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ABSTRACT

Other People's Money: The Microfoundations of Optimal Currency Areas*

The theory of optimal currency areas, due to Mundell and McKinnon, has enjoyed a revival of interest in the wake of European discussions of monetary union. The basic theme of this old literature is that there are potential gains for stabilization policy in an independent exchange rate and money because rigidity of prices causes an inadequate response of relative prices to shocks. This theme has been taken up recently in empirical work on fixed versus floating exchange rates. This paper examines whether there is support for it in the microfoundations of linked open economies. It uses the cash-in-advance general equilibrium approach of Lucas, following along the lines of Canzoneri and Diba, but focuses on instability and its costs rather than optimal transformation ratios. It finds support for the insights of the optimal currency area literature. The result comes from the cash-in-advance constraint, which causes labour supply to respond to expected inflation (and so money growth) between this and the next period: the household faces an inevitable delay between working (receiving cash) and being able to spend the proceeds. This delay is the microfoundation analogue of the 'nominal (price) rigidity' in the optimal currency area models. Though the direction of money supply responses is orthodox (counter-cyclical), however, it is not clear whether it stabilizes prices (though it probably stabilizes output). By contrast, in the empirical work stability has been gauged by the variance of output and prices. Hence this microfoundations model, though in a way supporting the optimal currency area literature, does not mimic what that literature regards as 'the real world'.

JEL classification: F4
Keywords: EMU, optimal currency area, microfoundations, cash-in-advance model

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NON-TECHNICAL SUMMARY

The theory of optimal currency areas, due to Mundell and McKinnon, has enjoyed a revival of interest in the wake of European discussions of monetary union. The basic theme of this old literature is that there are potential gains for stabilization policy in an independent exchange rate and money because rigidity of prices causes an inadequate response of relative prices to shocks. This theme has been taken up recently in empirical work on fixed versus floating exchange rates. In the European context there have been three studies of potential macro stability under monetary union using stochastic simulations: Minford *et al* (1990, 1992), EC Commission (1990), and Masson and Symansky (1992). In the world context Brookings will soon publish the results of a stochastic simulations exercise comparing the performance of various rules for domestic money targeting with each other and with an exchange rate targeting rule: a large number of multi-country models were included in order to control for model specificity. Generalization from all this work is not easy but there is a tendency in it to find some support for the contention of the optimal currency literature.

This paper examines whether there is support for this literature in the microfoundations of linked open economies. It uses the cash-in-advance general equilibrium approach of Lucas (1980), following along the lines of Canzoneri and Diba (1992), but focuses on instability and its costs rather than optimal transformation ratios. I conclude that there is support in this model for the insights of the optimal currency literature.

The representative household in the home country maximizes a utility function over domestic and foreign goods and leisure. It also has to use the proceeds of income earned in the previous period (plus its government transfer and asset disposals) to acquire goods in the current period: income depends on work, proportionately. There are four markets in the model: (perishable) goods, money, physical capital and foreign exchange. Under floating exchange rates the money supply can be chosen by the home government, and I assume that the money supply rule is mean-reverting and innovation-responsive.

Optimal monetary policy induces households to take more leisure when there is a boom (domestic or foreign), and take less leisure in a slump. The policy has its effect through intertemporal substitution of leisure. Given that output is perishable, households cannot insure by selling the excess to a storing agency; hence they should take more leisure instead. This only happens if there is activist monetary policy, however.

This monetary policy response is orthodox: leaning against the boom and expanding money in the slump. Under fixed exchange rates foreign monetary policy is substituted for this economy through fixed exchange rates. It is plain enough that households' welfare will in general be reduced compared with floating except in the unlikely event that the foreign agent's preferences are the same as the home agent's, so that optimal policies will coincide under fixed and floating rates.

I show that within this simple two-country model there are microeconomic foundations for the advantages which the optimal currency area literature claims for floating exchange rates and independent monetary policy. This result is obtained in a very simplified model, but removal of these simplifications – logarithmic utility, perishability of output (zero investment), no government spending other than transfers, no nominal bonds – does not seem likely to overturn the result. The result arises from the cash-in-advance constraint, which causes labour supply to respond to expected inflation (and so money growth) between this and the next period: the household faces an inevitable delay between working (receiving cash) and being able to spend the proceeds. This delay is the microfoundations analogue of the 'nominal (price) rigidity' in the optimal currency area models. The analogue is closer than it may seem: the micro household receives income at a price that is from its viewpoint 'fixed' inappropriately, but there is no mechanism (e.g. of speculative storage) by which the market can remove this inapproriateness. Only monetary policy can.

In some respects, however, this microfoundations support may be shaky. Even though the direction of money supply responses is orthodox, contracting in the boom, expanding in the slump, it is not clear whether it stabilizes prices (though it probably stabilizes output). By contrast, in the empirical work stability has been gauged by the variance of output and prices.

Furthermore, the difference in this microfoundations model between fixed and floating rates relies entirely on the presence of activist monetary policy (if domestic and foreign money supplies were fixed the regimes would not differ), whereas in the optimal currency area models floating rates are potentially helpful even with fixed money supplies. Hence this microfoundations model, though in a way supporting the optimal currency area literature, does not mimic what it regards as 'the real world'.

Other people's money: the microfoundations of optimal currency areas

Patrick Minford (University of Liverpool)

The theory of optimal currency areas, due to Mundell (1961) and McKinnon (1963) (and see Kenen 1969), has enjoyed a revival of interest in the wake of European discussions of monetary union. The basic theme of this old literature is that there are potential gains for stabilisation policy in an independent exchange rate and money because rigidity of prices causes an inadequate response of relative prices to shocks. This theme has been taken up recently in empirical work on fixed versus floating exchange rates. In the European context there have been three studies of potential macro stability under monetary union using stochastic simulations: Minford et al. (1990, 1992), EC Commission (1990), and Masson and Symansky (1992). In the world context Brookings is about to publish the results of a stochastic simulations exercise comparing the performance of various rules for domestic money targeting with each other and with an exchange rate targeting rule: a large number of multi-country models participated, in order to control for model specificity. Generalisation from all this work is not easy but there is a tendency in it to find some support for the contention of the optimal currency literature.

This paper is an attempt to examine whether there is support for it in the microfoundations of linked open economies. It uses the cash-in-advance general equilibrium approach of Lucas (1980), following along the lines of Canzoneri and Diba. (1992); however the focus is on instability and its costs rather than optimal transformation ratios. I conclude that there is support in this model for the insights of the optimal currency literature.

The structure of the open economy model

There are two countries, not necessarily identical. (Three would add to realism but makes no difference to the argument.) We assume that the foreign country, whose activities are denoted by asterisks, is substantially larger than the home, unasterisked, country.

The representative (infinitely-lived) household in the home country maximizes a logarithmic utility function over domestic and foreign goods and leisure:

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t \left(\ln c_t + \ln c_t' + \alpha \ln l_t\right) \qquad (1)$$

subject to the constraints that:

$$\theta_t = m_t + m'_t/c_t + r_t\ p_t\ s_t; \tag{2}$$

$$\theta_t = p_{t-1}\ y_{t-1} + r_t\ p_t\ s_{t-1} + T_t; \tag{3}$$

$$y_t = (1-l_t)^{\pi}\ d_t\ s_t; \tag{4}$$

$$m_t \geq p_t\ c_t; \tag{5}$$

$$m'_t \geq p_t^*\ c_t'; \tag{6}$$

where c(c')= home (foreign) goods consumed,

l= the leisure fraction of full potential working time (a number close to 0.5 by construction),

θ =wealth,

m(m')= home (foreign) money held,

s= physical assets ('trees') held,

r= the real price of tress,

p(p*)= home (foreign) price level,

e= the exchange rate,

y=income,

d=tree yield of perishable output ('fruit') with fully working household- d_t is strictly positive always, and distributed randomly (with zero serial correlation) around a mean of d

T= money transfer from the government.

Because of the sequencing in the model, the household has to use the proceeds of income in the last period (plus its government transfer and asset disposals) to acquire goods this period: income depends on work, proportionately. Assuming, as is normal, the expected nominal return that money's zero nominal return is dominated by that of physical assets, the first order conditions are routinely:

$$c'_t/c_t = p_t\ e_t/p^*_t \qquad (7)$$

$$E_t\ [p_t(1-1t)^{\pi}\ d_t + r_{t+1}]/r_t = [E_t\ c_{t+1}\ p_{t+1}]/\beta c_t p_t \qquad (8)$$

$$\alpha/1_t = E_t\ \beta\pi p_t d(1-1_t)^{\pi-1}/p_{t+1}\ c_{t+1} \qquad (9)$$

The first expresses the trade-off between consumption of home and foreign goods; the second that between present and future consumption; the third between leisure and (future) consumption.

Abroad, the foreign household maximizes analogously (with the same notation but asterisked), yielding:

$$c_t{}^{*\prime}/c^*_t = p^*_t/p_t e_t \qquad (10)$$

$$E_t\ [p^*_t\ (1-1^*_t)^{\pi^*}d^*_t + r^*_{t+1}]/r^*_t$$

$$= E_t\ c_{t+1}{}^*\ p_{t+1}/\beta^* c^*_t p^*_t \qquad (11)$$

$$\alpha^*/1^*t = E_t\ \beta^*\pi^* p^*_t d^*_t (1-1^*_t)^{\pi^*-1}/p^*_{t+1}\ c^*_{t+1} \qquad (12)$$

We now turn to the conditions for market-clearing, at home first. For simplicity we set the (fixed) per capita supply of trees at 1. The stock of money is M_t. New money is created by government and handed over to households as a transfer during the financial-market-clearing period before the shopping period, so that

$$M_t - M_{t-1} = T_t \qquad (13)$$

Analogously abroad, we assume

$$\bar{s}^* = 1 \qquad (14)$$

and

$$M^*_t - M^*_{t-1} = T^*_t \qquad (15)$$

Financial markets then clear by setting

$$s_t = 1 = s^*_t \qquad (16)$$

$$M_t = m_t + m^{*\prime}_t = p_t(c_t + c^{*\prime}_t) \qquad (17)$$

$$M^*_t = m^*_t + m'_t = p^*_t(c^*_t + c'_t) \qquad (18)$$

$$\text{and } m^{*\prime}_t = m'_t/e_t \text{ i.e. } p_t c^{*\prime}_t = p^*_t c'_t/e_t \qquad (19)$$

The last is the foreign exchange (balance of payments) constraint, that foreigners' demand for home money be equal to domestic households' demand for foreign money when converted into the same currency.

In the shopping period, money balances will be spent on goods (home on home, foreign on foreign) so that goods market equilibrium implies:

$$M_t = p_t\, y_t \qquad (20)$$

$$M^*_t = p^*_t\, y^*_t \qquad (21)$$

(by Walras' Law, that is via the budget constraints of government and households, the equilibrium in any one of the four markets- goods, money, trees and foreign exchange- is familiarly redundant).

Define the real exchange rate, $RXR_t = p_t e_t / p^*_t$

It follows that:

$$y_t = c_t + c'_t / RXR_t \qquad (22)$$

which by the home-foreign consumption trade-off, (7), yields:

$$c_t = \tfrac{1}{2} y_t \qquad (23)$$

and $c'_t = \tfrac{1}{2} y_t RXR_t$ (24)

Analogously abroad

$$c^*_t = \tfrac{1}{2} y^*_t \qquad (25)$$

and $c^{*\prime}_t = \tfrac{1}{2} y^*_t / RXR_t$ (26)

Using the foreign exchange constraint, (19), gives

$$c'_t / c^{*\prime}_t = RXR_t \qquad (27)$$

and so, using (24) and (26),

$$RXR_t = y^*_t / y_t \qquad (28)$$

Finally we solve for l_t from (9) as

$$(l_t / 1 - l_t) = \alpha / 2\beta\pi \quad E_t M_{t+1} / M_t \qquad (29)$$

so that given l_t is a proportion close to 0.5 by construction, we can loglinearise (29) around $l_t = 0.5$ to obtain

$$2\ln l_t \approx \ln[(\alpha/2\beta\pi\ E_t\ M_{t+1}/M_t)] + \text{constant} \qquad (30)$$

Monetary policy, exchange rates and welfare

Under floating exchange rates, M_t can be chosen by the home government. Let us write the rule as mean-reverting and innovation-responsive:

$$M_t = \bar{m}\ [(d_t/d)^{2k}\ (d^*_t/d^*)^{2k'}] \qquad (31)$$

where (d_t, d^*_t) are strictly positive numbers distributed around means (d, d^*).

Under fixed exchange rates $(e_t = \bar{e})$, the price level and money supply are governed by

$$M_t/y_t = pt = RXR_t.p^*_t/\bar{e} \qquad (32)$$

hence

$$M_t = RXR_t p^*_t y_t/\bar{e} = y^*_t p^*_t/\bar{e} = M^*_t/\bar{e} \qquad (33)$$

using (28) and (21); or normalising $\bar{e}$ at 1, $M_t = M^*_t$. Let us presume that M^*_t follows an analogous rule to (31):

$$M^*_t = \bar{m}^*\quad [(d^*_t/d^*)^{2k^*}\ (d_t/d)^{2k^{*\prime}}] \qquad (34)$$

It follows under rules (31) and (34) that

$$E_t\ M_{t+1} = 0 = E_t\ M^*_{t+1}$$

The representative household's welfare can be written as:

$$U_t = E_t \sum_{t=0}^{\infty} \ln\ [d_t(1-l_t)^{\pi}/2 \quad + \ln\ [d^*_t(1-l^*_t)^{\pi^*}/2] \quad +\alpha \ln lt$$

∞

$$\approx E_t \sum_{t=0} [\ln d_t + \ln d^*_t + (\alpha - \pi) \ln l_t - \pi^* \ln l^*_t + \text{constant}] \quad (35)$$

loglinearising $\ln(1-l_t)$ around $l_t = 0.5$ as before.

Under floating rates this becomes after substituting for l_t, l_t^* and then monetary policy rules, (31) and (34):

$$U_t = E_t \sum_{t=0}^{\infty} [(1-k\alpha+k\pi+k^{*\prime}\pi^*)\ln(d_t/d)+$$

$$(1-k'\alpha+k'\pi+k^*\pi^*) \ln(d_t^*/d^*) + \text{constant}] \quad (36)$$

The government can choose k and k′ to insure households completely against shocks to yields d_t/d and d^*_t/d^* : $k = (1+k^{*\prime}\pi^*)/(\alpha-\pi)$, $k'=(1+k^*\pi^*)/(\alpha-\pi)$. This maximizes the expected utility of these risk-averse households.

Assuming $\pi > \alpha$, optimal monetary policy induces households to take more leisure when there is a boom (domestic or foreign), and take less leisure in a slump. The policy has its effect through intertemporal substitution of leisure. Given that output is perishable, households cannot insure by selling the excess to a storing agency; hence they should take more leisure instead. However, this only happens if there is activist monetary policy (non-zero k responses at home or abroad).

Optimal policy could alternatively operate on future money in response to current output shocks- say, if a current response could not be engineered. Thus we could have a rule:

$$M_{t+1} = (d_t/d)^k \, (d^*_t/d^*)^{k'} \, M_t \tag{36}$$

In this case to induce households to enjoy more leisure in the boom requires them to expect rising prices next period. However we will assume that there is sufficient current information for the government to respond countemporaneously.

If so, this monetary policy response is orthodox: leaning against the boom and expanding money in the slump. Under fixed exchange rates, the equivalent utility for the representative home agent becomes

$$U_t = E_t \sum_{t=0}^{\infty} [(1-k^{*\prime}\alpha+k^{*\prime}\pi+k^{*\prime}\pi^*)\ln(d_t/d) + (1-k^*\alpha + k^*\pi + k^*\pi^*)\ln(d^*_t/d^*)] \tag{37}$$

Here foreign monetary policy is substituted for this economy through fixed exchange rates. It is plain enough that households' welfare will in general be reduced compared with floating, since k^* and $k^{*\prime}$ will not in general be chosen optimally for the home agent. Only if the other agent's preferences are the same as the home agent's ($\alpha=\alpha^*$) will optimal policies coincide.

It is worth briefly exploring some of the possibilities for the home country - arising from the policies followed abroad. The foreign country might plausibly follow either a Friedman rule setting $k^*=k^{*\prime}=0$ or an optimal activist rule.

If the foreign country follows a Friedman rule, then under fixed rates the home country is also forced to do the same, implying that there is no offsetting leisure response to the swings in output yield (d_t, d^*_t); whereas under floating it can respond optimally.

If the foreign country follows an optimal activist rule, then under fixed rates it will set $k' = 1/(\alpha^*-[\pi^*+\pi])$. Since α is not equal to α^* this will not stabilise domestic utility as in (37). Under floating, (36) will be perfectly stabilised and we will have:

$$\begin{bmatrix} (\alpha-\pi) & 0 & -\pi^* & 0 \\ 0 & (\alpha-\pi) & 0 & -\pi^* \\ -\pi & 0 & (\alpha^*-\pi^*) & 0 \\ 0 & -\pi & 0 & (\alpha^*-\pi^*) \end{bmatrix} \begin{bmatrix} k \\ k' \\ k^{*\prime} \\ k^* \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 1 \end{bmatrix}$$

or $Ak = 1$

The determinant of A is :

$$|A| = [(\alpha-\pi)\ (\alpha^*-\pi^*) - \pi^*\pi]^2$$

$$= [-\alpha^*\pi-\alpha(\pi^*-\alpha^*)]^2 > 0$$

The solution for k is for example:

$k = [-\alpha\alpha^*\pi^* - \alpha^{*2}(\pi-\alpha) + \pi\pi^*(\alpha^*-\alpha)]/|A|$

On the assumption that (α, α^*) are of low order relative to π, π^*, then unless they are extremely different k will tend to be negative.

For k′ we have

$k' = [-\alpha\alpha^*\pi^* - \alpha^{*2}(\pi-\alpha)]/|A|$

which will be negative if $\pi > \alpha$.

Equivalently

$k^{*\prime} = [-\alpha^*\alpha\pi - \alpha^2(\pi^* - \alpha^*)]/|A|$

negative again if $\pi^* > \alpha^*$;

and $k^* = [-\alpha^*\alpha\pi - \alpha^2(\pi^*-\alpha^*) + \pi^*\pi(\alpha-\alpha^*)]/|A|$

which like k is probably negative, with $\pi^* > \alpha^*$.

These details show that it is likely monetary policy both at home and abroad will under floating lean against the business cycle in a normal manner.

Whether this orthodox response will stabilise output and prices (compared with no response) is more uncertain : for example it turns out that under floating

$$\ln y_t = (1+\pi k) \ln (d_t/d) + \pi k' \ln (d^*_t/d^*) + \text{constant}$$

$$\ln p_t = [(2-\pi)k-1] \ln (d_t/d) + (2-\pi) k' \ln (d^*_t/d) + \text{constant}$$

With a negative k, monetary policy will stabilise prices with respect to d_t shocks provided $\pi > 2$ and output provided $\pi k > -2$. A non-zero k′ will destabilise both prices and output with respect to d^*_t; but if $\ln d^*_t$ is correlated with

$\ln d_t$, positively or negatively, the overall effects of policy are more complex.

It seems likely that $\ln d_t$ and $\ln d^*_t$ will be positively correlated, that $1 < \pi < 2$ and that $0 > k > -1$ (similarly k'). In this case we would tend to find a stabilising effect of monetary policy on output but destabilising on prices. For example, let $\ln (d^*_t/d^*) = 0.5 \ln (d_t/d)$, $\pi = 1.5$, $k = k' = -0.5$;

then $\ln y_t = -0.125 \ln (d_t/d)$

$\ln p_t = -1.375 \ln (d_t/d)$

against with no response (Friedman rule)

$\ln y_t = \ln (d_t/d)$

$\ln p_t = -\ln (d_t/d)$

Conclusions

What this paper has shown is that within a simple two-country model there are microfoundations for the advantages alleged in the optimal currency area literature for floating exchange rates and independent monetary policy. Removal of the simplifications in this model- logarithmic utility, perishability of output (zero investment), no government spending other than transfers, no nominal bonds- does not seem likely to overturn this result. The result comes from the cash-in-advance constraint which causes labour supply to respond to expected inflation (and so money growth) between this and next period: the household faces an inevitable delay between working (receiving cash) and being able to spend the proceeds. This delay is the microfoundations analogue of the 'nominal (price) rigidity' in the optimal currency area models. The analogue is closer than it may seem: the micro household receives income at a price that is from its viewpoint 'fixed' inappropriately, but there is no mechanism (eg. of speculative storage) by which the market can remove this inappropriateness. Only monetary policy can.

However in some respects this microfoundations support may be shaky. Even though the direction of money supply responses is orthodox, and monetary policy works by leaning against the business cycle-generating less work, so less output, in the boom and vice versa - whether it actually stabilises output and prices is not clear (though it seems likely to stabilise output). By contrast in the empirical work stability has been gauged by the variance of output and prices.

Furthermore, the difference between fixed and floating rates relies in this microfoundations model entirely on the presence of activist monetary policy (if domestic and foreign money supplies were fixed the regimes would not differ), whereas in the optimal currency area models floating rates are potentially helpful even with fixed money supplies.

What this final discussion shows is this microfoundations model at least does not yet mimic what the optimal currency area literature regards as 'the real world'.

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