

Does a Monetary Union Require International Fiscal Policy Co-ordination?

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I INTRODUCTION

In the debate over the set up of a single European currency, one of the principal areas of concern has been the implication of a single currency for the behaviour of sovereign fiscal authorities, and the possible need to constrain this behaviour.¹ The importance of this problem will clearly depend upon the degree of effective independence that a European Central Bank can establish. However, even with a Central Bank that is independent in the sense that it is not bound by mandate to purchase any national government debt, there will still remain a situation of strategic interaction between many sovereign fiscal authorities and the Central Bank. What are the likely outcomes of this strategic interaction?

This paper presents a theoretical analysis designed to provide some possible answers to this question. We look at a situation where the set-up of a monetary union alters the strategic environment within which fiscal authorities operate. This alteration can have profound effects on the behaviour of

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1. See for instance, *European Economy* (1990).

the fiscal authorities, depending upon the operating procedures of an "independent" Central Bank. If the Central Bank chooses to monetise national debt in an "optimal" fashion, the equilibrium under a single currency will have higher government spending, higher real interest rates, and lower investment levels than under independent multiple currencies.

The particular focus is the behaviour of fiscal authorities in some period prior to the set up of a single currency. The key element of the analysis hinges on the fact that the fiscal authorities can predict accurately the future behaviour of the Central Bank. This leads the actions of fiscal authorities to depend on the particular operating rules of the Central Bank. A variety of different assumptions might be made about these rules. The Bank could be assumed to divide up the revenue from debt monetisation according to some fixed formula, independent of current conditions. Alternatively, based on the assumption that the Bank is concerned with the welfare of the whole community, it could distribute the revenue from monetisation so as to maximise some community social welfare index. In this case, the outstanding national debt of a country relative to its trading partners will determine its level of transfers.

But if this second type of rule applies, independent fiscal authorities will take this into account in their choice of fiscal policies, and will alter policies so as to leave the country with a higher stock of external debt than it would otherwise have. One government can effectively force another to pay some of its national debt. In this sense the model gives a precise formulation of the notion of "soft" fiscal budget constraints in a monetary union. In a symmetric equilibrium of the game between monetary authorities, there is in fact never any transfer of debt burden, but nevertheless, overall public spending is higher, interest rates are higher, and investment is lower.

The results of the paper can be thought of having implications either for the design of operating procedures within a monetary union, or for the necessity of coordination between *fiscal* authorities as a prerequisite for a successful monetary union. In the first case, the monetary authority would be better not to have the discretionary ability to monetise debt. It would do better with the first rule defined above, where revenue distribution was nondiscretionary. In the second case, if sovereign fiscal authorities could effectively coordinate their fiscal policies, they would eliminate the negative externalities arising from independent fiscal actions, and welfare would be higher.²

2. Other papers that have addressed issues concerning monetary union are Canzoneri and Rogers (1990), Chang (1990), Cassella (1990), and Voss (1990). None of these papers focus on the strategic interaction between fiscal authorities within the union in the manner done here.

II THE MODEL

In this section I outline the structure of the model employed. There are two periods within which actions are taken. The first period, period zero, can be thought of as "before" the monetary union is set up, and the second period, period 1, as "after" the formation of the union. The critical issue is the strategic interaction between the behaviour of independent fiscal authorities in period zero and the Eurofed in period 1. Throughout the paper highly restrictive assumptions on the specification of preferences and technology are made. This seems justified in order to better illustrate the points to be made. In fact very few of these assumptions are critical for the main results.

Limit the analysis to that of two countries that make up a "world" economy. This could easily be generalised without losing any of the qualitative results. Call the countries Home and Foreign. In each country there are consumers and firms who have, by assumption, unrestricted access to international capital markets. There is no uncertainty.

Consumers

Consumers must divide their income up between consumption in the two periods. Consumers in country j have utility given by:

$$U = \log c_{0j}^{\theta} m_{0j}^{(1-\theta)} + \gamma \log g_{0j} + \beta \log c_{1j}^{\theta} m_{1j}^{(1-\theta)} \quad (1)$$

$$0 < \beta < 1, \quad 0 < \theta < 1. \quad j = H, F.$$

In (1), c_{ij} represents consumption of the homogeneous world good in country j in time i , while m_{ij} represents real money holdings for country j , time i . Assume that, in the absence of a monetary union, it is the "own" currency which enters into (1) for each j . The argument for using a "money in the utility function" specification is that (1) can represent an indirect utility function where the role of money is to reduce transactions costs of trading, not directly modelled at this level, but implicit in a "higher level" maximisation procedure. Feenstra (1986) gives a rigorous exposition of this argument.³

The variable g_{0j} represents consumption of a government provided good in the first period. This is taken as given by private households in choosing

3. An alternative way to introduce money into the model would be to impose a cash-in-advance constraint on transactions (see Stockman, 1980, Helpman, 1981 or Lucas, 1982). This would require that all consumption be financed by previously accumulated money balances. But the cash-in-advance model requires a particular lagged structure of income payments that make it difficult to integrate into a two period model with investment decisions.

optimal consumption and money holdings.⁴

Consumers in country j own the j firm and pay taxes in each period to the j government. Take the home country for example. In making consumption allocation decisions, home consumers face the constraints:

$$p_{0H}c_{0H} + M_{0H} + e_0q_F B_{pH} + t_{0H} = p_{0H}(y_{0H} - k_H) + M_H \quad (2)$$

$$p_{1H}c_{1H} + M_{1H} + t_{1H} = p_{1H}y_{1H}(k_H) + e_1 B_{pH} + M_{0H} \quad (3)$$

p_{iH} is the home country price level in time i , M_{iH} the nominal money holdings of the home country's household in time i , B_{pH} the private purchase of foreign currency denominated bonds, where e_i is the exchange rate (the price of foreign currency), and q_F is the unit price of the bond (the inverse of one plus the foreign nominal interest rate). Finally t_{iH} represents taxes paid to the fiscal authority in time i . The assumption that bonds are denominated in foreign currency alone is purely for notational simplicity. Interest rate parity obviously ensures that home and foreign currency denominated bonds are perfect substitutes. We may write the price of a domestic nominal bond as $q_H = e_0q_F/e_1$.⁵ Foreign households face a similar set of constraints.

Firms

Firms in each country have the problem of choosing investment rates to maximise profits. The home firm maximises:

$$\pi(q, k) = (e_0q_F/e_1)p_{1H}y_{1H}(k_H) - p_{0H}k_H \quad (4)$$

Assuming a concave production technology, this implies a solution $k_H(q)$, where $q (=q_H p_{1H}/p_{0H})$ is defined as the real discount factor, or the inverse of one plus the real interest rate. By concavity, $k_H'(q) > 0$. Investment in the foreign firm is analogous, giving the solution $k_F(q)$. Since there is just one "world" commodity, and free trade, we must have $p_H = ep_F$ in each period, so the real discount factor faced by firms in each country is the same. We assume identical technologies, therefore investment must be equal across countries.

4. Alternatively, we could think of g_{0j} as the consumption of some initial "old" generation, who live only for period 0 in our model, and consume only if resources are provided by government. Under this interpretation, the role of government is purely redistributive. The only difference in the results with this alternative specification is one of interpretation.

5. In these budget constraints, we have not allowed for country i residents to purchase country j money, $i \neq j$. In fact, allowing them to do so would make no difference at all, since with a positive nominal interest rate they would never hold foreign money. When there is a monetary union in the second period, home and foreign money are perfect substitutes (in the second period).

Government

Governments in each country have the job of providing the good g_{0j} . They do this by taxing their own private sector directly, and by using any revenue accrued from the Central Bank. The budget constraints of the home government are written as:

$$p_{0H}g_{0H} = t_{0H} + e_0q_F B_g + X_{0H} \quad (5)$$

$$t_{1H} + X_{1H} = e_1 B_g \quad (6)$$

Here B_g is the first period borrowing of the home government from the private sector, and X_{iH} represents the issue of securities to the Central Bank, or the extent of government borrowing that is "monetised". The freedom with which the government can do this will clearly depend upon the exchange rate arrangement. Under a free float, the government, with the consent of the national Central Bank, is free to choose whatever pattern of X_i 's it likes. Under a monetary union, it is the Eurofed that chooses the levels of the X_{1j} 's. The foreign government constraints can be described in an identical manner.

Central Banks

The budget constraints of Central Banks will differ depending upon whether the monetary union is in existence or not. Take first the case of independent Central Banks, or, equivalently, multiple currencies in every period. Again focus on the home country case. Then the home Central Bank has the following set of budget constraints:

$$\bar{M}_{0H} - \bar{M}_H = X_{0H} + e_0 q_F B_{bH} \quad (7)$$

$$\bar{M}_{1H} - \bar{M}_{0H} = X_{1H} - e_1 B_{bH} \quad (8)$$

Where \bar{M}_{iH} denotes the aggregate money stock. Thus, in the first period, the Central Bank finances the purchase of government issue by printing money. In addition, it may purchase foreign reserves, or what is the same thing, foreign denominated securities, at domestic price $e_0 q_F$. In the second period, it again finances government issue, and in addition, earns $e_1 B_{bH}$ on its holdings of foreign securities. Note at this stage that there are no restrictions on the nature of the exchange rate regime that the Central Bank follows. However, this specification, along with the government budget constraints, *does* imply that the public sector satisfies an independent inter-temporal solvency constraint. Thus, this specification *excludes* by assumption

the case of a monetary union.

Now let's look at a monetary union. Since (by assumption) the monetary union comes about only in the second period, the date 0 Central Bank budget constraints are as before.

The monetary union is assumed to be set up at the beginning of date 1. In that case, the budget constraints of the two Central Banks for date 1 are pooled. There is one autonomous monetary issuing authority, which we call the Eurofed. Any government issue, from either country, which is financed by money, must go through the Eurofed.

In setting up the Eurofed, we must confront two crucial issues.⁶ First, at what rate will the old home and foreign currencies be converted to the new Eurocurrency? Second, what rule will the Eurofed use for the distribution of revenues earned to individual countries? This second question is in fact a two part one, since the Eurofed must decide upon both an overall issue of money, and the distribution of the revenues from this between the two countries.

The first question is one that I in fact avoid, by making a very simple assumption. I assume that the old currency of either country trades at par under the new Central Bank. This of course presents a temptation for a country to engage in an excessively expansionary monetary policy in the initial period. But I eliminate this possibility by assuming that monetary growth in the first period is set to zero. This seems to be in line with reality. Monetary discipline, or at least convergence to a common inflation rate, is a prerequisite for admittance to a monetary union. In any case, I am primarily interested in the incentive effects of the union on fiscal policy, rather than on the behaviour of the pre-union monetary authorities.

The second question is solved by assuming that the Eurofed sticks to a zero inflation policy. In fact, because money is "neutral" in the second period, there will be no optimal rate of inflation, and so the money stock of the Eurofed will not be pinned down. Since I then have to artificially pick a growth rate, I may as well pick zero. In that case, any monetisation of country *i*'s debt involves a pure transfer from country *j*. This is at the heart of all the results.

To summarise, the budget constraints of Central Banks in the Monetary Union will be characterised by:

$$\bar{M}_{0j} = \bar{M}_j \quad j=H, F. \quad \bar{M}_1 = \bar{M}_{0H} + \bar{M}_{0F} + \tilde{X}_{1H} + \tilde{X}_{1F} \quad (9)$$

In line with the remarks above, we will end up setting $\tilde{X}_{1H} + \tilde{X}_{1F} = 0$. Now I go on to discuss a competitive equilibrium in this two country model taking the pattern of taxes, government spending, and Central Bank transfers as given, and known with certainty by the private sector.

6. See Chang (1990), for an interesting discussion of these features of a monetary union.

III COMPETITIVE EQUILIBRIUM UNDER ALTERNATIVE EXCHANGE RATE REGIMES

In this section I construct the competitive equilibria of the model under a variety of assumptions about the exchange rate regime. The major distinction between regimes concerns whether or not the consolidated public sector is constrained to match expenditures and receipts, in present value terms. Under free floating this will always be the case, and it will also continue to hold under a fixed exchange rate regime as long as the Central Bank satisfies a present value constraint. But in a monetary union this is explicitly not the case. There may be fiscal transfers between countries. The presence of these transfers is the critical element in the paper. The reader of Helpman (1981) will find these arguments familiar.

I derive a competitive equilibrium to the two country model taking as given a path of taxes, government redistribution policies, and Central Bank transfers. It will be helpful first to rewrite the private sector budget constraint of country j as:

$$p_{0j}c_{0j} + M_{0j}(1 - q_j) + q_j(p_{1j}c_{1j} + M_{1j}) = p_{0j}(y_{0j} - k_j) + M_j - t_{0j} + q_j(p_{1j}y_{1j}(k_j) - t_{1j}) \quad (10)$$

Equation (10) must hold in any exchange rate regime. Households in country j choose consumption rates and money holdings for each period, taking prices, taxes, income, and interest rates as given, in order to maximise utility (1). That is, they solve problem P1:

P1 Choose c_{ij}, M_{ij} to Maximise (1) Subject to (2) and (3), $i=0, j=H, F$.

The definition of a competitive equilibrium differs according to the exchange rate regime. A competitive equilibrium under independent public budget constraints is defined as the set $X = \{c_{ij}, k_j, \hat{p}_{ij}, \hat{e}_i, \hat{q}_j\}$ $i=0, 1, j=H, F$, that satisfies:

- (i) Consumer maximisation, given by P1.
- (ii) Profit maximisation in each country.
- (iii) Government budget constraints, given by (5) and (6) for $j=H, F$.
- (iv) Independent Central Bank budget constraints, given by (7) and (8) for $j=H, F$.
- (v) Market clearing, given by

$$c_{0H} + c_{0F} + k_H + k_F + g_H + g_F = y_{0H} + y_{0F}$$

$$M_{0j} = \bar{M}_{0j} = \bar{M}$$

$$J = H, F.$$

$$M_{1j} = \bar{M}_{1j} = \bar{M}$$

With multiple currencies, the money market for each country must clear independently in each time period.

Alternatively, a competitive equilibrium with a Monetary Union, (set up in the second period) is defined as the set $Z=(\hat{c}_{ij}, \hat{k}_j, \hat{p}_{ij}, \hat{e}_i, \hat{q}_j)$ $i=0, 1, j=H, F$, that satisfies:

- (i) Consumer maximisation, given by P1.
- (ii) Profit maximisation in each country.
- (iii) Government budget constraints, given by (5) and (6) for $j=H, F$.
- (iv) Pooled Central Bank budget constraints, given by (9).
- (v) Market clearing, given by:

$$c_{0H}+c_{0F}+k_H+k_F+g_H+g_F=y_{0H}+y_{0F}$$

$$M_{0j} = \bar{M}_{0j} = \bar{M} \quad J = H, F.$$

$$M_{1H} = M_{1F} = \bar{M}_1 = 2\bar{M}$$

The single important difference between the two regimes is just the second period Central Bank budget constraint. The notation makes clear that we are assuming (a) zero money growth in each period, and (b) equal first period money stocks in each country.

Appendix A presents the full solution for the competitive equilibria in each regime. It will be helpful to state a number of results derived there.

Result 1: For given spending rates g_H and g_F , the real interest factor q and investment in each country is independent of the exchange rate regime.

This is an immediate consequence of the assumption of identical preferences in the two countries. A monetary union differs qualitatively from a multiple currency economy only due to the possibility of income transfers across countries. With identical preferences, transfers cannot affect the real interest rate. Hence investment is unaffected. The result is demonstrated in Appendix A. The market real discount factor is given by:

$$q = \beta(y_{0H}+y_{0F}-k_H-k_F-g_H-g_F)/(y_{1H}(k_H)+y_{1F}(k_F)) \quad (11)$$

The optimal investment policy of firms implies, from (4)

$$qy_{1j}'(k_j)=1, \quad j=H, F. \quad (12)$$

We may illustrate the determination of the world real interest rate and investment for each country in Figure 1. The qq curve describes equation (11), or, implicitly, the world capital supply locus. The DD curve represents (12), or

the capital demand curve, the same for each country. An equilibrium q and k_0 is described by the intersection of the two. From (11) we may see that a rise in g_H or g_F will unambiguously raise the world real interest rate and reduce investment expenditure in each country.

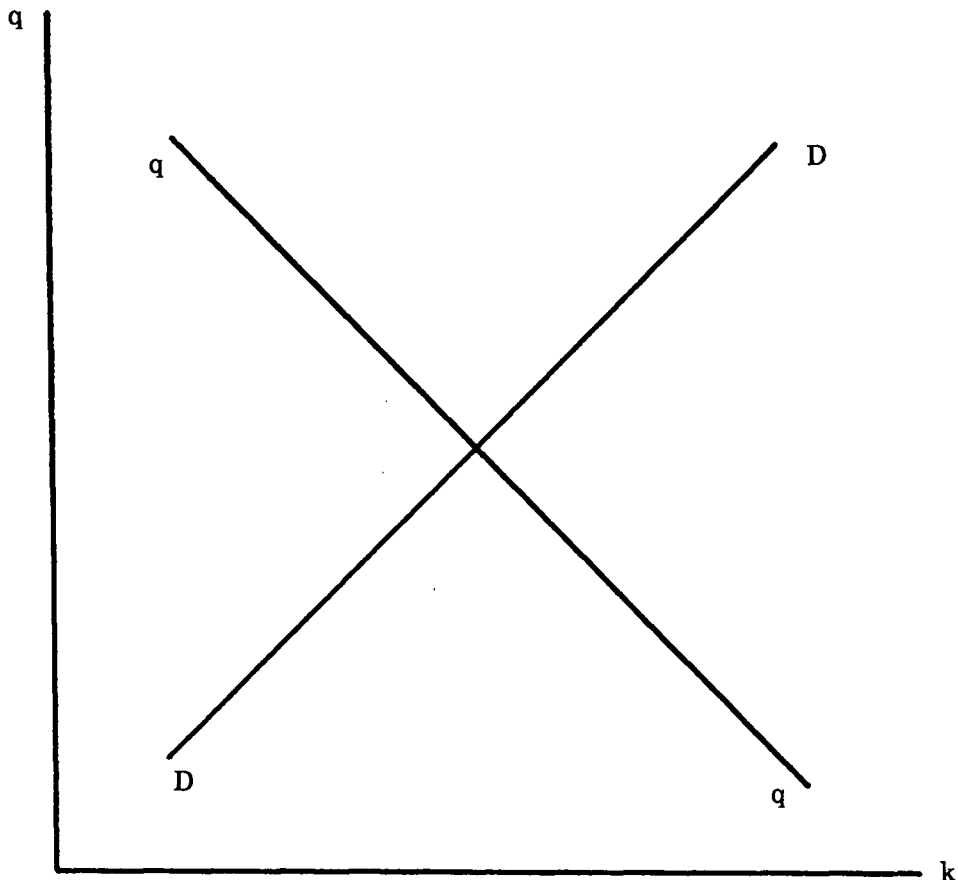


Figure 1

We now move on to analyse the equilibrium allocations in alternative exchange rate regimes.

Multiple Currency Regimes

First focus on regimes in which the public sector budget constraints are intertemporally balanced, or equivalently, there are multiple currencies. This may include both floating exchange rates and fixed exchange rates in which there are no transfers between countries. We now state:

Result 2: When public sector budget constraints are intertemporally balanced, for each country, the following condition holds:

$$c_{0j} + qc_{1j} = y_{0j} - k_j - g_j + qy_{1j} \quad (13)$$

Thus consumption, in each country, adds up, in present value terms, to the value of income, less investment and government spending. Condition (13) is obtained simply by adding together the budget constraints of the private sector, government, and Central Banks in each country under independent public sector budget constraints. It is then straightforward to use first order conditions for the consumers maximisation problem and market clearing to derive the solutions for consumption allocations under independent budget constraints. These can be written as:

$$c_{0j} = (1+\beta)^{-1}(y_{0j}-k_j-g_j+qy_{1j}) \quad c_{1j} = \beta/(q(1+\beta)) (y_{0j}-k_j-g_j+qy_{1j}) \quad (14)$$

where q is given as in (11).

The solutions for real balances, money holdings and nominal interest rates can be obtained from the first order conditions for consumer maximisation. Appendix A derives the following solutions:

$$M_{0j}/p_{0j}(1-q_j) = M_j/p_j(1-q_j) = (1-\theta)/\theta \quad c_{0j} \quad (15)$$

$$M_{1j}/p_{1j} = (1-\theta)/\theta \quad c_{1j} \quad (16)$$

$$q_j = q(p_{0j}/p_{1j}) = q(c_{1j}/c_{0j}) (1-q_j) = \beta/(1+\beta) \quad (17)$$

Monetary Union

I now turn to the analysis of the equilibrium under a monetary union, again taking all policy settings as given. As we know already, the solution for the real interest rate is the same as under multiple currencies, so long as the g_i variables are the same. Using this result, Appendix A derives the following solutions for consumption allocations in each country:

$$c_{0j} = \theta/(\beta+\theta)[y_{0j} - k_j - g_j + q(y_{1j} + (\tilde{X}_j + M_j)/p_1)] \quad (18)$$

$$c_{1j} = \beta/q \quad c_{0j} \quad j = H, F. \quad (19)$$

where \tilde{X}_j is the transfer from the Eurofed to country j consumers, and M_j denotes money carried over from the previous period. Now using optimal money demand functions, the equilibrium condition for the money market,

and that for the goods market, in the second period, we have

$$\bar{M}_1 = M_{1H} + M_{1F} = (1-\theta)/\theta p_1(c_{1H}+c_{1F}) = (1-\theta)/\theta p_1(y_{1H} + y_{1F}) \quad (20)$$

Substituting this into (18), we arrive at the solution for consumption rates

$$c_{0j} = \theta/(\beta + \theta)[y_{0j} - k_j - g_j + q(y_{1j} + (\bar{X}_j + M_j)/\bar{M}_1)(y_{1H} + y_{1F})(1-\theta)/\theta)] \quad (21)$$

Unlike the environment with multiple currencies, the equilibrium under the monetary union does not require that, at the national level, the present value of consumption equals the present value of output. This is because, with a second period monetary union, the higher is the fraction of the world money stock, \bar{M}_1 , held by country j , the higher is j 's purchasing power, and therefore the higher is its wealth. The fraction of the world money stock held by country j is determined by (a) its first period money supply M_j , carried over by residents of j , and (b) the transfer \bar{X}_j from the Eurofed. As discussed in the previous section, we assume that M_j is common across countries, since we assume first period monetary growth convergence preceding the union. Thus a country's share of second period world money supply, and therefore its wealth, is directly affected only by the transfer policies of the Eurofed.

Equilibrium holdings of real balances, and nominal interest rates in each country, in a monetary union, are written as:

$$M_{0j}/p_{0j}(1-q_j) = M_j/p_{0j}(1-q_j) = (1-\theta)/\theta c_{0j} \quad (22)$$

$$M_{1j}/p_1 = (1-\theta)/c_{j1} \quad (23)$$

$$q_j = q(p_{0j}/p_1) = \beta(c_{j0}/c_{j1}) (c_{j1}/c_{j0}) (1-q_j) = \beta/(1+\beta) \quad (24)$$

In the first period, the individual country money markets must clear, with country j residents holding all country j currency, in equilibrium. In the second period, the world money market clears. Given the assumptions made about monetary policy, the nominal interest rate under a monetary union is the same as under multiple currencies.

Using these solutions, we may state:

Result 3: With identical first period income and government spending rates across countries, and zero transfers, the competitive equilibrium under a monetary union is the same as that under independent budget constraints.

To show this just take (21), setting $q = \beta(y_0 - g_0 - k_0)/y_1$, $X_{1j} = 0$, and $M_j/\bar{M} = \frac{1}{2}$, and we get the solution for c_{0j} :

$$c_{0j} = y_0 - k_0 - g_0.$$

This result is hardly surprising, since with complete symmetry each country must consume half of world output, after investment and government spending have been taken away. I state the result principally because in the symmetric Nash equilibrium of the game between fiscal authorities outlined below, transfers between countries through the Eurofed are in fact zero, yet we shall see that the incentives in the game under a monetary union lead to very different outcomes than those under independent budget constraints.

IV DETERMINATION OF OPTIMAL FISCAL POLICY UNDER ALTERNATIVE REGIMES

Using the solutions to the competitive equilibrium model for the two alternative regimes, I now model the optimal determination of the levels of government spending for the fiscal authorities, and, in the case of a monetary union, the determination of the transfer policy of the Eurofed.

The approach taken is to assume that a fiscal authority in any country is benevolent in the sense that it wishes to maximise utility of the domestic representative agent. However, it must do this conditional on the solutions to the competitive equilibrium — the fiscal authority is not an omnipotent central planner who chooses all allocations for the economy directly.

Optimal Fiscal Policy under Multiple Currencies

In choosing g_H , the home government will take account of the effect that its choice has on the world real interest rate. Governments are “large players” in a strategic sense. This implies that the action of each government has direct effect on the welfare of the other country. As a result, the determination of g_j for each country becomes a game between the two governments. In this game the strategies of the two players are g_H and g_F . I now demonstrate that under the assumptions already made, the Nash equilibrium of this game is efficient. In other words, there are no inefficiencies from “sovereignty” in fiscal policy when there are multiple currencies. To allow for a complete closed form solution, a further assumption is made here. In what follows, assume that $y_1(k) = Ak^\alpha$, for $A > 0$, $0 < \alpha < 1$.

From the competitive equilibrium solutions under multiple currencies, given by (11) and (14)-(17), we may substitute into (1) to derive the objective functions of government j , written as:

$$\hat{U}_H(g_H, g_F) \quad \hat{U}_F(g_H, g_F) \tag{25}$$

A Nash equilibrium of the game between governments in the presence of multiple currencies is the solution (\hat{g}_H, \hat{g}_N) that solves:

$$\begin{array}{cc}
 \text{P2 Maximise } \hat{U}_H(g_H, g_F) & \text{Maximise } \hat{U}_F(\hat{g}_H, g_F) \\
 g_H & g_F
 \end{array}$$

Clearly a Nash equilibrium as defined subsumes the competitive equilibrium allocations. The functions (25) are constructed by taking (1), and rearranging to get:

$$U_j = \log c_{0j} + \gamma \log g_j + \beta \log c_{1j} - (1 - \theta) \log (1 - q_j) + K_0 \tag{26}$$

where K_0 is a constant, depending upon the parameters β and θ . Then substituting from the solutions (11) and (14)-(17), we arrive at:

$$U_j = (1 + \beta) \log (y_{0j} - k_j - g_j + q(g_j, g_{-j})y_{1j}) + \gamma \log g_j - \beta \log q(g_j, g_{-j}) \tag{27}$$

where the function $q(g_j, g_{-j})$ describes the implicit solution for the interest rate factor given in (11) and (12), the notation being interpreted such that if $j=H$, $-j$ denotes F , and vice versa.

With identical preferences and endowments, the symmetric Nash equilibrium for $g_H = g_F$, using (27) is:

$$g^N = \gamma / (1 + \gamma) (y_0 - k_0) \tag{28}$$

It then follows that the common solution for k is:

$$k = \beta \alpha y_0 / (1 + \gamma + \beta \alpha) \tag{29}$$

It is easy to verify using (27) that a symmetric cooperative determination of g_N and g_F would produce the identical values. Thus there are *no* Nash inefficiencies of independent policy making in the presence of multiple currencies.

The reason for this result is not hard to divine. With independent national budget constraints, the only spillovers that occur across markets are "pecuniary" externalities. Government policy in country j affects country i only through its impact on world real interest rates. But with identical preferences and technology, there is no net asset trade between countries, and thus to a first order, the welfare effect of interest rate changes are zero. Thus, in the absence of any effective spillovers between countries, a Nash equilibrium of the game is fully efficient.

Of course this efficiency result could be overturned by allowing for differences between countries that gives rise to net asset trade. However, these

types of spillovers are well known, though probably not important in reality. What I wish to focus on is the additional policy externalities introduced by moving to a monetary union, even *with* zero asset trade between countries.

Monetary Union

The determination of optimal fiscal policies in a monetary union is more difficult than under independent budget constraints. The principal issue to address is how transfers from the Eurofed are determined. We will see that there can be a dramatic difference in equilibrium outcomes depending upon the assumptions made in this respect. In a sense then, our results suggest the appropriate design of the operating rules of the Eurofed. We return to this below.

Recall that, once in the monetary union, the Eurofed must make decisions both about the aggregate growth rate of money, or the aggregate seignorage revenue, and the distribution of revenue between countries. As noted, we choose zero as a benchmark for the aggregate growth rate of money. Thus, the issue of revenue transfer is the only one that has to be explicitly addressed. Three different transfer mechanisms are examined. The first one is based on the presumption that the Eurofed can follow a discretionary policy of choosing transfers optimally. The second assumes a transfer rule based on public debt outstanding, while the third takes transfers as a given prearranged fraction of the total seignorage revenue, beyond the control of the Eurofed decision makers.

(i) *Optimal Discretionary Transfers*

Assume that the Eurofed has to decide, in period 1, the transfer to each country, \tilde{X}_{1j} , subject to the constraint that $\tilde{X}_{1H} + \tilde{X}_{1F} = 0$. What should we use for the Eurofed's objective function? Given the symmetry of the model, it is natural to take this as $U_H + U_F$; the equal-weighted sum of national utilities.

To derive the joint solution to the fiscal policy game and the transfers of the Eurofed, we start in period 1, taking the levels of private and public debt as given. Thus, from the standpoint of the Eurofed, in period 1, consumption of country j is:

$$c_{1j} = y(k_j) + (B_{pj} - t_{1j})/p_1 = y(k_j) + (B_{pj} - B_{gj} + \tilde{X}_{1j})/p_1 \quad (30)$$

Note that the aggregate money growth constraint removes the ability of the Eurofed to affect p_1 . Then, the Eurofed chooses \tilde{X}_{1H} to maximise (since real balances are proportional to consumption in period 1).

$$\log(y(k_H) + (B_{pH} - B_{gH} + \tilde{X}_{1H})/p_1) + \log(y(k_F) + (B_{pF} - B_{gF} - \tilde{X}_{1H})/p_1)$$

Using symmetry, this gives:

$$\tilde{X}_{1H} = \frac{1}{2}(B_{gH} - B_{gF}) - \frac{1}{2}(B_{pH} - B_{pF}) \quad (31)$$

This gives, conditional on the debt levels of the public and private sectors, the optimal transfers. Then if the home country has a high level of external debt, $(B_g - B_{gF}) > 0$, then it will be a net recipient. Of course there is no reason to expect that the relative levels of debt will be determined oblivious to this transfer policy. The government of each country will in fact choose to take the transfer function into account in its first period decision.

From (31) the transfer from the Eurofed depends upon national debt, but because consumers are forward looking in their savings behaviour, national debt will depend partly on the predicted transfers. In order to derive the equilibrium transfer function, one must compute the second part of this inter-relationship. Note that, although in equilibrium, consumers will accurately forecast transfers, since this is a rational expectations model, behaving competitively, they do not take into account the marginal effect of their savings decisions on the transfers. Appendix B shows that, in a competitive equilibrium under a monetary union:

$$q(B_{pF} - B_{pH})/p_1 = \beta(g_F - g_H)/(1+\beta) + q_2\tilde{X}_{1H}/p_1(1+\beta) + q(B_{gF} - B_{gH})/p_1 \quad (32)$$

Now we may substitute this into (31), using the definition of \tilde{X}_{1H} , to derive the equilibrium transfer function, conditional on government spending. This gives:

$$q\tilde{X}_{1H}/p_1 = \frac{1}{2}(g_H - g_F) \quad (33)$$

If the Home country has a higher rate of first period government spending in period 0, it will come into the second period with a positive level of external debt, as Home consumers desire to smooth out consumption over the two periods. This will precipitate a positive transfer from the Eurofed.

Finally, we can substitute this transfer function into the competitive equilibrium allocations for the monetary union, given by (11), and (21)-(24), substitute these in turn into (1) for $j=H, F$ to derive objective functions for each government, and analyse the game between fiscal authorities in the first period in the choice of government spending levels.

Defining the objective functions as $\tilde{U}_H(g_H, g_F)$ and $\tilde{U}_F(g_H, g_F)$, we can define a Nash equilibrium as the pair $(\tilde{g}_H, \tilde{g}_F)$ that solve:

$$\begin{array}{ccc} \text{P3} & \text{Maximise } \tilde{U}_H(g_H, \tilde{g}_F) & \text{Maximise } \tilde{U}_F(\tilde{g}_H, g_F) \\ & g_H & g_F \end{array}$$

The objective functions for P3 can be derived in the same manner as those of the multiple currency case. The symmetric Nash solution to this game gives:

$$g = \gamma \left(\frac{1}{2} + \gamma \right) (y_0 - k) \quad (34)$$

Now, using the optimal investment condition, we may derive

$$k = \beta \alpha \left(\frac{1}{2} \right) / \left(\frac{1}{2} + \gamma + \beta \alpha \right) y_0 \quad (35)$$

In a Nash equilibrium of the fiscal policy game with a monetary union, government spending levels are higher in each country, and the level of investment is lower. Consequently, the world real interest rate is higher. Moreover, government spending levels are inefficient. In fact, each country ends up with a lower utility level than under multiple currencies, since government spending is inefficiently high, and transfers from the Eurofed are zero in equilibrium. If governments could cooperate at time zero, they would choose to reduce spending, in fact reduce them to precisely their values in a Nash equilibrium with independent budget constraints.

This suggests to us that the idea that the Eurofed should just choose an optimal pattern of transfers given the existing debt levels at its inception, is a very poor one. Governments are likely to take this into account and choose inefficient fiscal policies in a non-cooperative equilibrium, leading to a lower growth rate in each country, and making all countries unambiguously worse off. The pooling of budget constraints in the second period, along with the transfer policy of the Eurofed, opens up a negative externality between national fiscal policies that is absent in the situation of independent budget constraints.

(ii) *Public Debt Transfer Rule*

The second operating rule for the determination of transfers is based on public debt outstanding. This might be more realistic as a description of a community Central Bank than the previous assumption of complete discretion. Nevertheless, this also gives rise to a negative externality between national fiscal policies.

To see this, make the assumption that, again, the Eurofed is constrained by the zero aggregate money growth rule, but it determines transfers to country j in proportion to the difference between public debt of country j and the average community public debt. Thus:

$$\tilde{X}_{1j}/p_1 = B_{gj} - \frac{1}{2}(B_{gH} + B_{gF}) \quad (36)$$

In this case, the externality operates through public debt, rather than external national debt. Therefore, other things being equal, the government of each country will desire to have a higher public debt. In fact, unless we put some additional constraint on the problem, there is in fact no finite solution for public debt in the fiscal policy game, since each government will issue an unbounded value of public debt which goes to finance transfers to domestic residents in the initial period. Accordingly, we impose the additional constraint that $t_{0j} \geq 0$; tax rates must be non negative. In this case, each government will clearly set $t_{0j} = 0$, in order to maximise the value of public debt in the second period. Thus $qB_{gj} = g_j$ will always characterise a solution to this game.

Substituting this into (36), we find that the transfer function under the public debt transfer rule is exactly as in the case with discretionary transfers. Thus, the game has exactly the same form as P3, and so conditions (34) and (35) characterise an equilibrium to this game also. Again, public spending and interest rates are inefficiently high. However, in this example the higher public spending is unambiguously associated with a higher public debt, in both countries. In the previous case the distribution of national debt between public and private was irrelevant, due to "Ricardian Equivalence".

(iii) *Fixed Transfers*

From a welfare point of view, a better set of operating rules for the Eurofed is to distribute seignorage revenue in some fixed, non-discretionary manner. Say that transfers are set at a fixed level. In this case the natural transfer would be zero to each country, stated in advance. This would eliminate the negative strategic interaction between fiscal authorities in the first period, and in this simple model, exactly replicate the efficient solution under independent budget constraints.

Although this would be the optimal transfer policy, the problem is that, without some form of binding precommitment, it is not time consistent. If the Eurofed operates independently, with discretionary powers, the inferior equilibria described above will always occur. These results then suggest that a European Central Bank effectively independent of national governments will not guarantee an efficient outcome for the determination of monetary and fiscal policy. It is necessary that the discretionary powers of the Eurofed need to be circumscribed so that it cannot engage in redistributive fiscal policies.

From a game theoretic point of view, the result may be understood by "second best" reasoning. If we add a benevolent player (the Eurofed) to a

game of conflict between two original players, there is no necessary implication that the new outcome is welfare enhancing. In this case welfare falls because of the additional strategic channels introduced by the benevolent player.

Alternatively, the model might be interpreted as suggesting the need for effective coordination of fiscal policy in a monetary union. Under this interpretation, the model gives a precise sense in which the introduction of a monetary union "softens" the budget constraint facing each government. Holding foreign public debt as given, a one unit increase in domestic debt implies a less than one unit increase in the present value of tax revenue, when governments recognise the incentives and constraints facing the future monetary authority. With effective international fiscal coordination, the fiscal budget constraint would once more be perceived to be exactly as "hard" as it in actual fact is.

V CONCLUSIONS

This paper examines only one aspect of the workings of a monetary union. In fact there is no "need" for a monetary union in the model as set out, since at best, the union can leave welfare unaffected. But the point of the paper was to illustrate a potential negative aspect of a single currency regime. It seemed better to illustrate this point, and the basic strategic linkage underlying it, in a model uncluttered by other factors. Of course there are many other positive features of a monetary union, perhaps much more important than those in the paper, that are left out. An important one is the transactions costs of multiple currencies, not modelled at all here. If these were large, the welfare statements made above would have to be qualified. Canzoneri and Rogers (1990) discuss these in detail.

The model does nevertheless, give some indication of the way to avoid costly strategic inefficiencies that can arise when a supra national institution leads to a partial pooling of budget constraints. The core implication of the paper is that it is difficult to envisage how fiscal authorities can operate independently of one another under the umbrella of a monetary union.

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APPENDIX A

In this Appendix the results stated in Section III are established. In order to do this, the competitive equilibrium under the two different regimes must be computed. Take the maximisation problem for country j , described as P1. This implies the conditions:

$$c_{0j}^{-1} = \theta/(1-\theta)M_{0j}/p_{0j}(1-q_j) \quad (A1)$$

$$c_{1j}^{-1} = \theta/(1-\theta)M_{1j}/p_{1j} \quad (A2)$$

$$c_{0j}^{-1} = (\beta/q_j) c_{1j}^{-1} \quad (A3)$$

First we look at the multiple currency regime. Imposing the fiscal and monetary authority's budget constraint on (10) gives condition (13), and so Result 2. Then, impose (A2) on (13) to get (14). (15) and (16) follow directly from (A1) and (A2), and (17) follows from (A1), (A2) and (A3).

Using commodity market clearing gives Result 1 and (11) for the multiple currency regime. With full symmetry it is then easy to show the part of Result 3 that pertains to the multiple currency regime.

Now look at the Monetary Union. To establish Result 1, use (A1)-(A3), together with (10), to derive the demand functions under a monetary union as

$$c_{0j} = \theta(1+\beta)[y_{0j} - k_j - g_j + \bar{M} + q(y_{1j} + (\tilde{X}_j)/p_1)] \quad (A4)$$

$$M_{0j}/p_{0j}(1-q_j) = (1-\theta)/(1+\beta)[y_{0j} - k_j - g_j + \bar{M} + q(y_{1j} + (\tilde{X}_j)/p_1)] \quad (A5)$$

$$M_{1j}/p_1 = (1-\theta)/((1+\beta)q_j)[y_{0j} - k_j - g_j + \bar{M} + q(y_{1j} + (\tilde{X}_j)/p_1)] \quad (A6)$$

Now using (A4) and (A2) to derive demand functions for real balances, we can impose first period commodity market clearing, and money market clearing in both periods, as defined in the text. Result 1 can easily be derived from these.

To derive (18), take the conditions (A2) and (A3) above. Then impose first period money market clearing in (10). Using (A2) and (A3) in the resulting expression for (10) gives (18).

APPENDIX B

To derive expression (32), take (A4) for countries H and F separately. By (2), amended to include first period money market clearing, the value of home private assets is:

$$qB_{pH} = y_{0H} - k_H - g_H + qB_{gH} - \theta/(1+\beta)[y_{0H} - k_H - g_H + \bar{M}/p + q(y_{1j} + (\bar{X}_j)/p_1)] \quad (A7)$$

Now employing the corresponding equation for the foreign country, and subtracting one from the other, together with symmetry, gives (32).