Joining the European Monetary Union — comparing first and second generation open economy models

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Abstract

We log-linearise the Dellas and Tavlas (DT) model of monetary union and solve it analytically. We find that the intuition of optimal currency analysis of DT's second generation open economy model is essentially the same as that of first generation models. Monetary union results in no welfare loss if its member states are symmetric. However, asymmetry causes loss in welfare both due to the failure of the union policy to deal suitably with a country's asymmetric shocks and due to an active monetary policy by union in pursuit of its distinct objectives. The asymmetry in DT is largely due to the differing wage rigidities across countries.

Keywords: monetary union, representative agent model, multi-country model, wage rigidity, asymmetry.

JEL codes: F41, F42, E42

In recent discussions about joining European Monetary Union — henceforth EMU — much use has been made of macroeconomic models' predictions of the extent of macro instability which might arise from a country abandoning its own monetary policy in favour of the general EMU one. A typical example of such discussions was those within the UK; a brief survey of the arguments can be found in Minford (2002). In sum on the one side were the supposed micro-economic benefits for the UK of joining — through the reduction of the barriers to trade and capital movements with the rest of the EMU. While on the other side were the macro-economic costs associated with the loss of the monetary policy instrument[1]. To these arguments could also be added those concerned with politics or issues connected to EMU via politics (such as the possibility of greater subjection to intrusive regulation) but not to do with monetary economics per se. Central in turn to the discussions of the monetary case were simulations of the effects of losing independent monetary policy.

For the most part these simulations — generally carried out by stochastic simulation — were performed on 'first generation' models, by which we mean models in the Mundell-Fleming tradition extended in terms of recent macro-modelling developments such as rational expectations and unrestricted capital accounts. One example for the UK was Minford et al (2004); Minford (2002) discusses some other results from rival efforts. The basic finding of these sorts of exercises has been that there is a non-negligible loss of macro-stability likely for the UK on joining the EMU.

There has been little attention to what would be predicted by the 'second generation' models, by which we mean models with full micro-foundations such as are to be found in Obstfeld and Rogoff (1996). The reason for this lack of attention appears to be the difficulty of constructing credible simulations within these models at their current stage of development — see Canzoneri et al (2005) for a frank discussion of the difficulties of evaluating cooperative monetary policies within the second generation framework. An early attempt to evaluate joining EMU was made by Minford (1995) but it did little more than find that within a fairly crude second generation model the joining of EMU meant that the gains from the home country's 'activist' money supply policy (i.e one where money reacted to shocks rather than following a fixed growth rule) could not be realised in an EMU and could be replaced by losses from the activist policies of the EMU money itself if these were different from how the home policy would have reacted.

However a recent paper by Dellas and Tavlas (2005) has made a rather elaborate attempt to evaluate EMU within a custom-built second generation model. They find that for a country like the UK the key reason why EMU is destabilising is that its wage contract structure is less rigid than in the EMU, whereas countries like France and Germany within EMU have similar wage rigidity and hence for them EMU creates no problems. On the face of it this conculsion is rather at varaince with those discussed

[1] granted that if for some reason this instrument could only be used poorly then such costs could be turned into benefits, nevertheless for the UK the general consensus was that since 1992 its new monetary regime of inflation targeting had denonstrated a capacity for stabilising monetary policy.

earlier where the stress is on the degree of asymmetry between countries joining EMU. True, differing wage rigidity is one such asymmetry; but so far has never been identified as the key one.

The Dellas-Tavlas model is highly non-linear and is solved numerically. Though they explain their results convincingly, it is not entirely easy to see how they arise in detail within the intricate mechanics of their model. Yet it is of considerable interest to understand just why it is that they find EMU's macroeconomic costs to fall in the way they say and to see whether this can be reconciled with the well-understood results from the first generation models. Ideally we would like the intuitive reasoning within the two first and second generation approaches to be consistent, or at the very least to know how the differences if any arise so that we can reevaluate our analyses of the joining issue. That is the task that this paper attempts.

The paper begins (section 1) with a loglinearisation of the Dellas-Tavlas model to make the essential mechanisms transparent and tractable. It then derives the key policy results (section 2). In section 3 it compares these with the first geneartion results typefied by Minford et al. and draws the essential contrasts and parallels. The conculsion then follows that actually the two approaches can be understood naturally within a common framework.

1 The Dellas-Tavlas model loglinearised:

As we have seen the Dellas-Tavlas (2005) model is non-linear and must be solved numerically, thus losing the apparent transparency/tractability of the workhorse model. However, it turns out that the Dellas-Tavlas model can be simplified and linearised without too much trouble, so enabling a high degree of transparency in its workings.

The model's structure under floating, to recap, has the representative household in each country owning that country's intermediate good which is produced under perfect competition with flexible prices, via Cobb-Douglas technology by profit-maximising firms hiring labour and capital from households at going wages and capital rental rate; the household chooses under flexible wages the labour supply (under fixed wages the wage for its expected labour supply), the stock of capital (thus investment), the stock of home and foreign bonds, and its consumption (plus enough money to acquire it, via cash in advance); offers for this list of variables are therefore determined by the household's first order conditions. The government fixes government expenditure and also the money supply (or an interest rate which thereby generates a money supply). The resulting demands for goods and services are for CES bundles of intermediate goods from all countries, produced under perfect competition by profit-maximising firms. Market-clearing for each country's intermediate good determines its price; and for money determines each country's interest rate. The exchange rate is then fixed by the uncovered interest parity condition coming from the consumer's demand for home and foreign bonds.

Under fixed exchange rates the joint interest rate is determined by the joint money supply. However, each country's real interest rate can differ as its prices can differ; uncovered real interest parity now governs the real interest rate differential while goods market-clearing governs differential prices.

In what follows we will eliminate the dynamics of the model by assuming the the capital stock is fixed and that all shocks are for one period only without serial correlation. In the model investment gives rise to a change in capital stock in the following period, thus during the period of the current shock the capital stock is fixed. This is also the period when wages are fixed either totally or partially, so it is when most of the effect occurs. The dynamics therefore essentially produces an echo of the current shock effects, where the size of the echo depends on eth size of the current effect. Eliminating dynamics should not change the ranking of shock effects, which is our focus in trying to understand the nature of the differential effects across regimes and shocks; it will of course change total variances, persistence and impulse response profiles and clearly for this reason in estimation one would always wish to include the dynamics.

The advantage analytically of removing the dynamics is that the expected future solution remains the steady state. (Introducing dynamics is not in fact hard to do: models like this have a dominant root which sets the saddlepath and typically the model jumps onto the saddlepath in the period after the shock. However, computing this adds needless complication for our purpose here.)

Another simplification we make is to assume a single foreign country. In fact again because of the CES and Cobb-Douglas bundling used it is not difficult to aggregate over foreign countries; so we can think of each country dealing with a foreign country which is an aggregate of however many we need to examine. The aggregate produces an effective (weighted) exchange rate, average GDP etc.

The household first-order conditions for country S:

The only non-standard condition relates to capital where there is an adjustment cost on investment. Investment is carried out to the point where the marginal-utility-weighted, discounted future flow of rentals minus the adjustment cost equals the current marginal utility cost of the investment. Holding capital fixed, we omit this. We now treat bonds as ordinary nominal bonds with a single period to maturity The other conditions then give rise to the usual intertemporal consumption relation (with Cobb-Douglas utility):

$$E_t \frac{C_{t+1}^S}{C_t^S} = \beta E_t \frac{(1+R_t^S)P_t^S}{P_{t+1}^S}$$

the work-consumption trade-off:

$$\frac{W_t^S}{P_t^S} = \frac{\theta C_t^S}{1-h_t^S}$$

(this is used to determine the fixed nominal wage); and the uncovered interest parity (UIP) condition across home and foreign bonds:

$$\frac{(1+R_t^F)e_t}{(1+R_t^S)} = \frac{E_t(P_{t+1}^S C_{t+1}^S)^{-1}}{E_t(P_{t+1}^S C_{t+1}^S)^{-1}(e_{t+1})^{-1}}$$

The above conditions involve expectations of ratios which give rise to risk-premia if we take a second order Taylor expansion. These premia are a function of the second moments of the economy and will vary with regimes; we should note this but also note that these premia do not enter directly into the representative agent's welfare, rather the same second moments will enter that directly. Thus we do not need to include these premia in the model in order to determine the second moments resulting from any regime; for that regime these will be constants when a shock is applied and hence the effect of the shock is independent of the premia. In linearising the model to get an approximation for computing the effects of shocks we can and will omit these. We can then proceed to a straightforward loglinearisation of the above:

$$1) E_t \ln C_{t+1}^S - \ln C_t^S = r_t^S - \delta$$

where $\delta = 1 - \beta$ is the rate of time preference and r is the real interest rate allowing for expected inflation, expressed in fractions per period. (Note that $\ln(1+x) \simeq x$ for small x fractions.)

Expressing all variables from now on in terms of deviations from steady state we can rewrite this as:

$$1) \ln C_t^S = -r_t^S$$

$$2) \ln \overline{W_t} = \ln\theta + E_{t-1}\ln C_t^S + E_{t-1}\ln P_t^S + E_{t-1}\ln H_t^S + \text{ constant=0 (in deviations from steady state)}$$

Here we have made H (work hours share of total available time) of order 0.5 so that $\Delta\ln(1-H_t) \simeq -\Delta\ln(H_t)$

$3) R_t^S = R_t^F - E_t e_{t+1} + e_t = R_t^F + e_t$ in deviations. Here we use e_t as the log of foreign currency per units of S currency so that a rise is an appreciation.

Equivalently we can express this as UIP in real terms:

$3) r_t^S = r_t^F - E_t x_{t+1} + x_t = r_t^F + x_t$ where x_t is the log of the real exchange rate (a rise is a real appreciation, decline in price competitiveness) in terms of the CPIs.

From now on we will drop the time subscript since all variables are dated currently.

Firms' demands:

Turn next to firms. Intermediate-goods-producing firms have demand for capital which generates the rental rate of capital, which we can ignore; and demand for labour which in logs is:

$4) \ln H^S = \ln(1-\alpha) + \ln Y^S - \ln W + \ln P_Y^S$ in deviations where the price is the GDP deflator not the CPI (which in logs is $\ln P^S \simeq (1-m^S)\ln P_Y^S + m^S \ln(P_Y^F/e)$ where m^S is the S share of imports.) Note that therefore $x = \ln P^S - \ln(P^F/e) = (1-m^S-m^F)\{\ln P_Y^S - \ln(P_Y^F/e)\} = (1-m^S-m^F)x_Y$;

also that $\ln P^S = \ln P_Y^S - m^S x_Y = \ln P_Y^S - \frac{m^S}{1-m^S-m^F}x$

From the CES bundling final-goods industry we can loglinearise demands as follows for S-country output:

5) $\ln Y^S = \ln Q^S + m^F f \ln Q^F - m^S \ln Q^S - \sigma\{(1-m^S)m^S + (1-m^F)m^F f\}x_Y$

where σ is the elasticity of substitution and f is the ratio of the real size of foreign to home GDP. The first three terms are the income effects of rising demand at home and abroad for home output. The last term's coefficient is the substitution effect, derived as the effect of a 1 percent rise in the real exchange rate:

=-(rise in imports + fall in exports both as % of home GDP)$= -\{(\Delta \ln imports^S\ ).\frac{imports^S}{Y^S} - (\Delta \ln imports^F\ ).\frac{imports^F}{Y^F}\frac{Y^F}{Y^S}\}$

To obtain the rise in imports for example, define D as home output sold on the home market and note that the substitution effects $\Delta M^S = -\Delta D^S$; now $\frac{-\Delta M^S}{M^S} + \frac{\Delta D^S}{D^S} = -\sigma \Delta x_Y$ by the CES first-order condition. Thus $\frac{-\Delta M^S}{M^S} - \frac{\Delta M^S}{M^S}\frac{M^S}{D^S} = -(\Delta \ln imports^S)(\frac{1}{1-m^S})$ so that $\Delta \ln imports^S = (1-m^S)\sigma\Delta x_Y$. Analogously the fall in exports is $-\Delta \ln imports^F = -(1-m^F)\sigma \Delta x_Y$.

Loglinearising the composition of demand gives:

6) $\ln Q^S = \overline{c^S}\ln C^S + \overline{g^S}\ln G^S$

where $\overline{c}, \overline{g}$ are respectively the shares of consumption and government spending in GDP.

The production function for home intermediate output gives us in deviations

7) $\ln Y^S = (1-\alpha)\ln H^S + u^S$

where $u^S = \ln \alpha^S + (1-\alpha)\ln \Gamma$, the log of the composite productivity shock.

We now list the model above, using lower case letters to indicate logs:

1)$c^S = -r^S$

2)$r^S = r^F + x$

3)$h^S = y^S - w^S + p_Y^S$

4)$y^S = q^S + m^F f q^F - m^S q^S - \sigma' x$

where $\sigma' = \frac{\sigma\{(1-m^S)m^S + (1-m^F)m^F f\}}{1-m^S-m^F}$

5)$q^S = \overline{c^S}c^S + g^S$

where $g^S = \overline{g^S}\ln G^S$

6)$y^S = (1-\alpha)h^S + u^S$

7)$\mu^S = p^S + c^S$

The last is the cash in advance constraint where μ =money supply.

The wage is a weighted average, with weight ψ, of the fixed nominal wage (=0) and the flexible wage, w^{*S}.The latter is found by solving the model in 'Walrasian' mode. Plainly the flexible real wage depends on all the real shocks to the model (money shocks will be n eutralised by equiproportional movement in wages) in both countries; we will denote this $\overline{w}^{*S}$.The flexible nominal wage we will write as $w^{*S} = \overline{w}^{*S} + p^S$. The key point here is that allowing wages to be partially set by this reduces the level of nominal rigidity. Thus:

8)$w^S = (1-\psi)(\overline{w}^{*S} + p^S)$

An equivalent set of equations prevails for the foreign country.

We can use equations 3,6 and 8 (and use $p_Y^S = p^S + \frac{m^S}{1-m^S-m^F}x$ to derive an open economy aggregate supply curve:

(AS) $y^S = \frac{1}{\alpha}\left\{u^S + \psi(1-\alpha)p^S - (1-\psi)(1-\alpha)\overline{w}^{*S} + \frac{m^S(1-\alpha)}{1-m^S-m^F}x\right\}$

Note that equations 1 and 7 imply that money has direct control over interest rates, controlling for prices:

$\mu^S = p^S - r^S$

while (2) gives

$x = r^S - r^F = (\mu^F - p^F - [\mu^S - p^S])$ (by the last equation)

And hence the AS becomes:

(AS) $y^S = \frac{1}{\alpha}\left\{u^S + \psi(1-\alpha)p^S - (1-\psi)(1-\alpha)\overline{w}^{*S} + \frac{m^S(1-\alpha)}{1-m^S-m^F}(\mu^F - p^F - [\mu^S - p^S])\right\}$

We may now derive the open economy aggregate demand curve in steps as follows from equations 1, 2, 4, 5, and 7.

Using 1,2,4 and 5, we obtain:

$y^S = -\{(1-m^S)\overline{c}^S + \sigma'\}r^S + (1-m^S)g^S - (m^F f\overline{c}^F - \sigma')r^F + m^F f g^F$ so that using the money expression above we obtain:

(AD) $y^S = \{(1-m^S)\overline{c}^S + \sigma'\}\{\mu^S - p^S\} + (1-m^S)g^S + (m^F f\overline{c}^F - \sigma')\{\mu^F - p^F\} + m^F f g^F$

Solving for $\overline{w}^{*S}$

We now note that this is the real wage found in the model when $\psi = 0$ (ie wages are entirely flexible). We can find the labour market equilibrium from the work-consumption trade-off first order condition:

$\overline{w}^{*S} = w - p^S = c^S + h^S$

which provides the supply of labour; and from equation 3 which provides the demand for labour:

$h^S = y^S - w + p_Y^S = y^S - (\overline{w}^{*S} + p^S - p_Y^S) = y^S - \overline{w}^{*S} + \frac{m^S}{1-m^S-m^F}x$ from above

From these two equations we can solve

$\overline{w}^* = 0.5y^S + 0.5c^S + 0.5\frac{m^S}{1-m^S-m^F}x$

Remembering that $c^S = \mu^S - p^S$ and that $x = r^S - r^F = (\mu^F - p^F) - (\mu^S - p^S)$ and using the AD equation above for y^S we can rewrite

$\overline{w}^{*S} = 0.5\{(1-m^S)\overline{c}^S + \sigma' + 1 - \frac{m^S}{1-m^S-m^F}\}\{\mu^S - p^S\}^* + 0.5(m^F f\overline{c}^F - \sigma' + \frac{m^S}{1-m^S-m^F})\{\mu^F - p^F\}^*$
$+0.5(1-m^S)g^S + 0.5m^F f^{-1}g^F$

where $\{\mu^S - p^S\}^*$ and $\{\mu^F - p^F\}^*$ are the flexprice values of home and foreign real balances.

To find these we substitute for $\overline{w}^*$ into the AS equation above setting $\psi = 0$ and solve with the AD curve to obtain after some tedious manipulation:

$\{\frac{1-\alpha}{\alpha}(0.5 + \frac{1.5m^S}{1-m^S-m^F})\} + \{(1-m^S)\overline{c}^S + \sigma'\}(1 + 0.5\frac{1-\alpha}{\alpha})\{\mu^S - p^S\}^* +$
$[(1+0.5\frac{1-\alpha}{\alpha})\{\sigma' - m^F f\overline{c}^F\} - \{\frac{0.5m^S(\frac{1-\alpha}{\alpha})}{1-m^S-m^F}\}]\{\mu^F - p^F\}^* = -(1+0.5\frac{1-\alpha}{\alpha})(1-m^S)g^S - (1+0.5\frac{1-\alpha}{\alpha})(m^F f)g^F + \frac{1}{\alpha}u^S$

There will be an analogous equation for $\{\mu^F - p^F\}^*$. We may then write these variables in terms of the productivity shocks and the government spending shocks as follows:

$$\begin{bmatrix} \{\frac{1-\alpha}{\alpha}(0.5 + \frac{1.5m^S}{1-m^S-m^F})\} + \{(1-m^S)\overline{c}^S + \sigma'\}(1 + 0.5\frac{1-\alpha}{\alpha}) & -(1 + 0.5\frac{1-\alpha}{\alpha})\{\sigma' - m^F f\overline{c}^F\} - \{\frac{0.5m^S(\frac{1-\alpha}{\alpha})}{1-m^S-m^F}\} \\ -(1 + 0.5\frac{1-\alpha}{\alpha})\{\sigma' - m^S f^{-1}\overline{c}^S\} - \{\frac{0.5m^F(\frac{1-\alpha}{\alpha})}{1-m^S-m^F}\} & \{\frac{1-\alpha}{\alpha}(0.5 + \frac{1.5m^F}{1-m^S-m^F})\} + \{(1-m^F)\overline{c}^F + \sigma'\}(1 + 0.5\frac{1-\alpha}{\alpha}) \end{bmatrix} \begin{bmatrix} \{\mu^S - p^S\}^* \\ \{\mu^F - p^F\}^* \end{bmatrix}$$

$$= -(1 + 0.5\frac{1-\alpha}{\alpha}) \begin{bmatrix} 1-m^S & m^F f \\ m^S f^{-1} & 1-m^F \end{bmatrix} \begin{bmatrix} g^S \\ g^F \end{bmatrix} + \frac{1}{\alpha} \begin{bmatrix} u^S \\ u^F \end{bmatrix}$$

or in matrix form: $O(\mu - p)^* = -(1 + 0.5\frac{1-\alpha}{\alpha})Gg + \frac{1}{\alpha}u$

Hence finally we write the solution for the vector of $\overline{w}^*$as:

$\overline{w}^* = 0.5W(\mu - p)^* + 0.5Gg$

so that

$\overline{w}^* = 0.5[I - (1 + 0.5\frac{1-\alpha}{\alpha})WO^{-1}]Gg + 0.5O^{-1}\frac{1}{\alpha}u$

For convenience write the matrix

$$0.5O^{-1}\frac{1}{\alpha} = \begin{bmatrix} k^S & l^S \\ k^F & l^F \end{bmatrix}$$

so that ignoring government spending $\overline{w}^{*S} = k^S u^S + l^S u^F$

2 The model and welfare under fixed and floating exchange rates

2.1 Fixed exchange rates:

For fixed exchange rates all the above equations apply in both countries but the money supply, being the same, flows freely between the two countries and of course the nominal exchange rate being fixed $x = p^S - p^F$. However, the total money supply of the two countries combined is fixed, thus also:

$\mu = \frac{1}{1+f}\mu^S + \frac{f}{1+f}\mu^F$

which by virtue of equations 1 and 7 in each country give:

$\mu = \frac{1}{1+f}\mu^S + \frac{f}{1+f}\mu^F = \frac{1}{1+f}p^S + \frac{f}{1+f}p^F - \{\frac{1}{1+f}r^S + \frac{f}{1+f}r^F\}$

and using equation 2 which now gives us $r^S = r^F + p^S - p^F$in the above we obtain:

$\mu = p^F - r^F$

Our curves now become:

(AS) $y^S = \frac{1}{\alpha}u^S + \psi(\frac{1-\alpha}{\alpha})p^S - (1-\psi)(\frac{1-\alpha}{\alpha})\overline{w}^* + \frac{m^S(\frac{1-\alpha}{\alpha})}{1-m^S-m^F}(p^S - p^F)$

and

(AD) $y^S = \{(1-m^S)\overline{c}^S + m^F f\overline{c}^F\}\mu + (1-m^S)g^S + m^F f g^F - \{(1-m^S)\overline{c}^S + \sigma'\}p^S - (m^F f\overline{c}^F - \sigma')p^F$

The equilibrium real wage is solely determined by real shocks and so has the same solution under fixed rates as under floating. In effect the real balances are distributed to give the same real balances as under floating across the two countries

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2.2 Comparing fixed, floating and flexprice solutions:

We now solve each model using the appropriate AS and AD equations above for home and foreign prices (and thus for all the other variables). Under floating we obtain the following matrix where for convenience we have suppressed the government spending shocks and also held the money supplies constant —call this passive monetary policy:

$$\begin{bmatrix} \psi^S(\frac{1-\alpha}{\alpha}) + \frac{m^S(\frac{1-\alpha}{\alpha})}{1-m^S-m^F} + (1-m^S)\overline{c}^S + \sigma' & -\frac{m^S(\frac{1-\alpha}{\alpha})}{1-m^S-m^F} - \sigma' + m^F f\overline{c}^F \\ -\frac{m^F(\frac{1-\alpha}{\alpha})}{1-m^S-m^F} - \sigma' + m^S f^{-1}\overline{c}^S & \psi^F(\frac{1-\alpha}{\alpha}) + \frac{m^F(\frac{1-\alpha}{\alpha})}{1-m^S-m^F} + (1-m^F)\overline{c}^F + \sigma' \end{bmatrix} \begin{bmatrix} p^S \\ p^F \end{bmatrix}$$

$$= \begin{bmatrix} -\frac{1}{\alpha} + (1-\psi^S)(\frac{1-\alpha}{\alpha})k^S & (1-\psi^S)(\frac{1-\alpha}{\alpha})l^S \\ (1-\psi^F)(\frac{1-\alpha}{\alpha})l^F & -\frac{1}{\alpha} + (1-\psi^F)(\frac{1-\alpha}{\alpha})k^F \end{bmatrix} \begin{bmatrix} u^S \\ u^F \end{bmatrix}$$

or

$Ap = Nu$

It turns out that under floating the solution is exactly the same if union money supply, μ, is held constant. We thus discover that if monetary policy is passive, then it makes no difference whether one is in fixed or floating regimes. Any difference comes about because under floating a monetary policy tailored to the home economy is possible whereas under fixed the union monetary policy is tailored to the union average (this can respond inappropriately both to home and foreign shocks).

If we now introduce the monetary shocks, it turns out we can write the solution under floating:

$Ap_{FL} = Nu + M\mu_{FL}$

where

$M = \begin{bmatrix} m_{11} = a_{11} - \psi^S(\frac{1-\alpha}{\alpha}) & m_{12} = a_{12} \\ m_{21} = a_{21} & m_{22} = a_{22} - \psi^F(\frac{1-\alpha}{\alpha}) \end{bmatrix}; \mu_{FL} = \begin{bmatrix} \mu^S \\ \mu^F \end{bmatrix}$; a_{ij},$m_{ij}$are the cells of the A,M matrices

It follows that

$\mu_{FL} - p_{FL} = -A^{-1}Nu + (I - A^{-1}M)\mu_{FL}$

$$= \frac{1}{D}\left[\begin{array}{cc} \psi^S\psi^F(\frac{1-\alpha}{\alpha})^2+\psi^S(\frac{1-\alpha}{\alpha})m_{22} & -a_{12}\psi^F(\frac{1-\alpha}{\alpha}) \\ -a_{21}\psi^S(\frac{1-\alpha}{\alpha}) & \psi^S\psi^F(\frac{1-\alpha}{\alpha})^2+\psi^F(\frac{1-\alpha}{\alpha})m_{11} \end{array}\right]\mu_{FL} - A^{-1}Nu$$

where D is the determinant of A.

Under fixed rates we have:

$$Ap_{FX} = Nu + m\mu_{FX}$$

where $m = \left[\begin{array}{c} m_{11}+m_{12} \\ m_{22}+m_{21} \end{array}\right]$ and μ_{FX} is the joint money supply.

It then follows that:

$$I\mu_{FX} - p_{FX} = -A^{-1}Nu + (I - A^{-1}m)\mu_{FX}$$

$$= \frac{1}{D}\left[\begin{array}{c} \psi^S\psi^F(\frac{1-\alpha}{\alpha})^2+\psi^S(\frac{1-\alpha}{\alpha})m_{22}-a_{12}\psi^F(\frac{1-\alpha}{\alpha}) \\ -a_{21}\psi^S(\frac{1-\alpha}{\alpha})+\psi^S\psi^F(\frac{1-\alpha}{\alpha})^2+\psi^F(\frac{1-\alpha}{\alpha})m_{11} \end{array}\right]\mu_{FX} - A^{-1}Nu$$

where I here is the 2x1 vector $\left[\begin{array}{c} 1 \\ 1 \end{array}\right]$

Now we note that welfare in the home country is:

$$U^S = c^S - \theta h^S$$

while

$h^S = \frac{y^S - u^S}{1-\alpha}$ from the production function

and from the AD curve

$$y^S = \{(1-m^S)\bar{c}^S + \sigma'\}\{\mu^S - p^S\} + (m^F f\bar{c}^F - \sigma')\{\mu^F - p^F\} \text{ (FLOAT)}$$

and

$$y^S = \{(1-m^S)\bar{c}^S + \sigma'\}\{\mu - p^S\} + (m^F f\bar{c}^F - \sigma')\{\mu - p^F\} \text{ (FIX)}$$

while

$$c^S = \{\mu^S - p^S\}; c^F = \{\mu^F - p^F\} \text{ (FLOAT)}$$

and

$$c^S = \{\mu - p^S\}; c^F = \{\mu - p^F\} \text{ (FIX)}$$

Thus:

$$U^{SFL} = (1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\{\mu^S - p^S\}^{FL} - \tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\{\mu^F - p^F\}^{FL} + \tfrac{\theta}{1-\alpha}u^S \text{(FLOAT)}$$

$$U^{SFX} = (1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\{\mu - p^S\}^{FX} - \tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\{\mu^F - p^F\}^{FX} + \tfrac{\theta}{1-\alpha}u^S \text{(FIX)}$$

and

$$U^{SFLEX} = (1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\{\mu^S - p^S\}^{FLEX} - \tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\{\mu^F - p^F\}^{FLEX} + \tfrac{\theta}{1-\alpha}u^S \text{(FLEX)}$$

In the standard approach U^{SFLEX} is taken as the benchmark around which the expected welfare is computed. We can now gain insight into the welfare situations in two stages. First we note that with

U^{SFL} being optimised in both countries by realising the flexprice real balances, we can *conceive* of a globally optimal monetary policy under floating with home and foreign monetary instruments targeted to react to shocks so as to produce the optimal welfare. This policy sets $\{\mu - p\}^{FL} = \{\mu - p\}^{*}$ and so[2]

$$O^{-1}\tfrac{1}{\alpha}u = A^{-1}Nu + (I - A^{-1}M)\widehat{\mu_{FL}}$$

and so

$$\widehat{\mu_{FL}} = (I - A^{-1}M)^{-1}(O^{-1}\tfrac{1}{\alpha} - A^{-1}N)u$$

Suppose that the monetary rule in place achieves this — the evidence of models suggests that a variety of rules get reasonably close Then we can secondly think of the Fixed rate welfare (where there is only one monetary instrument and so such optimisation is impossible) in terms of its deviation from the optimised Floating solution.

$$U^{SFL} - U^{SFX} = (1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\left[\widehat{\{\mu^S - p^S\}}^{FL} - \{\mu - p^S\}^{FX}\right]$$

$$-\tfrac{\theta}{1-\alpha}(m^F f^{-1}\bar{c}^F - \sigma')[\widehat{\{\mu^F - p^F\}}^{FL} - \{\mu - p^F\}^{FX}$$

where the hat over the Floating real balances shows that they have been optimised.

Substituting into this from our solutions above for real balances we obtain after some manipulation:

$$U^{SFL} - U^{SFX} = \tfrac{1}{D}\begin{pmatrix} (1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\left[\psi^S\psi^F(\tfrac{1-\alpha}{\alpha})^2 + \psi^S(\tfrac{1-\alpha}{\alpha})m_{22}\right] \\ -\tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\left[-a_{21}\psi^S(\tfrac{1-\alpha}{\alpha})\right] \end{pmatrix}(\widehat{\mu^S} - \mu)$$

$$+\tfrac{1}{D}\begin{pmatrix} -(1 - \tfrac{\theta}{1-\alpha}\{(1-m^S)\bar{c}^S + \sigma'\})\left[\psi^F(\tfrac{1-\alpha}{\alpha})m_{12}\right] \\ +\tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\left[\psi^S\psi^F(\tfrac{1-\alpha}{\alpha})^2 + \psi^F(\tfrac{1-\alpha}{\alpha})m_{11}\right] \end{pmatrix}(\widehat{\mu^F} - \mu)$$

The expected value of this is:

$$E(U^{SFL} - U^{SFX}) = -\tfrac{0.5}{D}\begin{pmatrix} (1 - \tfrac{\theta}{1-\alpha}[\{(1-m^S)\bar{c}^S + \sigma'\})\begin{pmatrix} \psi^S\psi^F(\tfrac{1-\alpha}{\alpha})^2 + \\ \psi^S(\tfrac{1-\alpha}{\alpha})m_{22} \end{pmatrix} \\ -\tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\left[-a_{21}\psi^S(\tfrac{1-\alpha}{\alpha})\right] \end{pmatrix} Var(\widehat{\mu^S} - \mu)$$

$$-\tfrac{0.5}{D}\begin{pmatrix} -(1 - \tfrac{\theta}{1-\alpha}[\{(1-m^S)\bar{c}^S + \sigma'\})\left(\psi^F(\tfrac{1-\alpha}{\alpha})m_{12}\right) \\ +\tfrac{\theta}{1-\alpha}(m^F f\bar{c}^F - \sigma')\left[\psi^S\psi^F(\tfrac{1-\alpha}{\alpha})^2 + \psi^F(\tfrac{1-\alpha}{\alpha})m_{11}\right] \end{pmatrix} Var(\widehat{\mu^F} - \mu)$$

where D is positive and both the coefficients on the variances can be taken to be positive, indicating that any non-zero differences of the floating optimised money supply from the joint fixed money supply will raise the relative welfare of Floating.

We can now note that *given* that there are (as will be inevitable) differences of average union money supply from the country optimum, a crucial determinant of its effect on welfare in the union will be the two ψ coefficients. With $\psi^S = \psi^F = 0$ (full indexation, no nominal rigidity), there will be no effect. With $\psi^S = \psi^F = 1$, the effect is maximised. Since both ψs enter similarly into A, assuming that the other parameters are not dissimilar across countires (as they are not — see the D-T calibration) both home and foreign rigidity have a similar effect in raising the effectiveness of monetary policy.

[2] Note that if we follow the variant approach (Minford et al, 2003) that the nominal rigidity is an optimising arrangement, then the welfare optimum benchmark will be one where welfare will be one where welfare is fully stabilisied (as if $u = 0$). In this case optimal monetary policy under floating will set $\{\mu - p\}^{FL} = 0$ and so $\widehat{\mu_{FL}} = -(I - A^{-1}M)^{-1}(A^{-1}N)u$. The rest of the analysis goes through as in the standard approach.

3 Comparing Dellas-Tavlas with first generation models

3.1 Understanding the Dellas-Tavlas results:

We can summarise what we have found in the Dellas-Tavlas model::

1) The difference between union and Floating welfare is *solely* due to differences in monetary responses to shocks — if money was entirely passive, the regimes would be the same.

2) Monetary policy under Floating is *able in principle* to respond optimally to shocks whereas under Fixed it is not.

3) If monetary policy under floating behaves close to optimally, then welfare under fixed will be reduced (a) the more that union money supply departs from country Floating money supply responses (b) the more that either country has nominal rigidity.

It is an old result of optimal currency area literature that country symmetry enables the welfare loss from union to be minimised. Here this is reflected in $Var(\widehat{\mu^{FL}} - \mu)$; if the countries have the same structure and so react in the same way to country shocks, then the optimal $\widehat{\mu^{FL}}$ in both countries will be the same and μ can be chosen to be the same too. The key asymmetry is ψ; symmetry occurs if the matrices A, M and N are all symmetric. This requires that $m, \bar{c}$ and ψ are the same for both countries. inspection of D-T's calibration at once reveals that $m = \overline{\omega}_{FG} = 0.04 \simeq m^G = \overline{\omega}_{GF} = 0.05$ and that $\bar{c}^F = \overline{\omega}_{FF} = 0.93 \simeq \bar{c}^G = \overline{\omega}_{GG} = 0.94$. Thus if $\psi^F = \psi^G$, plainly there will be symmetry and thus provided the floating and union rules are both approximately optimal (or depart from optimality in a similar way as is guaranteed here by the use of similar Henderson-McKibbin-Taylor rules), then union welfare will be close to floating welfare.

By the same argument, with ψ^{UK} at 0.5 the UK-continent matrices A, M, N will be asymmetric and $Var(\widehat{\mu^{FL}} - \mu)$ will be non-zero. Given that the absolute sizes of both ψ^{UK} and ψ^{FG} are both far from zero, this matters and produces a welfare difference between union and floating.

3.2 Understanding Minford et al (2004) for the UK:

Minford et al (2004) carried out a large-scale stochastic simulation exercise for the Liverpool Model of the UK, under floating and monetary union. Shocks were drawn by bootstrapping the 16 years' model errors from 1986-2002. The rest of the EU zone, REU, contributes its real interest rate, real exchange rate and inflation series, modelled by univariate ARIMA processes. The rest of the world, ROW, contributes world trade volume and world real interest rates. The bootstrapping preserves shock contemporaneity and so any cross-correlation (symmetries) present in the shock data.

The study finds that there is a general rise in macro variability under EMU for the UK. About a fifth of the loss occurs with a *passive* REU monetary policy which is interpreted as one where the REU variables are all noise-free. The other four fifths comes about because REU policy is *active,* with the most important noise coming from REU's real exchange rate.

In terms of the D-T model, we can interpret the passive REU policy as one where $\mu = 0$. Hence $Var(\widehat{\mu^{FL}} - \mu)$ will simply reflect the benefits of activist monetary policy under floating in the UK. This is of some importance because such activism is optimal.

The active REU policy in fact reflects the way that for the UK the rest-of-world model, F, combines REU and ROW to create μ_F. When the UK floats freely, μ_F is an *average* of the rest of the world's monetary conditions — mostly stable enough. However when the UK is in EMU, μ_F is an average of μ_{REU}, and of μ_{ROW} *converted* into euros. If the REU's real exchange rate is volatile it will destabilise the latter component, even if μ_{ROW} is itself stable. The key element is the instability of the dollar v. euro rate, therefore, which produces a high instability in μ_F under EMU for the UK. As is well-known this rate has been extraordinarily unstable and so hence has μ_F.

4 Conclusions

What we have found is that the intuition of optimal currency analysis lies behind Dellas and Tavlas' second generation model just as it did behind the first generation models. This is that where there is country symmetry then the shared optimal monetary policy of the union will be the same as the optimal monetary policy of each and so union will involve no loss of welfare. Furthermore there are two sources of loss under asymmetry: first, that due to the failure of the union policy to deal suitably with a country's asymmetric shocks (this is where the union has a passive — ie. constant money rule — policy). Second, there is that due to an active monetary policy by the union in pursuit of its distinct objectives. These two elements together cause the loss of welfare What is distinctive about Dellas-Tavlas is the characterisation of the asymmetry as being concentrated in the extent of wage rigidity, whereas in Minford et al the asymmetries emerge implicitly from the data on world and REU exogenous processes (the non-UK economies are not modelled explicitly). Thus clearly there are empirical differences between these two approaches in detail, though we have not attempted in this paper to compare those details; but then so there are between all the different studies within the first generation models (we have no others for the second generation ones). The encouraging conclusion is that the two modelling approaches can be regarded as using the data differently to measure the same thing, allowing others to be presented with useful alternative estimates of an important phenomenon.

References

[1] Canzoneri, Matthew, Robert Cumby and Behzad Diba (2005) 'The Need for International Policy Coordination: What's Old, What's New, What's Yet to Come', Journal of International Economics,66 (2), 363-384.

[2] Dellas, Harris and George Tavlas (2005) 'Wage rigidity and Monetary union', The Economic Journal, 115 (506), 907-927, Oct 2005

[3] Minford, Patrick (1995) 'Other people's money: cash-in-advance microfoundations for optimal currency areas', Journal of International Money and Finance, 14 (3), June 1995, pp. 427-440.

[4] Minford, Patrick (2002) 'Should Britain join the euro? — the Chancellor's five tests examined', IEA Occasional Paper 126, September 2002, Institute of Economic Affairs, London.

[5] Minford, Patrick, David Meenagh and Bruce Webb (2004) 'Britain and EMU: Assessing the Costs in Macroeconomic Variability', World Economy, 27 (3), 301-358.

[6] Minford, Patrick, Eric Nowell and Bruce Webb (2003) 'Nominal contracting and monetary targets-drifting towards indexation' The Economic Journal, 113 (484), 65-100, January, 2003

[7] Obstfeld, Maurice, and Kenneth Rogoff (1996) *Foundations of International Macroeconomics*, Cambridge, MA: MIT Press.