply thereby generating a depreciation in the nominal exchange rate. This translates into a sharp depreciation of the terms of trade. Monetary policy in the integrated economy, however, is constrained: being centralized it cannot react to asymmetric shocks. Therefore the real depreciation induced by the fall in the relative price of domestic goods is much more muted on impact (as the nominal exchange rate is fixed). Yet the dynamics in relative prices display a persistent depreciation that induces a much more persistent adjustment in both output and consumption. This result illustrates the role of the flexibility of monetary policy (and therefore of the nominal exchange rate) in accelerating the adjustment of the economy in response to asymmetric shocks. It follows that the conclusion that flexible exchange rates might be more destabilizing is actually not warranted. The dynamic effect of the inertial adjustment in relative prices might in fact generate larger output instability when monetary policy is constrained. In *Table 1a* second moments for inflation and output are reported in order to illustrate this point. In the face of asymmetric supply shocks relinquishing monetary independence implies an increase in the volatility of output by roughly 33%.

Demand Shocks: is monetary *dependence* destabilizing ? In *Figure 3* impulse responses to a domestic demand shock are displayed. Both inflation and consumption demand rise. This triggers a tightening in monetary policy for the independent economy and both a nominal and a real appreciation. The exchange rate channel of monetary policy is therefore in principle stabilizing when the economy is hit by demand shocks. The different behavior of monetary policy across regimes generates in fact a sharply different response of output in the two economies. For the independent economy, the rise in real interest rates dampen the response of consumption. This effect, coupled with the sharper real depreciation that is causing a deterioration of the trade balance, determines a fall in output.[3] The absence of any monetary policy tightening for the integrated economy, however, allows an expansionary effect of the shock. What seems clear from the picture is that unconstrained monetary policy allows to dampen the fluctuations of output. The results in *Table 1a* confirm this intuition. The volatility of output again increases substantially upon relinquishing monetary policy independence. In this case the intuition that abandoning the exchange rate channel of monetary policy is destabilizing seems to be supported by the model.

To summarize, relinquishing monetary policy independence in the face of asymmetric shocks (both demand and supply) seems to cause larger instability in output, even when flexible exchange rates might appear in principle more destabilizing as in the case of supply shocks. In this case the crucial factor is the resulting inertial adjustment in the terms of trade when the nominal rate is not free to float. So far for output (in)stability. But how about stabilization of inflation ?

Fixing the exchange rate as a nominal anchor for inflation Let's go back to inspecting *Figure 2* and *3*. Notice the different behavior of domestic inflation under the two regimes. Consider the case of supply shocks first. When monetary policy is unconstrained inflation falls sharply and returns gradually to its steady state value. However in the case of an integrated economy the initial disinflation is followed by a period of moderate inflation. A symmetric pattern can be identified in response to a demand shock. The

[3]This depressing effect of a positve aggregate demand shock on output, though, is sensitive to parametrization, in particualr to the choice of γ (the degree of openness) and ρ (the elasticity of substitution between domestic and foreign goods). By either reducing γ or ρ a moderate expansion in output can be obtained, notwithstanding the result on more muted fluctuations in output.

initial rise in inflation is followed, in the case of the integrated economy, by a subsequent period of deflation. *Figure 4* shows the implied path for the (domestic) price level under the two regimes. The key difference is the stationarity of the price level in the case of integrated policy. Notice that this is a general feature of a regime of *fixed* exchange rates in the face of *asymmetric* shocks, both supply and demand. In this case, in fact $\widehat{e}_t = 0$ and $\widehat{P}_t^* = 0$, given that the Union is not affected by the domestic shock. Therefore the expression for the terms of trade becomes: $\widehat{S}_t = -\widehat{P}_t^H$, so that the stationarity of the terms of trade translates into the one of the domestic price level. As suggested by Woodford (1999), stationarity of the price level is a typical feature of history-dependent (optimal) polices. Being the private sector forward-looking, the commitment to maintaining a fixed exchange rate induces here expectations of future overshooting in the path of inflation. A Taylor rule, although allowing the maintenance of monetary policy flexibility, does not deliver this feature of commitment to any future course of policy action, which instead can be interestingly acquired by having the country linking its policy to the one conducted in the currency area. The results in *Table 1a* and *1b* confirm this intuition. Both in the case of supply and demand shocks the reduction in the volatility of inflation acquired by permanently fixing the exchange rate is substantial. In our framework we can interpret this result as a sort of credibility gain that the domestic central bank acquires by resorting to an irrevocably fixed exchange rate as a nominal anchor. This outcome seems to rationalize past choices of high-inflation European countries (Spain, Italy, Greece) that joined the EMS during the 1980's with the goal of reducing inflation variability by anchoring the exchange rate to the German DM, thereby adopting a strategy of importing credibility[4]. To what extent such an anti-inflationary strategy might be preferable to a credible commitment to inflation-targeting policies is a topic that definitely warrants further investigation.

Overall, the analysis above identifies a potential trade-off for a small open economy considering the participation to a monetary union. The relinquishment of the monetary stabilization tool seems to imply a large cost in terms of output volatility, but gains from using the nominal exchange rate as an anchor seem to emerge as long as the stabilization of inflation is concerned.

[4] Giavazzi-Pagano (1988) label this as "the advantage of tying one's hands".

The role of the (a)symmetry of shocks. Does the model support the Mundellian intuition that it is asymmetric shocks that really determine the cost of relinquishing monetary independence ? In Table 1a second moments for both inflation and output are reported, conditional on the presence of *correlated* domestic and foreign shocks. As it stands clear, in this case the performance of the two regimes seems to disappear, especially in terms of inflation performance. *Figure 5* plots the impulse response of the domestic price level in the face of correlated supply and demand disturbances. As it stands clear now a unit root in the price level characterizes both the response under an independent and an integrated regime. The reason lies in the fact that both the domestic and the foreign price level react endogenously to the shocks, therefore inducing non-stationarity also under a regime of permanently fixed exchange rates. The tightness of the potential trade-off between output and inflation volatility faced by a country joining a currency area is therefore inversely related to the degree of symmetry of the shocks. The inflation variability premium that the membership of a currency union seems to grant tends to vanish in the presence of correlated shocks. As far as the goal of stabilizing inflation is concerned, then, a higher degree of asymmetry of shocks makes now the participation to a currency area for a small open economy more attractive, unlike the suggestion of the traditional literature on the OCA.

The analysis of the potential costs of relinquishment of monetary policy independence has been conducted so far only in terms of stabilization goals. Let's now turn to a more direct analysis of its welfare consequences.

4 Welfare Analysis

In this section I evaluate the business cycle cost of relinquishing monetary policy independence by looking directly at a measure of welfare. Along the lines of Lucas (1987) and as in Schmitt-Grohe-Uribe (2000), let's define ψ as the fraction of steady-state consumption that the representative household in the small economy would be willing to forego in order to avoid business cycle fluctuations. In this sense ψ captures a welfare cost that is directly connected with the conduct of monetary policy as stabilization policy. This measure is assumed to satisfy:

$$U((1-\psi)\overline{C}, \overline{N}) = E_t\{U(C_t, N_t)\}$$

Therefore ψ represents the real cost the consumer would be willing to pay to maintain certainty equivalence. In Appendix C I show that by employing a second order approximation of the utility function in the neighborhood of the steady state ψ can be written as:

$$\psi = -\frac{1}{2}[(1-\chi_c)Var(\widehat{C}_t) + (1-\chi_n)Var(\widehat{N}_t)] \tag{16}$$

where $Var(.)$ denotes the unconditional variance and $\chi_c \equiv -\frac{U_{cc}}{U_c C}$, $\chi_n \equiv -\frac{U_{nn}}{U_n N}$.

In *Table 2* a quantitative evaluation of the welfare cost associated with the relinquishment of the monetary stabilization tool is reported, both in the case of asymmetric (domestic) and symmetric shocks, i.e., shocks that hit simultaneously the small economy and the Union. The values of ψ in the table denote percentage points of non-stochastic steady consumption the domestic household is willing to forego to avoid business cycle fluctuations. Interestingly, in all cases the relinquishment of the monetary stabilization tool is associated with an increase in the welfare cost. The intuition relies in the inertial adjustment of relative prices that a regime of constrained monetary policy imposes in response to shocks. As it was clear from Figure 2 and 3 the persistence in the adjustment of output and consumption in response to supply and demand shocks was much larger under a regime of integrated monetary policy. The inability of the nominal exchange rate to compensate for the staggered behavior of prices induces excess volatility in output and consumption which result to be undesirable from a welfare point of view. With respect to the analysis of stabilization the welfare evaluation delivers a more stringent result on the undesirability of abandoning monetary policy and exchange rate flexibility as stabilization tool.

4.1 Does openness matter ?

It is a typical argument in the OCA literature that the cost of relinquishing monetary policy independence should be decreasing in the degree of openness of the economy. The main idea is that a more open economy will feature a closer synchronization of prices and exchange rates, therefore de-emphasizing the role of the nominal exchange rate as a stabilization tool. This argument, though, relies on the assumed different degree of exchange rate pass-through between relatively close and more open economies. In the context of our model the pass-through of exchange rate movements onto prices is immediate and independent of the degree of openness. Yet a robust feature of our framework (under monetary independence) is an inverse relationship between the volatility of the terms of trade and the degree of openness. Hau (2000) provides strong empirical evidence in favor of this result. In a model with perfect pass-through (where the role of the expenditure switching effect is central[5]), this inverse relationship depends on the systematic behavior of monetary policy in response to shocks. The key point is that any shock that determines a fluctuation in the terms of trade will affect real marginal costs with a coefficient that is increasing in γ. In Appendix A I show that a log-linear expression for equilibrium real marginal costs μ_t can be written:

$$\widehat{\mu}_t = \tau\widehat{Y}_t + \gamma\widehat{S}_t + \sigma\widehat{C}_t - (1+\tau)\widehat{Z}_t$$

Since the sensitivity of marginal costs to the terms of trade is increasing in γ, any given shock will determine a larger effect on *domestic* inflation the larger is the degree of openness. Therefore, for a given foreign interest rate, the domestic (autonomous) central bank will be more aggressive in stabilizing the interest rate differential and, in a sticky price environment, the terms of trade[6]. *Figure 6* shows that the effect of openness on the volatility of the terms of trade is substantial in our model. By having the import share γ varying from 0.1 to 0.9 the volatility of the terms of trade is reduced to half. On the same graph we report also the implied volatilities of consumption and output as a function of the degree of openness. As it stands clear more open economies tend to display higher real instability. Therefore from this perspective the cost of relinquishing the monetary stabilization tool might be high. The result above seems to point out another trade-off faced by a country considering the participation to a monetary union. In *Table 3* the welfare *differential* between a regime of independent and integrated monetary policy for different degrees of openness is reported. As it stands clear the narrowest differential is obtained for an intermediate degree of openness ($\gamma = 0.5$), when the trade-off between lower instability of the terms of trade and

[5]See Obstfeld-Rogoff (2000) for empirical evidence in favor of the role of the expenditure-switching effect.

[6]Notice that this explanation differs from the one reported in the theoretical section of Hau(2000). That paper features a model with *exogenous* monetary policy and non-traded goods, so that the law of one price applies only to a subset of goods. This implies a magnification effect in the adjustment of the exchange rate to achieve any given variation in prices. The smaller is the share of non-traded goods (i.e., the higher is the degree of openness), the smaller is the magnification effect.

higher output/consumption instability is minimized. Unlike the conclusion of the traditional literature on OCA, then, our framework suggests that a higher degree of openness does not necessarily make an economy a better candidate for participating in a monetary union.

5 Conclusions

The recent onset of a common currency area in Europe has given birth to a totally new international monetary arrangement. The macroeconomic analysis on the desirability of a monetary union has so far been conducted only in terms of a more traditional approach based on the literature on Optimal Currency Areas of the 1960's. According to this literature, relinquishing monetary policy and exchange rate flexibility for economies with nominal rigidities delivers a cost which is proportional to the degree of asymmetry in the distribution of shocks.

In this paper I provide an open economy general equilibrium framework for the analysis of both the stabilization and welfare costs of relinquishing monetary independence. When faced with asymmetric shocks, by not allowing monetary policy to respond for fine-tuning purposes, a small open economy may experience a substantial increase in the variability of real activity. On the other hand, by anchoring the nominal exchange rate permanently, the same economy can gain a credibility premium that will dampen the variability in inflation. The tightness of this trade off is shown to be inversely related to the degree of symmetry of the shocks. The higher the correlation of disturbances, the lower is the inflation variability premium that the small economy can enjoy by embracing the currency area. As far as welfare is concerned, though, the relinquishment of monetary independence is always associated with a welfare loss. Independently of the underlying distribution of shocks, in fact, the larger persistence in the adjustment of real relative prices in the case of permanently fixed exchange rates delivers undesirable excess business cycle fluctuations. Finally, and unlike the traditional OCA view, not necessarily a higher degree of openness makes a small open economy a better candidate for participating in a currency area. More open economies display lower variability in the terms of trade but also larger instability in output and consumption. This implies that a deepening of the trade intensity is not necessarily a prerequisite for the sound viability of a currency area.

A Appendix A

In this section I describe the underlying structural model for the small economy in greater detail.

A.1 Household's Problem

Consumers yield utility from real consumption and leisure.

$$W_t \equiv E_t \sum_{t=0}^{\infty} \beta^t \{U(C_t)\omega_t - V(N_t)\}$$

where C is consumption, N is total hours worked, and ω_t is a demand shifter, i.e., a shock to the marginal utility of consumption. In the following it is shown how ω can be interpreted as an aggregate demand shock, i.e., a shock to an optimizing IS equation.

The real consumption index C_t is a CES aggregate of C_H and C_F.Therefore:

$$C_t = C(C^H, C^F) = ((1-\gamma)^{\frac{1}{\rho}}(C_t^H)^{\frac{\rho-1}{\rho}} + \gamma^{\frac{1}{\rho}}(C_t^F)^{\frac{\rho-1}{\rho}})^{\frac{\varrho}{\varrho-1}} \tag{17}$$

where $C^H = (\int_0^1 C_H(i)^{\frac{\vartheta-1}{\vartheta}} di)^{\frac{\vartheta}{\vartheta-1}}$ and $C^F = (\int_0^1 C_F(j)^{\frac{\vartheta-1}{\vartheta}} dj)^{\frac{\vartheta}{\vartheta-1}}$ represent composite indexes of domestic and foreign (imported) goods, respectively. Both goods are tradeable. In the following, I assume $\vartheta > 1$. Notice that $\gamma \in [0,1]$ is the share of home-produced goods in total consumption, and $\varrho > 1$ is the elasticity of substitution between domestic and foreign goods.

Define $P^H = (\int_0^1 P^H(i)^{1-\vartheta} di)^{\frac{1}{1-\vartheta}}$ and $P^F = (\int_0^1 P^F(j)^{1-\vartheta} dj)^{\frac{1}{1-\vartheta}}$ as the associated price indexes, both expressed in units of the domestic currency. Accordingly, an aggregate utility-based domestic price index can be defined as:

$$P_t = ((1-\gamma)(P_t^H)^{1-\varrho} + \gamma(P_t^F)^{1-\varrho})^{\frac{1}{1-\varrho}} \tag{18}$$

The system of FONCs for the household's problem yields :

$$\lambda_t = U_c(C_t)\omega_t \tag{19}$$

$$\lambda_t \frac{W_t}{P_t} = V_n(N_t) \tag{20}$$

$$\lambda_t = (1+i_t)\beta E_t\{\lambda_{t+1}\frac{P_t}{P_{t+1}}\} \tag{21}$$

$$\lambda_t = (1+i_t^*)\beta E_t\{\lambda_{t+1}\frac{P_t}{P_{t+1}}\frac{e_{t+1}}{e_t}\} \tag{22}$$

The optimal allocation of consumption between domestic and foreign goods yields typical isoelastic demand functions:$C_t^H = (1-\gamma)(\frac{P_t^H}{P_t})^{-\rho}$ and $C_t^H = (1-\gamma)(\frac{P_t^H}{P_t})^{-\rho}$.

By combining equation (21) and (22), I can derive the following asset pricing condition under uncertainty:

$$E_t\{\lambda_{t+1}\frac{P_t}{P_{t+1}}[(1+i_t) - (1+i_t^*)\frac{e_{t+1}}{e_t}]\} = 0 \tag{23}$$

A certainty equivalence log-linear version of (23) yields an uncovered interest parity condition, i.e., equation

A.1.1 The Open-economy IS curve.

By combining equation 19 and 21 and log-linearizing one obtains:

$$\widehat{C}_t = E_t\{\widehat{C}_{t+1}\} - \frac{1}{\sigma}(\widehat{i}_t - E_t\widehat{\pi}_{t+1}) - \frac{1}{\sigma}E_t\{\Delta\widehat{\omega}_{t+1}\} \tag{24}$$

By combining with equation 4 aggregate demand equation 8 can be obtained.

A.1.2 The Open Economy Phillips Curve

Price setting of the Calvo-type typically implies the following log-linear equation for newly set prices:

$$\widehat{P}_{t,new}^H = (1-\beta\phi)E_t\sum_{k=0}^{\infty}(\mu_{t+k} + \widehat{P}_t^H) \tag{25}$$

where $\widehat{\mu}_t$ denotes (log) real marginal costs.

By combining the equation above with the log-linear version of **??**, it yields:

$$\pi_t^H = \beta E\pi_{t+1}^H + \lambda\widehat{\mu}_t \tag{26}$$

where $\lambda \equiv [\frac{(1-\phi)(1-\beta\phi)}{\phi}]$.

The equilibrium in the labor market can be obtained by combining (9) and (10):

$$\frac{V_n(N_t)}{U_c(C_t)}\frac{P_t}{P_t^H}\frac{1}{Z_t} = \mu_t$$

Log-linearizing the equation above and the equation for the CPI I obtain:

$$\begin{aligned} \widehat{\mu}_t &= \tau\widehat{N}_t + (\widehat{P}_t - \widehat{P}_t^H) + \sigma\widehat{C}_t - \widehat{Z}_t && (27)\\ &= \tau\widehat{N}_t + \gamma\widehat{S}_t + \sigma\widehat{C}_t - \widehat{Z}_t && (28)\end{aligned}$$

$$\widehat{P}_t = (1-\gamma)\widehat{P}_t^H + \gamma\widehat{P}_t^F \qquad (29)$$

given that $(\widehat{P}_t - \widehat{P}_t^H) = \gamma(\widehat{P}_t^F - \widehat{P}_t^H) = \gamma\widehat{S}_t$, and where $\tau \equiv \frac{V_n(\overline{N})\overline{N}}{V_n(N)}$ is the elasticity of labor supply (evaluated in the steady state) under our parametrization of the utility function.

The (log-linearized) resource constraint of the economy reads:

$$\widehat{Y}_t = (1-\gamma)\widehat{C}_t^H + \gamma\widehat{C}_t^{H^*} \qquad (30)$$

By combining equations (5), (7) and (30), total consumption can be rewritten:

$$\widehat{C}_t = \frac{1}{1-\gamma}[\widehat{Y}_t - \rho\gamma(2-\gamma)\widehat{S}_t - \gamma\widehat{Y}_t^*)]$$

Substituting, and recognizing that $\widehat{Y}_t = \widehat{Z}_t + \widehat{N}_t$, the expression for real marginal costs becomes:

$$\widehat{\mu}_t = (\tau + \frac{\sigma}{\gamma})\widehat{Y}_t + \gamma[(1 - \frac{\sigma\rho(2-\gamma)}{1-\gamma})]\widehat{S}_t - (\frac{\sigma\gamma}{1-\gamma})\widehat{Y}_t^* - (1+\tau)\widehat{Z}_t$$

By substituting this expression in (26) we obtain equation (11) in the text.

B Appendix B: Welfare Measure

Let's consider a first order expansion of $U((1-\psi)\overline{C},\overline{N})$ around $\overline{C}$. This yields:

$$\begin{aligned} U((1-\psi)\overline{C},\overline{N}) &= U(\overline{C},\overline{N}) + U_c[\overline{C}-(1-\psi)\overline{C}] \\ &= U(\overline{C},\overline{N}) - \psi\overline{C}U_c \end{aligned}$$

By equating to $E\{U(C_t,N_t)\}$ we obtain:

$$\psi = -[\frac{E\{U(C_t,N_t)\} - U(\overline{C},\overline{N})}{U_c\overline{C}}]$$

Now consider a second order expansion of $U(C_t,N_t)$ around C_t and N_t :

$$U(C_t,N_t) = U(\overline{C},\overline{N}) + U_c(C_t-\overline{C}) + \frac{1}{2}U_{cc}(C_t-\overline{C})^2 + U_n(N_t-\overline{N}) + \frac{1}{2}U_{nn}(N_t-\overline{N})^2 \tag{31}$$

A second order approximation of C_t and N_t yields:

$$C_t = \overline{C}(1+\widehat{C}_t+\frac{1}{2}\widehat{C}_t^2)$$

$$N_t = \overline{N}(1+\widehat{N}_t+\frac{1}{2}\widehat{N}_t^2)$$

where $\widehat{C}_t = \log(\frac{C_t}{\overline{C}})$ and $\widehat{N}_t = \log(\frac{N_t}{\overline{N}})$.
Substituting in 31 we obtain:

$$\begin{aligned} U(C_t,N_t) &= U(\overline{C},\overline{N}) + U_c\overline{C}[\widehat{C}_t+\frac{1}{2}\widehat{C}_t^2] + \frac{1}{2}U_{cc}\overline{C}^2\widehat{C}_t^2 \\ &\quad + U_n\overline{N}[\widehat{N}_t+\frac{1}{2}\widehat{N}_t^2] + \frac{1}{2}U_{nn}\overline{N}^2\widehat{N}_t^2 \end{aligned}$$

This can be rewritten as:

$$U(C_t,N_t) = U(\overline{C},\overline{N}) + U_c\overline{C}[\widehat{C}_t+\frac{1}{2}(1-\chi_c)\widehat{C}_t^2] + U_n\overline{N}[\widehat{N}_t+\frac{1}{2}(1-\chi_n)\widehat{N}_t^2]$$

where $\chi_c \equiv -\frac{U_{cc}\overline{C}}{U_c}$ and $\chi_n \equiv -\frac{U_{nn}\overline{N}}{U_c}$.

Let's assume that $E\{\widehat{C}_t\} = E\{\widehat{N}_t\} = 0$. By taking unconditional expectations of 31 we obtain:

$$E\{U(C_t, N_t)\} = U(\overline{C}, \overline{N}) + \frac{1}{2}[U_c\overline{C}(1-\chi_c)Var(\widehat{C}_t) + U_n\overline{N}(1-\chi_n)Var(\widehat{N}_t)] \tag{32}$$

Therefore:

$$\psi = -\frac{\frac{1}{2}[U_c\overline{C}(1-\chi_c)Var(\widehat{C}_t) + U_n\overline{N}(1-\chi_n)Var(\widehat{N}_t)]}{U_c\overline{C}}$$

Consider now the expression for the real marginal cost function:

$$\frac{MC_t}{P_t^H} = \frac{1}{Z_t}\frac{U_c(C_t, N_t)}{U_n(C_t, N_t)}\frac{P_t}{P_t^H} = \frac{1}{Z_t}\frac{U_c(C_t, N_t)}{U_n(C_t, N_t)}g(S_t) \equiv \mu(C_t, N_t, Z_t, S_t)$$

where $\frac{P}{P^H} = [(1-\gamma)+\gamma S^{1-\rho}]^{\frac{1}{1-\rho}} \equiv g(S)$. In a balanced-trade steady-state it holds $\overline{C} = \overline{Y} = \overline{N}$. Furthermore, by assuming (without loss of generality) that the initial wealth distribution is such that $g(\overline{S}) = 1$ we obtain:

$$\mu(\overline{C}, \overline{N}, 1, 1) = 1 - \Theta$$

where $1 - \Theta \equiv \frac{(1-\tau)(\varepsilon-1)}{\varepsilon}$ summarizes the distortion in the steady-state output level due to taxes and imperfect competition. As in Rotemberg-Woodford (1999), we assume that the tax is exactly of the negative size to offset the distortion associated with market power. This implies $\Theta = 0$ and $U_c\overline{C} = U_n\overline{N}$. Therefore it follows:

$$\psi = -\frac{1}{2}[(1-\chi_c)Var(\widehat{C}_t) + (1-\chi_n)Var(\widehat{N}_t)]$$

which is equation 16 in the text.

References

[1] Angeloni, Ignazio and L.Dedola (1999): "From the ERM to the Euro:New Evidence on Economic and and Policy Convergence Among EU Countries", ECB Working Paper # 4.

[2] Artis, MJ and W.Zhang (1997): "Business Cycle, Exchange Rate Regimes and the ERM: is there a European Business Cycle?", International Journal of Finance and Economics, forthcoming.

[3] Bayoumi, T. and B. Eichengreen (1993): "Shocking Aspects of European Monetary Integration", in F. Torres and F.Giavazzi, eds., Adjustment and Growth in the European Monetary Union (Cambridge University Press, Cambridge, MA) 193-229.

[4] ————(1996): "Operationalizing the Theory of Optimum Currency Areas", CEPR Dicussion Paper # 1484.

[5] Calvo, Guillermo, 1983, "Staggered Prices in a Utility Maximizing Framework," *Journal of Monetary Economics*, 12, 383-398.

[6] Clarida, Richard, Jordi Galí, and Mark Gertler (1999): "Monetary Policy Rules in Practice: Some International Evidence" *European Economic Review*, vol. 42, 1033-1067.

[7] Frankel, J.A and A.K Rose (1996): The Endogeneity of the Optimum Currency Area Criteria", NBER W5700.

[8] Galí, Jordi, and Tommaso Monacelli (2000): "Optimal Monetary Policy and Exchange Rate Volatility in a small Open Economy" , Mimeo 2000.

[9] Hau, Harald (1999): "Real Exchange Rate Volatility and Economic Openness: Theory and Evidence," unpublished manuscript.

[10] Helg, Rodolfo, P. Manasse, T.Monacelli and R.Rovelli (1995), "How Much Asymmetry in Europe ? Evidence from Industrial Sectors", European Economic Review, Vol. 39, No5.

[11] Krugman, Paul (1993): "Lessons of Massachusetts for EMU", in F. Giavazzi and F. Torres (eds). The Transition to Economic and Monetary Union in Europe, New York, Cambridge University Press, pp. 241-261.

[12] Lucas, R. E., Jr.(1987): "Models of Business Cycles", Yrjo Yahnsonn Lectures Series, London and New York, Blackwell..

[13] McKinnon, R.(1964), "Optimum Currency Areas", American Economic Review, n.53, pp. 717-725.

[14] Mundell, R., (1961) "A Theory of Optimum Currency Areas", American Economic Review 51.

[15] Rotemberg, Julio and Michael Woodford (1999): "Interest Rate Rules in an Estimated Sticky Price Model," in J.B. Taylor ed., *Monetary Policy Rules*, University of Chicago Press.

[16] Schmitt-Grohe S. and Martin Uribe (2000): "Stabilization Policy and the Costs of Dollarization", unpublished.

[17] Woodford, Michael (1999), *Interest and Prices*, chapter 2, mimeo

Table 1a
Monetary Policy (In)dependence and Macroeconomic Stability

Asymmetric Shocks

	Domestic AS Shocks		*Domestic AD Shocks*	
	Independent	Integrated	Independent	Integrated
stdev(*Output*)	1.54	2.01	0.35	0.57
stdev(*Home Inflation*)	1.48	0.32	0.5	0.25

Table 1b
Monetary Policy (In)dependence and Macroeconomic Stability

Symmetric Shocks

	AS Shocks		*AD Shocks*	
	Independent	Integrated	Independent	Integrated
stdev(*Output*)	1.43	1.58	0.31	0.39
stdev(*Home Inflation*)	1.41	1.39	0.33	0.27

Table 2
Welfare Cost of Monetary (In)dependence

(units of steady-state consumption)

	AS Shocks		*AD Shocks*	
	Asymmetric	Symmetric	Asymmetric	Symmetric
Independent	0.56	.75	.11	.09
Integrated	0.65	.9	.32	.16

Table 3
Welfare Differential and Degree of Openness

$(\psi_{integrated} - \psi_{independent})$

Openness	*Domestic Shocks*	*All Shocks*
$\gamma = 0.1$	0.65	0.32
$\gamma = 0.5$	0.26	0.22
$\gamma = 0.9$	0.48	0.35

Figure 1a
Inflation and Interest Rates in Ireland

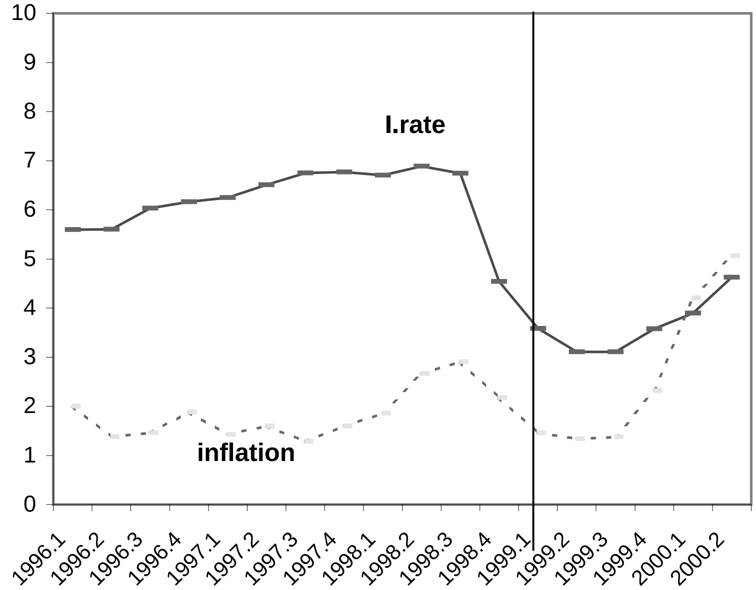
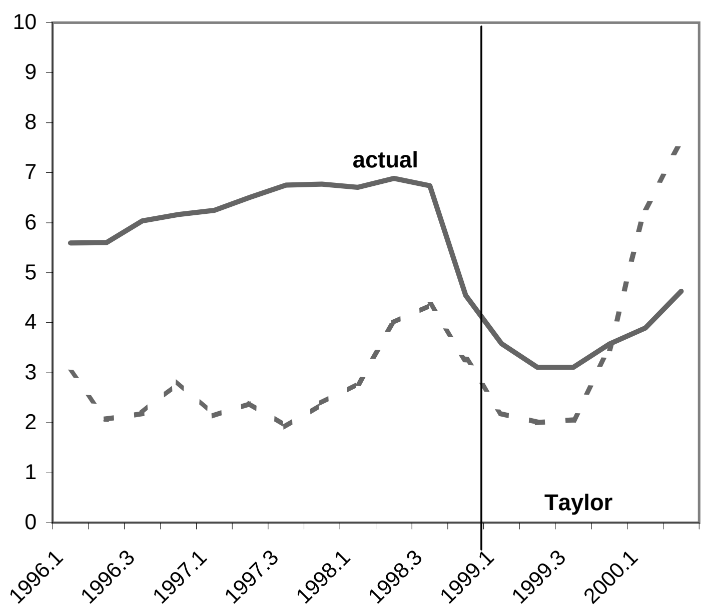


Figure 1b
Actual and Taylor Interest Rate in Ireland



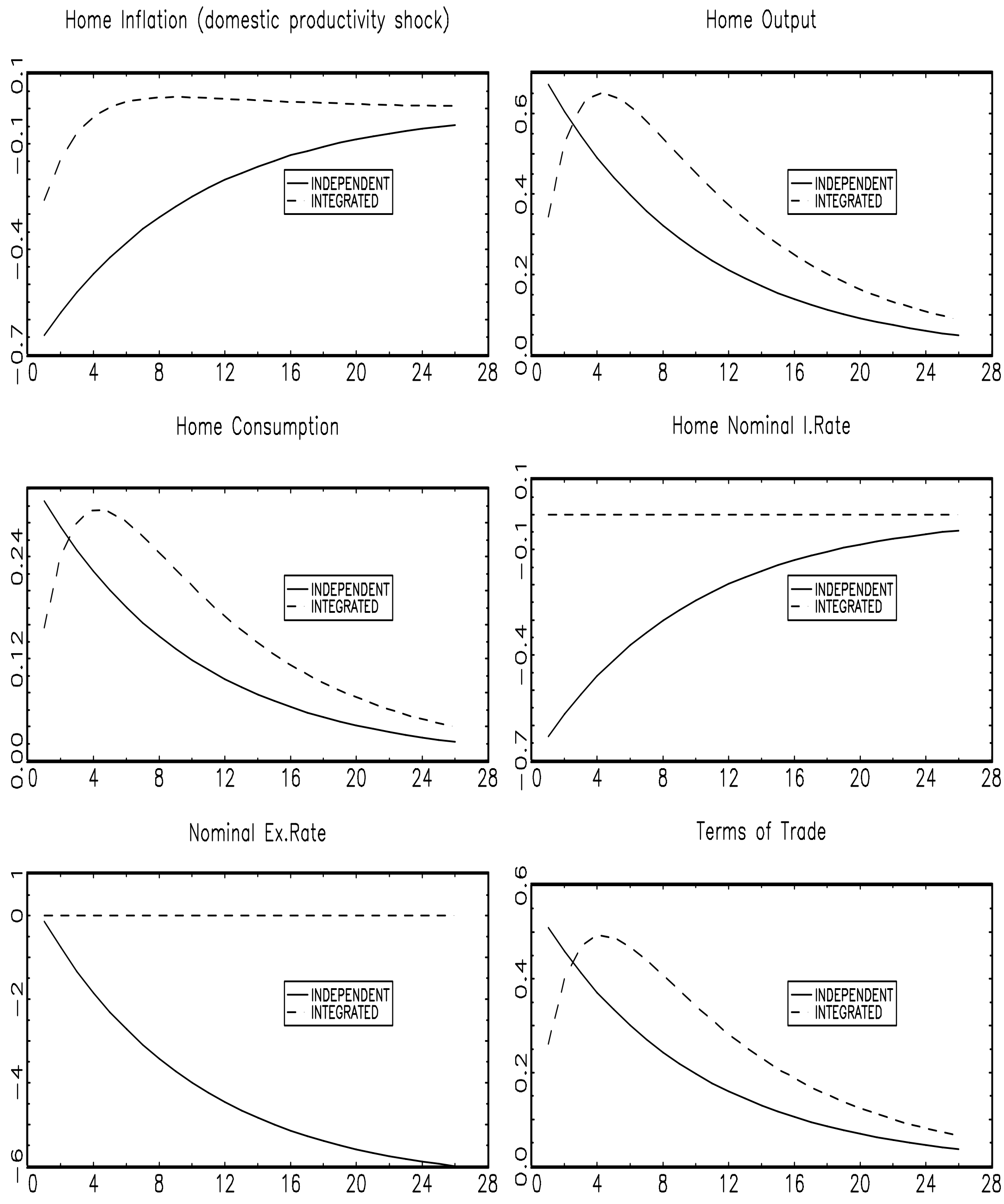


Figure 2: **Impulse Responses to a Domestic Productivity Shock.**

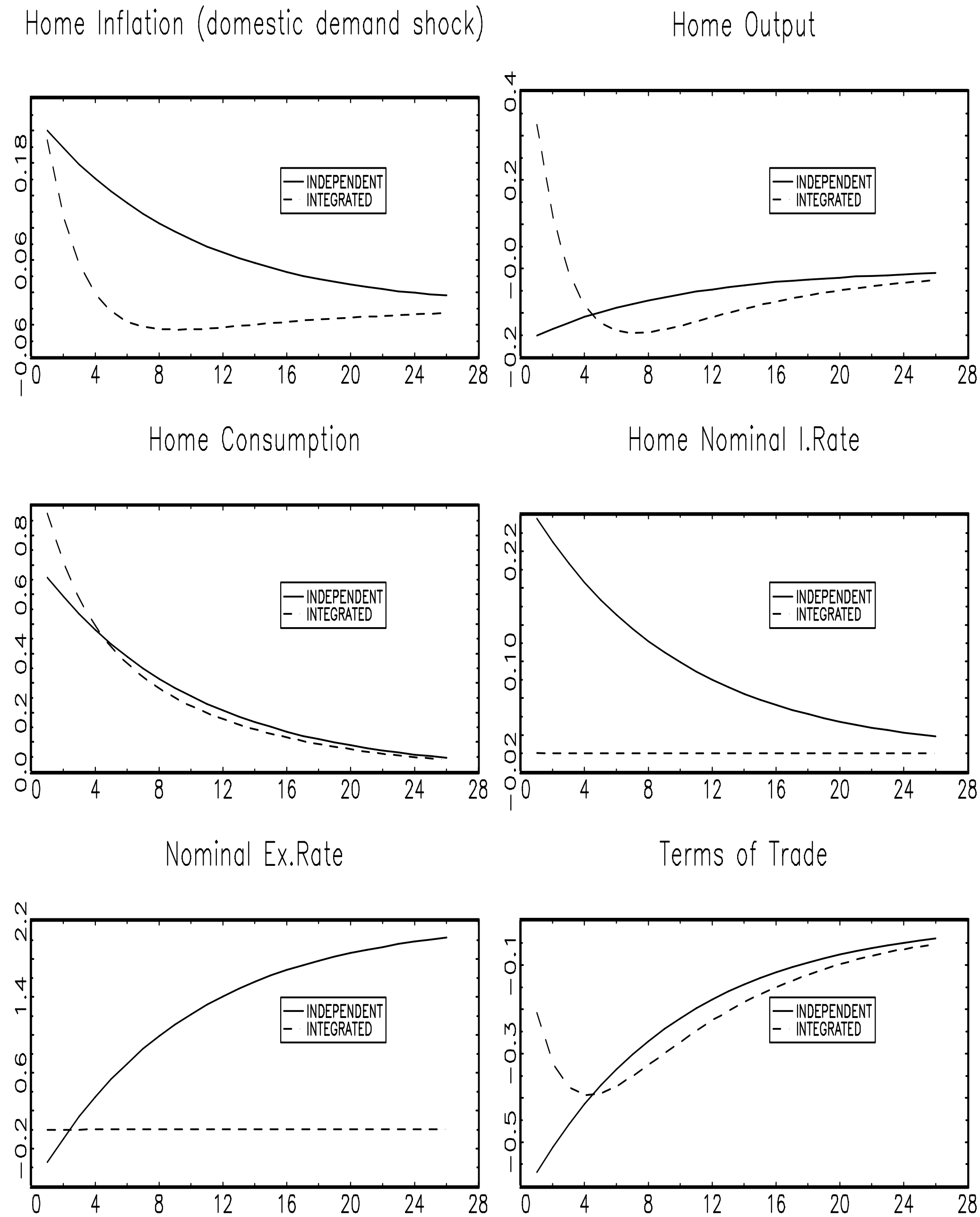


Figure 3: **Impulse Responses to a Domestic Demand Shock.**

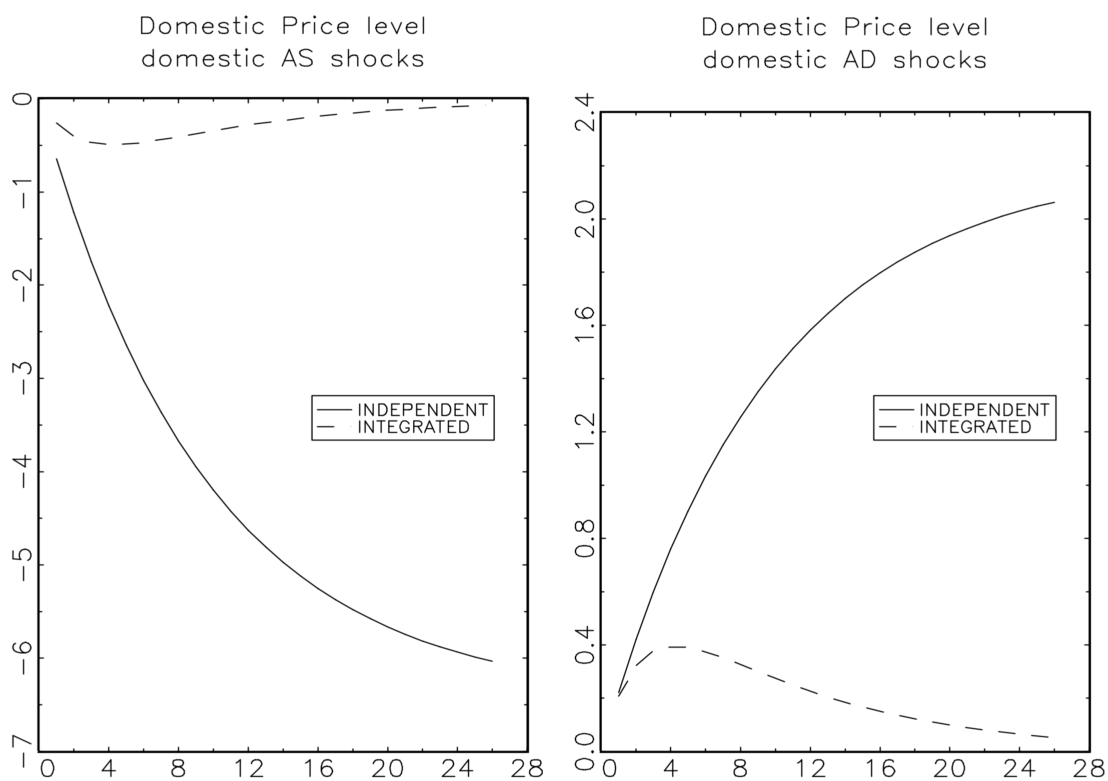


Figure 4: **Dynamics of the Domestic Price Level under the Two Monetary Regimes (domestic shocks only).**

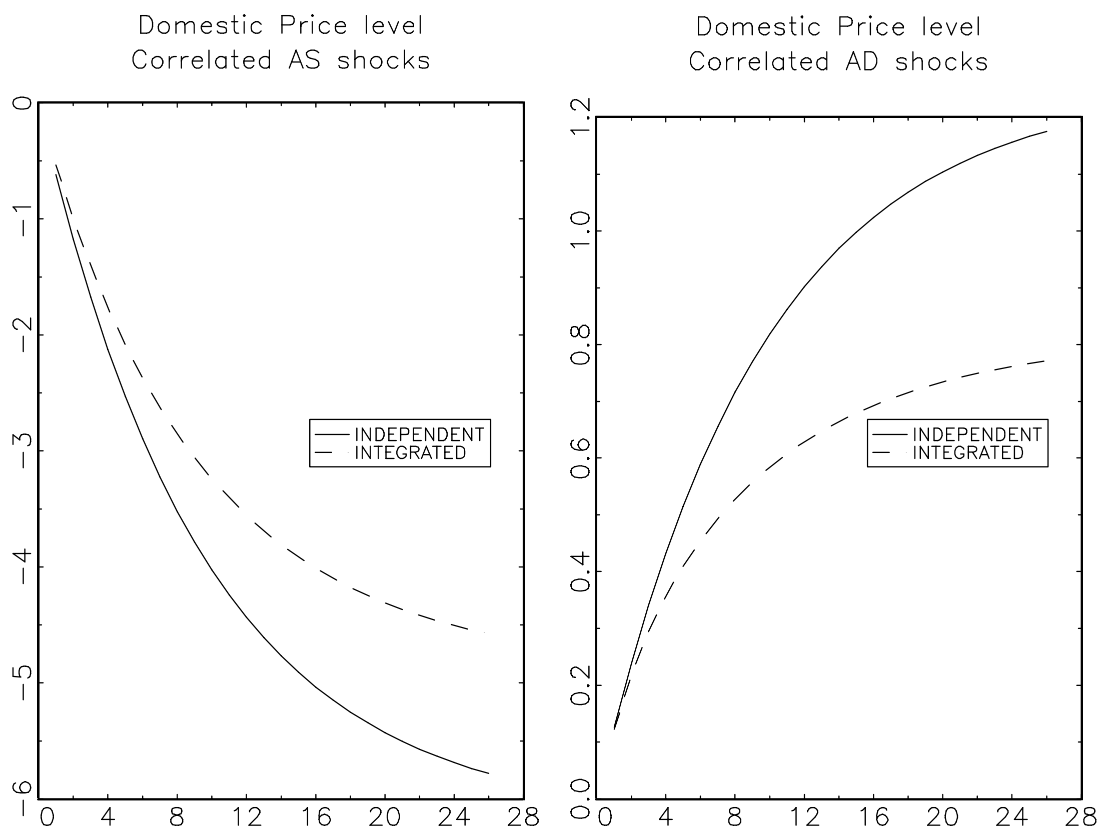


Figure 5: **Dynamics of the Domestic Price Level under the Two Monetary Regimes (cross-country correlated shocks).**

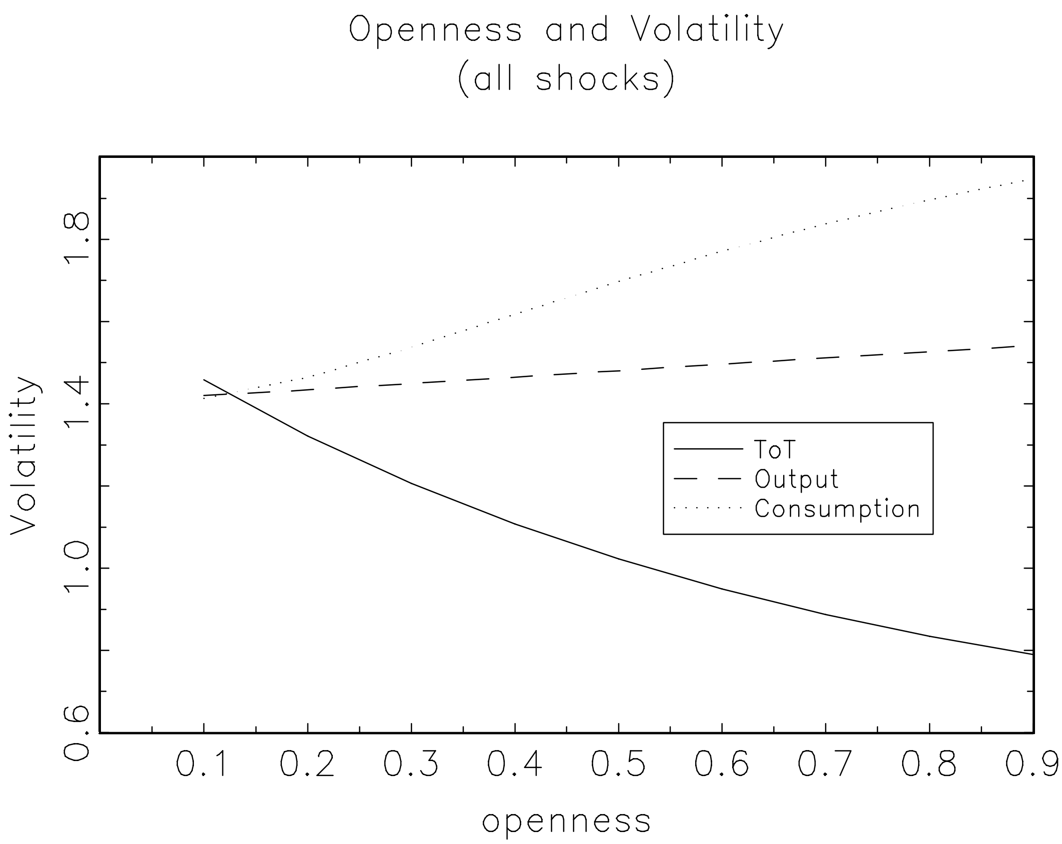


Figure 6: **Impact of Openness: Trade-off between Volatility of the Terms of Trade and Real Volatility.**