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MONETARY INTERDEPENDENCE UNDER ALTERNATIVE EXHANGE-RATE REGIMES

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ABSTRACT

This paper analyses and compares the effects of common demand and supply shocks on the setting of optimal monetary policies under a clean float, a managed exchange-rate system (such as the EMS) and a monetary union when welfare depends on unemployment and the cost of living. The results suggest that monetary union yields the smallest welfare loss and a float the greatest welfare loss and that the EMS gives France and Italy the opportunity to appreciate their currencies and reduce the damage to their welfare loss at the expense of Germany.

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1. Introduction

The European Monetary System is characterised by Germany hegemony in very much the same way that the Gold Standard was characterised by UK hegemony and Bretton Woods by US hegemony (e.g. Giavazzi and Giovannini, 1989). These are examples of managed exchange-rate regimes in the sense that Germany (UK or US) sets monetary policy for the region whilst the other countries effectively peg (pegged) their currencies to the Deutschemark (the pound or the dollar). In view of the arguments put forward by the Delors Committee in favour of economic and monetary union in Europe and the establishment of a European Central Bank, it is of importance to investigate the disadvantages of the European Monetary System compared with a European Monetary Union. This paper looks at the effectiveness and need for coordination of monetary policies, in the face of unemployment and inflation caused by adverse demand and supply shocks, under three regimes: (i) floating exchange rates; (ii) managed exchange rates and hegemony (the European Monetary System); and (iii) irrevocably fixed exchange rates and a centralised monetary policy (European Monetary Union). Since the European Community has already decided that eight member countries will have fully liberalised capital movements by 1st July 1990 and that the other countries will follow suit, it seems reasonable to assume perfect capital mobility in each of these three regimes.

2. Monetary policies under floating exchange-rates

A short-run Keynesian two-country model with nominal wage rigidity, inmobility of labour, imperfect substitution between home and foreign goods, perfect capital mobility and, for simplicity, static expectations can be written as:

$$y = -\bar{\sigma}\, r + \bar{\delta}\,(p^{*}+e-p) + \bar{f} + \gamma y^{*},\ 0 \leq \gamma < 1 \qquad (1)$$

$$y^{*} = -\bar{\sigma}\, r - \bar{\delta}\,(p^{*}+e-p) + \bar{f}^{*} + \gamma y,\ \bar{\sigma},\ \bar{\delta} > 0 \qquad (2)$$

$$m - p = y - \lambda r,\ \lambda > 0 \qquad (3)$$

$$m^* - p^* = y^* - \lambda r \qquad (4)$$

where y, $\bar{f}$, r, p, e and m denote real output, a demand shock, the (world) interest rate, the price level (an adverse supply shock), the nominal exchange-rate (price of foreign exchange in terms of domestic currency) and the money supply, respectively. Variables are expressed as percentage deviations from their steady-state values, except for r which is expressed as an arithmetic deviation from its equilibrium value. Foreign variables are denoted with an asterisk. Under floating exchange-rates both money supplies are exogenous policy instruments, since the exchange rate adjusts to keep the balance of payments in equilibrium. It follows that:

$$r = \tfrac{1}{2}[(1+\gamma)\ (f+f^*) - (m-p) - (m^*-p^*)]/(\sigma+\lambda) \qquad (5)$$

$$c \equiv p^*+e-p = \tfrac{1}{2}[(m-p) - (m^*-p^*) + (1-\gamma)\ (f^*-f)]/\delta \qquad (6)$$

$$y \equiv \tfrac{1}{2}[(2\sigma+\lambda)\ (m-p) - \lambda(m^*-p^*) + (1+\gamma)\lambda\ (f+f^*)]/(\sigma+\lambda) \qquad (7)$$

where $\sigma \equiv \bar{\sigma}/(1-\gamma)$, $\delta \equiv \bar{\delta}/(1+\gamma)$ and $f \equiv \bar{f}/(1-\gamma^2)$. Hence, a monetary expansion reduces world interest rates, leads to a depreciation of the real exchange rate and is a beggar-thy-neighbour policy. A (bond-financed) fiscal expansion increases world interest rates, leads to an appreciation of the real-exchange rate and is a locomotive policy. These results confirm the well-known analysis of Mundell (1968).

We will assume that each central bank is concerned about achieving on the one hand full employment and on the other hand ensuring a low cost-of-living index,

$$p_c = (1-\alpha)p + \alpha(p^*+e) = p + \alpha c,\ 0 < \alpha < 1 \qquad (8)$$

where α denotes the share of imports in final expenditures. Hence, the problem for the home central bank is

$$\underset{m}{\text{Min}}\ W \equiv (y-y^d)^2 + \bar{\vartheta}\ (p_c+\bar{\omega})^2,\quad y^d,\ \bar{\omega},\ \bar{\vartheta} \geq 0 \qquad (9)$$

and similarly for the foreign central bank. For example, a common adverse demand shock ($f=f^*=-d < 0$) causes unemployment and leaves the cost-of-living index unaffected, so the targets $y^d=(1+\gamma)\lambda d/(\sigma+\lambda) > 0$ and $\bar{\omega}=0$ are warranted. Alternatively, a common adverse supply shock (e.g., an increase in the wedge between producers' and consumers' wage, a detoriation in productivity or an increase in oil prices, $p=p^*=s > 0$) causes unemployment and an increase in the cost-of-living index, so $0 < y^d = \sigma s/(\sigma+\lambda) < s$ and $\bar{\omega}=s$ are warranted.

The non-cooperative outcome is where m minimises W given m^* and m^* minimises W^* given m and is denoted by the subscript F. The cooperative outcome is where m and m^* jointly minimise the global welfare loss, $W + W^*$, and is denoted by the subscript U. It is straightforward to establish that

$$m_F \equiv \left[\frac{\sigma+\lambda}{\sigma}\right] [y^d - (\vartheta/\hat{\sigma})\omega] < m_U \equiv \left[\frac{\sigma+\lambda}{\sigma}\right] y^d \qquad (10)$$

where $\frac{1}{2} < \hat{\sigma} \equiv (\sigma+\frac{1}{2}\lambda)/(\sigma+\lambda) < 1$, $\vartheta \equiv \frac{1}{4}\bar{\vartheta}\alpha^2/\delta^2$ and $\omega \equiv 2\delta\bar{\omega}/\alpha$. Note that a common demand shock creates no need for the international coordination of monetary policies, because non-cooperative decision-making already achieves full employment ($m_F= m_U= (1+\gamma)\lambda d/\sigma$, $y_F= y_U= y^d$). World interest rates fall ($r_F= r_U= -(1+\gamma)d/\sigma$), both because of the fall in the demand for goods caused by the shock and by the induced monetary expansions. A common adverse supply shock does create a need for international policy coordination, because otherwise monetary policies would be too tight and consequently there would be unemployment ($y_F= y^d-(\vartheta/\hat{\sigma})\omega < y_U= y^d$). The reason is that, in the absence of coordination, each central bank attempts to export inflation by appreciating its exchange rate. Policy coordination realises that such competitive appreciations are futile. Similar results are obtained by Oudiz and Sachs (1984), by Canzoneri and Henderson (1987), and by Oudiz and Sachs and others in Buiter and Marston (1985).

3. Managed exchange rates

The previous section considered the coordination of monetary policies under a clean float. Here an asymmetric regime of managed exchange rates is considered. In particular, the foreign central bank is assumed to be in full control of its money supply whilst the home central bank manages its

exchange rate and thereby gives up an independent monetary policy. This is in accordance with the view that the European Monetary System operates as a greater Deutschemark zone (Giavazzi and Giovannini, 1989); the Bundesbank determines the monetary policy for the whole of Europe whilst the other central banks of Europe peg and periodically realign their currencies vis-à-vis the Deutschemark. Similarly, it can be argued that the Gold Standard was characterised by UK hegemony and Bretton Woods by US hegemony. If there is pressure on the home currency to devalue ($e\uparrow$), the home central bank sells foreign currency in exchange for home currency in order to meet the deficit on the balance of payments and thereby defends its exchange rate. There is a corresponding fall in the home money supply, so that the home central bank cannot have an independent monetary policy. When e and m^*, rather than m and m^*, are exogenous, equations (5)-(7) can be rewritten as:

$$r = [-\delta e - m^* + \gamma f + f^* + \delta p + (1-\delta)p^*]/(\sigma+\lambda) \tag{11}$$

$$m = 2\delta e + m^* + (1-\gamma)\,(f-f^*) + (1-2\delta)\,(p-p^*) \tag{12}$$

$$y = [\sigma m^* + ((1-\gamma)\,\sigma+\lambda)\,f - ((1-\gamma)\sigma-\gamma\lambda)f^* + (2\sigma+\lambda)\,\delta(e-p) - ((1-2\delta)\sigma - \delta\lambda)p^*]/(\sigma+\lambda). \tag{13}$$

$$y^* = [\sigma m^* + \lambda\,(\gamma f+f^*) - \lambda\delta(e-p) - (\sigma+\lambda\delta)p^*]/(\sigma+\lambda). \tag{14}$$

A contraction in the German money supply ($m^*\downarrow$) leads to an equal fall in, say, the French money supply, because the French are defending themselves against a depreciating currency by buying up francs. Hence, the increase in European interest rates and the associated crowding out of private consumption and investment throughout Europe is twice as large as under a clean float. With a fixed exchange rate, there is no adverse effect on German net exports and employment arising from an appreciation of the Deutschemark and therefore monetary contraction in Germany increases unemployment throughout Europe by the same amount. Conversely, a German monetary expansion is now a locomotive (rather than) a beggar-thy-neighbour policy.

A devaluation of the currencies of the rest of Europe vis-à-vis the Deutschemark (e↑) improves net exports to Germany and thus boosts non-German employment and output and increases unemployment in Germany. To choke off the resulting excess supply of German money, European interest rates fall and as a result non-German money demand increases in line with non-German money supply. Since the European money supply increases and European interest rates fall, the increase in non-German output exceeds the fall in German output. Clearly, such a devaluation is a beggar-thy-neighbour policy. However, it increases the cost of living at home and decreases it in Germany.

We will now look at the situation where the central banks of the rest of Europe periodically realign and control their exchange-rate (e) to minimise W (given by (9)) and the Bundesbank chooses its money supply (m^*) to minimise W^*. Any complications arising from speculative attacks, e.g., agents selling liras for Deutschemarks, when a devaluation of the lira is anticipated, and credibility are ignored, even though all capital controls are assumed to be abolished. The reaction function of the Bundesbank is upward-sloping, because a devaluation of the other currencies causes German unemployment and a fall in the German cost of living so that the Bundesbank reacts with a monetary expansion. The reaction functions of the other central banks are downward-sloping, because a German monetary expansion boosts employment elsewhere in Europe and therefore the other central banks can afford to pay more attention to their cost-of-living targets and appreciate their currencies. Intersection of the reaction functions yields the outcome for a non-cooperative managed exchange-rate regime, which is denoted by the subscript M:

$$e_M = -[\vartheta/2\delta\ (\vartheta+\hat{\sigma})]\omega \leq e_F = e_U = 0 \tag{15}$$

$$m^*_M = \left[\frac{\sigma+\lambda}{\sigma}\right] y^d - \left[\frac{\lambda\vartheta}{2\sigma(\vartheta+\hat{\sigma})}\right]\omega \leq m^*_U \tag{16}$$

$$m_F = m^*_F \leq m_M = \left[\frac{\sigma+\lambda}{\sigma}\right] y^d - \left[\frac{(2\sigma+\lambda)\vartheta}{2\sigma(\vartheta+\hat{\sigma})}\right]\omega \leq m^*_M \leq m_U = m^*_U \tag{17}$$

$$r_U \leq r_M = -[y^d - \tfrac{1}{2}\vartheta(\vartheta+\hat{\sigma})^{-1}\omega]/\sigma \leq r_F \tag{18}$$

$$y_M = y^d - \vartheta(\vartheta+\hat{\sigma})^{-1}\omega \leq y_U = y^d \tag{19}$$

$$y_M^* = y_U^* = y^d \geq y_M \geq y_F = y_F^*. \tag{20}$$

The cooperative outcome chooses e and m^* to minimise the European welfare loss $(W+W^*)$ and yields the same full-employment outcomes as a cooperative clean float: $e_U = 0$, $y_U = y_U^* = y^d$, $m_U = m_U^* = (\sigma+\lambda)y^d/\sigma$ and $r_U = r_U^* = -y^d/\sigma$. In fact, it can be shown that international policy coordination under a managed exchange-rate system or under a clean float yields the same outcome as a European Monetary Union and are therefore all denoted by the subscript U. The associated welfare losses are:

$$0 \leq W_M = \vartheta\omega^2\,[(\vartheta+\hat{\sigma}^2)/(\vartheta+\hat{\sigma})^2] \leq W_U = W_U^* = \vartheta\omega^2 \leq \tfrac{1}{2}(W_M + W_M^*) \leq$$

$$W_M^* = \vartheta\omega^2\,[(2\vartheta+\hat{\sigma})/(\vartheta+\hat{\sigma})]^2. \tag{21}$$

In addition, it can be shown that [1]

$$\tfrac{1}{2}(W_M + W_M^*) \leq W_F = W_F^*. \tag{22}$$

One cannot say whether $W_F = W_F^*$ is less or greater than W_M^*. However, one can show that $W_F = W_F^*$ is less (greater) than or equal to W_M^*, whenever ϑ is small (large)[2].

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[1] The proof is that this inequality requires for $\omega>0$ that $g(\vartheta)\equiv\vartheta^2 + \hat{\sigma}(2-\hat{\sigma})\,\vartheta + \tfrac{1}{2}\hat{\sigma}^2 > 0$, which is the case as $g(0) = \tfrac{1}{2}\hat{\sigma}^2 > 0$ and $g'(0) = 2\vartheta + \hat{\sigma}(2-\hat{\sigma}) > 0$.

[2] $W_F = W_F^* < W_M^*$ requires that $f(\vartheta) \equiv \vartheta^2 + (2\hat{\sigma}-3\hat{\sigma}^2)\,\vartheta + \hat{\sigma}^2 - 2\hat{\sigma}^3 < 0$, so that $f(0) = \hat{\sigma}^2(1-2\hat{\sigma}) < 0$ and $f''(0) = 2$. Hence, this inequality holds for small ϑ and is violated for large ϑ.

4. Interpretation of the results

The interpretation of the above results is as follows:

(i) Coordination of monetary policies in the face of a common adverse demand or supply shock leads to full employment throughout Europe, irrespective of whether intra-European exchange rates float, are managed or are irrevocably fixed. This is achieved with an equal increase in all European money supplies and a fall in European interest rates, whilst intra-European exchange rates are unaffected. Hence, international coordination of monetary policies within Europe may facilitate the move towards a European Monetary Union.

(ii) In the face of a common adverse demand shock ($y^d > 0$, $\omega=0$), there is no need for international policy coordination as it does not create international conflict over the cost of living. This result holds for a clean float, the European Monetary System and a European Monetary Union.

(iii) A common adverse supply shock leads under a non-cooperative European managed exchange-rate system to an appreciation of the lira, franc and guilder vis-à-vis the Deutschemark even though the European economies are assumed to have symmetric structures and are hit by identical shocks. Hence, the non-German economies use an appreciation of the real exchange rate to disinflate away the consequences of an adverse supply shock. This occurs because the Bundesbank expands its money supply by more than the other European central banks. Germany achieves full employment but does not score on its cost-of-living target, whilst the rest of Europe scores less well on the unemployment target, but scores somewhat on its cost-of-living target. The rest of Europe achieves a smaller welfare loss than Germany, so that the exchange-rate realignment allows the rest of Europe to reduce the damage to its welfare at the expense of Germany.

(iv) Comparison of a non-cooperative managed exchange-rate system with a non-cooperative float shows that the latter leads to lower money stocks, higher interest rates and more unemployment because the latter leads to futile attempts to engage in competitive appreciations of the exchange rate and export inflation abroad.

(v) Comparison of a non-cooperative managed exchange-rate system with a European Monetary Union shows that the latter leads to higher money supplies and lower interest rates and thus to full employment in both Germany and the

rest of Europe. A managed exchange-rate system is worse for Germany (despite the fact that there is full employment in Germany) and better for the rest of Europe than a monetary union and for Europe as a whole it is worse than a monetary union. This is a reason why Germany may be keen on the recommendations for a more symmetric European System of Central Banks, recently proposed by the Delors Committee, and why the rest of Europe may be less keen.

(vi) A European Monetary Union yields the smallest welfare loss and a non-cooperative float yields the highest welfare loss. Under the European Monetary System France and Italy are better off than under monetary union whilst Germany is worse off, but on average Europe is better off with the European Monetary System than with a non-cooperative float and worse off with the European Monetary System than with a monetary union.

(vii) When countries are very conservative, i.e., care relatively much more about the cost of living than unemployment, then Germany prefers the European Monetary System to a non-cooperative float, else Germany prefers a floating exchange-rate regime. The reason is, of course, that the European Monetary System avoids to a certain extent competitive, **futile** attempts to appreciate the currency and thus leads to looser monetary policies and less unemployment.

5. Related work

Giavazzi and Giovannini (1986) also show that the non-German economies in a European managed exchange-rate system use an appreciation of the real exchange rate to disinflate a common adverse supply shock. However, their model does not have the real exchange rate affecting the cost of living but affecting aggregate supply through the usage of imported raw materials and their analysis does not fully compare welfare of the countries concerned for the alternative exchange-rate regimes. They also argue that with a country-specific demand shock, Germany can be better rather than worse off than the rest of Europe under a managed exchange-rate system. This result arises from the negative spill-over effects which in part relieve Germany from the bias in non-cooperative decision making. Basevi and Giavazzi (1987) perform a number of numerical exercises when the European economies do not have

identical structures and then, even under a monetary union, intra-European exchange rates need not remain fixed. This suggests that the completion of a common European market is a prerequisite for full monetary union within Europe. Kenen (1987) uses a two-country portfolio-balance model to analyse the question which exchange-rate regime allows individual governments to achieve their national objectives without international policy coordination and finds that the answer depends on both the nature and origin of the shock.

The analysis conducted in this paper is, of course, relevant for the understanding of non-cooperative stabilisation policies under alternative exchange-rate regimes and finds that a European Monetary Union is the most desirable regime. The studies in Buiter and Marston (1985) report numerical policy coordination exercises that allow for rational expectations and wage dynamics, but are restricted to floating exchange rates. One of the lessons is that international policy coordination can worsen the credibility and destroy the discipline of central banks and can thus be counterproductive (Rogoff, 1985; van der Ploeg, 1988). Hamada (1976) adopts a long-run monetary approach to the balance of payments with full employment to discuss international coordination of monetary policies under fixed exchange rates. The main result is that, in the absence of international policy coordination, inflation is too high when the increase in international reserves exceeds the average of desired balances of payments. Under floating exchange rates each country can isolate its inflation rate and there is thus no need for international policy coordination. Van der Ploeg (1987) considers a full-employment setting with capital accumulation and perfect asset mobility. Under a clean float an expansion in monetary growth reduces world real interest rates ard boosts capital accumulation and activity throughout the world (the interdependent Mundell-Tobin effect). Since inflation increases at home and nowhere else, no country wishes to carry the burden of reducing the world real interest rate and thus absence of international policy coordination implies a stale-mate in the sense that monetary growth, inflation and activity are too low whilst real interest rates are too high. Under fixed exchange rates these inefficiencies are considerably reduced, because all countries share the burden as well as the benefits of an increase in monetary growth and consequently there is much less need for international policy coordination.

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