ALTERNATIVE EXCHANGE RATE REGIMES AND THE TRANSMISSION OF DISTURBANCES: A GENERAL EQUILIBRIUM APPROACH

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NUMBER 182

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

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November, 1980

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The author thanks, without implicating, Assaf Razin and Lars E.O. Svensson for helpful discussions on the subject and Avinash Dixit for comments on an earlier draft. Financial support from the Jacob Wallenberg Research Foundation and the Royal Swedish Academy of Sciences is gratefully acknowledged.

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Abstract

Using a general equilibrium model with maximising agents, the transmission of disturbances under alternative exchange rate regimes are analysed and compared. Expectations of future prices and monetary policies are crucial to the analysis. Apart from specific results, the paper also provides an illustration of two more general points. First, conclusions from the analysis of globally fixed exchange rates or general floating, do not necessarily translate to the intermediate case of pegging in a world of otherwise floating rates. Second, the assumptions about the precise way that a fixed exchange rate is stabilized are critical for the results.

1. Introduction

The breakdown of the Bretton Woods system in the early seventies has been followed by drastic changes in the international financial system. In particular, countries have chosen different exchange rate arrangements.

Several of the major countries have adopted a system of essentially floating exchange rates. International monetary and macro theory has responded quickly to this development, as witnessed by the abundant literature on floating exchange rates during the last decade.

But the remaining countries have instead chosen to peg their exchange rates, e.g. to one of the major countries or to a currency basket. Effectively, such pegging leads to intermediate exchange rate regimes, the two polar cases being generally floating and global fixed rates. There has been little explicit analysis of such intermediate exchange rate regimes in the literature. The few studies that exist are mostly policy-oriented and treat either the proper choice of a basket for a developing country or problems in connection with the EMS.[1] One exception is the recent paper of Marston (1980) (see further below).

Most authors in the field seem to take it for granted that the standard analysis of fixed exchange rates carries over to the case when a country in a world of floating rates fixes the value of its currency. Analogously, in the analysis of economies on floating rates, it is generally assumed that it makes no difference to the analysis, whether the rest of the world consists of countries on an individual float or of blocs of countries with internally fixed rates. Admittedly, both these presumptionsare in most cases well motivated, because of their analytical convenience, but their validity should be more carefully investigated.

The purpose of this paper is therefore to analyse and compare alternative exchange rate regimes, without the just mentioned presumptions. Three regimes of major interest will be considered; general floating and two types of intermediate regimes; (i) two (or more) countries bilaterally fix their mutual exchange rate(s), jointly floating against the rest of the world, and (ii) one country (or a group of countries) unilaterally fix its exchange rate towards one (or a basket) of the floating currencies. (The importance to separate analytically a fixed exchange rate between two countries as the result of a mutual agreement - cooperative peg -

from one that results from one of the countries acting on its own - one-sided peg - was first pointed out in a recent paper by Helpman (1979).)

The subject matter of investigation is the transmission of disturbances between countries. We will then not only be interested in the effects on a particular country, but also in the working of the system as a whole. The focus is on theoretical issues. In particular, we will investigate under which conditions monetary disturbances are neutral and a related question; the insulation properties of floating exchange rates. One of the specific results of the paper is that these conditions are different in the three regimes.

To analyse intermediate exchange rate regimes, it is necessary to consider the interaction of at least three countries. This has been done in the recent papers by Marston (1980) and the present author (Persson (1980)).[2] Marston's model incorporates two countries, each characterised by an asset bloc, a price and a wage equation. He compares the effects on these countries of (stochastic) disturbances, originating in the rest of the world or in one of the countries, when they float independently and when they form an "exchange rate union". Persson uses a simple general equilibrium model of three countries to compare the transmission of disturbances under four different exchange rate regimes.

We will also here use a general equilibrium model of three countries as the common framework of analysis. The model is similar to that in Persson (1980) in that it is based on the same micro foundations, maximising agents and an explicit transactions role of money. But the present model is considerably richer in that it incorporates capital mobility and a more general treatment of expectations.

In the next section the features of the model that are common to all exchange rate regimes are laid out in full. Then we proceed to analyse the effects of monetary and real disturbances when there is general floating (section 3), two countries form a currency area (section 4), and finally when one country engages in a one-sided peg (section 5). A brief discussion of the results and of further work, in section 6, concludes the paper.

2. The Model

As explained in the introduction, the nature of the problem makes it necessary to analyse at least three countries. A generalisation to n countries adds nothing essential. We will also need an intertemporal framework, in particular to examine the roles of expectations and capital mobility. For simplicity, we will work with two periods only and study equilibria in the first period, contingent on agents' expectations of future variables. Hence, the approach is that of Hicksian temporary equilibrium. We will study only temporary competitive equilibria, that is all markets are assumed to clear via instantaneous price adjustment.

The model is largely inspired by the recent work of Helpman (1979) in its assumptions about the underlying institutional structure. This is pronounced in the treatment of money, and in the specification of how countries act to stabilise their exchange rates. From a methodological point of view, the teatment of temporary equilibrium and the use of dual methods in the work of Dixit (1976), (1980) have been another source of inspiration.

We thus consider a world that consists of three countries: the home country, the foreign country and a third country representing the rest of the world. Country-specific variables are denoted by the superscrips h, * and o, respectively.

There are three types of agents in each of these countries: households, firms and a Monetary Authority (MA for short). We are not interested in questions of distribution within the countries and will therefore study the behaviour of representative households and firms. As the crucial distinction here is between now and future we assume that only one composite good is produced, consumed and traded in this world. It is non-storable so there can be no investment neither in productive capacity nor in inventories. We thus abstract from relative price effects within periods. This means that trade in this model is purely intertemporal. The relative price between periods is thus the intertemporal terms-of-trade. The good is produced with one (country-specific) factor: labor, which is in fixed supply. Production and consumption can be thought of as taking place during the periods, while all financial transactions take place instantaneously at the beginning of the periods.

There are two types of financial assets. First, there is an international capital market, where loans are given at the beginning of the first period against the issue of short-term bonds that mature at the beginning of the second period. Households (and occasionally

MA's) but not firms engage in lending and borrowing, so there are pure consumption loans only. There are no bonds outstanding at the beginning of the first period. The face value of each bond is one unit of money. Bonds can be issued in all currencies.

Second, each country has its own money. These monies have the traditional triad of roles. As all assets they are potential stores of value, and as all prices are money prices, they are also units of account. More unconventionally, however, as in Helpman (1979), Lucas (1980) and Persson (1980), we follow Clower (1967) in making explicit money's role as a medium of exchange. What we consider is thus, in Clower's terms, a pure monetary economy. That is, money has to be one side in every transaction whether it concerns goods, factors or financial assets. In particular, to purchase foreign goods or assets one needs foreign money.

As there is no investment, firms' decisions regarding each period can be treated separately. They hire labor at the national labor markets at the beginning of the period and determine production so as to maximise profits. They accumulate the money received against sales during the period and use it to pay wages and profits to domestic households, at the end of the period. We will assume that all profits are distributed so these end-of-period payments (national income) completely exhuast firms receipts (national product). Observe that factor incomes hence are paid out with a lag. These rather restrictive assumptions allow us to represent the supply side in the economies with the volume and value of production. These are denoted by x_1^h, and $p_1^h x_1^h$ for the home country in the first period and analogously for the other countries. (In the remainder of this section, variables will be defined for the home country only. Notation for the two other countries is identical, except for the superscrips * and o).

An alternative assumption, which gives the same results, is that production is costless so that all income comes (with a lag) as profits. (This avoids the somewhat awkward feature that households provide labour without remuneration in the second period).

The representative (home country) household comes to the market with a given amount of money balances $\bar{M}^h$ plus a monetary transfer it receives from the home monetary authority D_1^h (which may be negative, taking the form of a lump-sum tax). There it is confronted with current prices p_1^h and interest rates r^h. It knows the forthcoming factor incomes and has expectations about future prices p_2^h and money transfers D_2^h. For simplicity, we take these expectations to be held with subjective certainty.

Given these variables it determines its consumption in the two periods c_1^h and c_2^h, its net borrowing B^h (which may of course be negative) and how much money to carry over to the future (hoard) m^h. This choice is based on the maximization of an intertemporal utility function U^h, with standard properties. In the case this plan includes purchases of foreign goods in the first period or foreign bonds (lending in foreign currency), it must acquire foreign money. This can be done either via the foreign exchange market or via borrowing in foreign currency.

Formally the optimization problem for the home country household is the following

$$\begin{aligned} &\text{Choose } (c_1^h,\ c_2^h,\ B^h \text{ and } m^h) \text{ so as to} \\ &\text{maximise } u^h = U^h (c_1^h,\ c_2^h) \\ &\text{subject to } p_1^h\ c_1^h + m^h - B^h \leq \bar{M}^h + D_1^h \\ &\text{and} \qquad p_1^h\ c_2^h \leq m^h + p_1^h\ x_1^h + D_2^h - (1 + r^h)\ B^h \end{aligned} \tag{1}$$

The two constraints are "liquidity constraints" that follow from our explicit transactions technology. To simplify the exposition, we have not disaggregated consumption, borrowing and hoarding in their domestic and foreign components. As we shall see below, in equilibrium, prices of all countries' goods and yields (including expected exchange rate changes) on all countries' assets are equal in home currency, which allows for aggregation.

If we divide the second liquidity constriant by $(1 + r^h)$ and add it to the first, we arrive at the more familiar budget constraint.

$$p_1^h\ c_1^h + \beta^h\ p_2^h\ c_2^h + (1-\beta^h)\ m^h \leq \bar{M}^h + D_1^h + \beta^h\ (p_1^h\ x_1^h + D_2^h), \tag{2}$$

where β^h is a discount factor: $\beta^h \equiv 1/(1+r^h)$. Equation (2) can then be substituted for the two liquidity constraints in (1).[3] As U^h is monotonically increasing, (2) will always be fulfilled with equality.

It follows directly from the budget constraint (2), that when the nominal interest rate is strictly positive the "portfolio choice" problem of households has a straightforward solution. Then all positive wealth carried over to the future will be in the form of bonds, as this eliminates the interest costs involved in holding money (the term $(1 - \beta^h) = r^h/(1 + r^h)$ in front of m^h).

Henceforth, we will indeed assume that $r > o$ in all countries. This assumption is made because it will be crucial for some of the analysis to separate money and other assets. It also facilitates the comparative statics considerably. However, it does not (as can be seen in (14) below) permit expected price falls beyond a certain limit. There are no conceptual problems involved with a zero interest rate, which would make bonds and money perfect substitutes. For negative interest rates, however, no agent would use bonds as a store of value, which would make money the only asset. The households may face a binding liquidity constraint also in the first period, so (2) would not longer be valid. See Persson (1980) for a discussion of such a model.

Given this assumption we can thus set $m^h = o$ everywhere above. It is then convenient to represent the households choice by help of the expenditure function. We define

$$E^h(p_1^h, \beta^h p_2^h, u^h) \equiv \min_{c_1^h, c_2^h} \{p_1^h c_1^h + \beta^h p_2^h c_2^h \mid U^h(c_1^h, c_2^h) \geq u^h\} . \qquad (3)$$

This function has some very useful properties. It is homogeneous of degree one in the two prices and increasing in u^h. Furthermore its derivatives with respect to the first two arguments are the Hicksian compensated demand functions for current and future goods. So in equilibrium we must have $c_1^h = E_1^h(p_1^h, \beta^h p_2^h, u^h)$.

Finally its derivative with respect to u^h is the inverse of the marginal utility of income. (For a thorough discussion of the expenditure function and its properties, see e.g. Dixit and Norman (1980, ch.2).

Using these properties, we can derive a general expression for the change in current consumption, which will be useful in our later comparative statics experiments. By the homogeneity of $E^h(\cdot)$, we know that in equilibrium

$$E^h(1,\mu^h,u^h) = \frac{M_1^h}{p_1^h} + \beta^h(x_1^h + \frac{D_2^h}{p_1^h}) \tag{4}$$

and

$$c_1^h = E_1^h(1,\mu^h,u^h), \tag{5}$$

where $M_1^h \equiv \bar{M}^h + D_1^h$ and $\mu^h \equiv \beta^h p_2^h/p_1^h$ are the intertemporal terms-of-trade. Now, differentiate (4) totally, manipulate using the definition of μ^h and solve for du^h. Then differentiate (5), substitute the expression for du^h and rearrange to finally end up with

$$\begin{aligned} dc_1^h = dE_1^h(\cdot) = \Big[(E_{12}^h - E_2^h \frac{E_{13}^h}{E_3^h}) + \frac{E_{13}^h}{E_3^h} \frac{1}{p_2^h} \;(p_1^h x_1^h + D_2^h)\Big]\, d\mu^h \; + \\ + \frac{E_{13}^h}{E_3^h} \Big[(\frac{1}{p_1^h} dM_1^h - \frac{M_1^h}{p_1^h} \frac{dp_1^h}{p_1^h}) + \beta^h\, dx_1^h + \beta^h(\frac{dp_1^h}{p_1^h} - \frac{dp_2^h}{p_2^h})x^h + \\ + \beta^h \frac{D_2^h}{p_1^h} (\frac{dD_2^h}{D_2^h} - \frac{dp_2^h}{p_2^h})\Big] \end{aligned} \tag{6}$$

Although awkward-looking at a first glance, this expression can be interpreted without too much effort. Consider first the ratio E_{13}^h/E_3^h that occurs frequently above. As we know that E_3^h is the inverse of the marginal utility of income, this ratio is nothing but the marginal propensity to consume (now) out of, (the present value of) total money income, c_y^h for short.

The first term in the first bracketed expression is thus the ordinary Slutsky equation. We assume that this term is positive, i.e. that goods in the two periods are gross substitutes. The second term is part of an income effect resulting from a change in β^h. In the second bracketed expression we first find the real balance effect and then an income effect accruing from a potential change in production. The last two terms represent the remaining part of the effect of the change in β^h, and the effect of changed expectations about monetary policy. We note, however, that they depend in a neat way on the "elasticity" of price expectations and the degree of correlation between expectations about prices and monetary policy.

This completes the description of home country households. The treatment of the other two countries is completely analogous.

The MA in each country, finally, thus makes transfers to (taxes) domestic households in the beginning of periods. This involves the issue of new (withdrawal of) money, thereby changing the domestic money stock in circulation. In addition to the conduct of these monetary policies the MA's may also take active part in exchange rate stabilization. We will be more specific on how this is performed below.

We are now in a position to state the conditions for a first period temporary equilibrium, that are common to all exchange rate arrangements

$$E^h(1,\mu^h,u^h) = \frac{M_1^h}{p_1^h} + \beta^h(x_1^h + D_2^h) \qquad (7)$$

(and analogously for the other countries).

$$E_1^h(\cdot) + E_1^*(\cdot) + E_1^o(\cdot) - x_1^h - x_1^* - x_1^o = 0 \tag{8}$$

$$B^{hh} + B^{*h} + B^{oh} = 0$$

$$B^{h*} + B^{**} + B^{o*} = 0 \tag{9}$$

$$B^{ho} + B^{*o} + B^{oo} = 0$$

$$p_2^h = \pi^h(p_1^h, \cdot\,) \quad \text{and analogously} \tag{10}$$

$$D_2^h = \Psi^h(\cdot) \quad \text{and analogously} \tag{11}$$

$$p_1^h = e_1^{h*}\, p_1^* = e_1^{ho}\, p_1^o\,, \tag{12}$$

Here (7) represents the budget constraint for each country, while (8) and (9) are the clearing conditons for the worlds goods and capital markets. The capital market is split according to the currency of denomination of the bonds (with an obvious notation).

Expectations about future prices and monetary policies are generated by the functions in (10) and (11). These formulations are quite general and can incorporate different hypotheses about how expectations are formed, among them "rational expectations". All exogeneous variables in the model and current goods prices are potential arguments in the functions which we take to be continuous.[4] The first argument in (10), p_1^h is explicitly displayed as it will be used to express changes in price expectations. We will fequently refer to the elasticity of expectations, defined as $d(\log p_2^h)/d(\log p_1^h)$ and analogously, an expression originally invented by Hicks (1939).

As there is only one good in the model the law of one price must hold in equilibrium. This is expressed by (12), where e_1^{h*} and e_1^{ho} are the home currency prices of foreign and rest-of-the-world currency. By cross consistency it follows that $e_1^{*o} = e_1^{ho}/e_1^{h*}$. Furthermore, we will assume that agents expect the law of one price to hold also in the future. Then (10), also defines expected future exchange rates.

In addition to (7) - (12) there are in each exchange rate regime, further equilibrium conditions concerning money stocks: These conditions, apart from closing the model, also provide a specific normalization of prices.

In equilibrium, the intertemporal relative prices that households in the three countries face must obviously be equal. In other words, there must be common intertemporal terms-of-trade, μ, or equivalently a common real rate of interest, ρ, in all countries, namely

$$\mu \equiv \frac{1}{1+\rho} = \frac{\beta^h p_2^h}{p_1^h} = \frac{\beta^* p_2^*}{p_1^*} = \frac{\beta^o p_2^o}{p_1^o} \tag{13}$$

This relative price is of course a key variable in the model.

From this relation, we can verify that the model, not surprisingly, has several neo-classical properties. By (13) and the definition of β^h, it is easy to derive the following familiar relation:

$$r^h = \rho + \left(\frac{p_2^h - p_1^h}{p_1^h}\right) + \rho\left(\frac{p_2^h - p_1^h}{p_1^h}\right) \tag{14}$$

The nominal interest rate faced by home country households is given by the Fisher relation. That is, it equals the real interest rate plus expected price increases and a cross-term.

Furthermore by (12), (13) the definition of β and our consistency assumption about expected prices and exchange rates one can readily establish

$$r^h = (1 + r^*) \frac{e_2^{h*}}{e_1^{h*}} - 1 = (1 + r^o) \frac{e_2^{ho}}{e_1^{ho}} - 1 . \tag{15}$$

So there is also nominal interest parity over the countries.

Before concluding this section we shall make some remarks regarding the existence of an equilibrium in a model of this type. A common problem in neo-classical monetary economics has been to ensure the existence of an equilibrium where the outstanding money stock is willingly held. Traditionally, a real balance effect in the excess demand function has been considered sufficient for existence. However, in an intertemporal framework the real balance effect may be insufficient to generate zero excess demand, unless supported by an intertemporal substitution effect. For example, raising current prices may not decrease demand sufficiently if the relative price of current goods in terms of future goods does not rise as well. This may be impossible if price expectations are elastic. (see e.g. Grandmont (1980) for the full argument). Certain restrictions then have to be laid on price expectations to ensure existence.[5]

The present model is less problematic, though First, the explicit transactions role of money makes the liquidity constraint binding as current prices go to infinity. Or alternatively the "income demand" for money goes to infinity (see Hool (1979) for a treatment of this in a more general model). Second, elastic price expectations are less of a problem, as the bonds in this model have a flexible yield. This means that μ can be changed without the ratio between current and (non-discounted) expected prices having to change.[6]

Uniqueness and stability of equilibrium are guaranteed by our assumption of gross substitutability.

We are now prepared to consider the different exchange rate arrangements and use the outlined model for some comparative static experiments.

3. Floating exchange rates

We first consider the case when all countries have a purely floating exchange rate. That is, the MA's do not make any interventions at all in the foreign exchange market. In a temporary equilibrium the balance-of-payments (b-o-p for short), b_1^h etc., must hence be zero in all countries.

Looking at the home country, we first define the current account surplus s^h in the first period

$$s_1^h \equiv p_1^h x_1^h - p_1^h c_1^h \qquad (16)$$

which is simply the trade surplus, because there are no interest payments in the beginning of the first period. Also, as there is no debt to be repaid the capital account surplus equals B^h, which from the first periods liquidity constraint is ($m^h = o$)

$$B^h = p_1^h c_1^h - M_1^h = 0 \qquad (17)$$

Adding (16) and (17) we arrive at the following equilibrium condition

$$M_1^h = p_1^h x_1^h = 0 \qquad \text{and analogously} \qquad (18)$$

We note that $p_1^h x_1^h$, in terms of Clower (1967) corresponds to the total (world) "reservation" demand for home money at the beginning of the first period. Thus (18) also says that the excess demand for home money in the beginning of the period is zero in equilibrium. There is yet another interpretation of (18). Again in Clower's terms, $p_1^h x_1^h$ is the home household's "income" demand for money in the end of the first period. That is, (18) can also be taken to mean that the excess demand for money in the end of the period is zero.

Both x_1^h and M_1^h are exogeneous so we can solve (18) directly for p_1^h. Prices are thus determined by the quantity theory of money. The special transactions structure makes velocity equal to 1.

<u>A temporary equilibrium under floating exchange rates</u> can now be defined. <u>It is a vector $(u, p_1, e_1^{ho}, e_1^{h*}, r, p_2, D_2)$ that satisfies (7) - (12) and (18)</u>. (All variables without superscripts are themselves vectors with three elements).

Because of the budget constraint in each economy, one of the (sets of) equations (8), (9) and (16) is not independent in equilibrium. Therefore, we can supress the explicit treatment of the bond market in the following. (As we do not need to separate bonds of different denomination in each country's budget constraint - see the comments on p.8 and (15) - we can indeed talk about <u>the</u> bond market in the present context).

The recursive structure of the model permits us to proceed stepwise, when analysing the effects of a particular disturbance. We start by differentiating (18) and (12) and solve for the change in p_1 and e_1. Then we (hypothetically, so far) determine the effects on p_2 and D_2 from (10) and (11). Finally we can, by help of (6) use (8) to solve for the change in μ. It is then easy to go backwards and reveal the impact on the other endogenous variables.

Following this approach we look at the effects of a monetary disturbance, say a rise in the first period money transfers in the home country; $dD_1^h = dM_1^h > 0$.

We find

$$\frac{dp_1^h}{p_1^h} = \frac{de_1^{h*}}{e_1^{h*}} = \frac{de_1^{ho}}{e_1^{ho}} = \frac{dM_1^h}{M_1^h} , \tag{19}$$

the expected quantity theory and law of one price results, but also

$$d\mu = -\Delta^{-1} \left[c_y^h \beta^h \left(\left(\frac{dp_1^h}{p_1^h} - \frac{dp_2^h}{p_2^h}\right) x_1^h + \frac{D_2^h}{p_1^h} \left(\frac{dD_2^h}{D_2^h} - \frac{dp_2^h}{p_2^h}\right)\right)\right] \tag{20}$$

$$\text{where } \Delta = (E_{12}^h - c_y^h E_2^h) + c_y^h \frac{1}{p_2^h} (p_1^h x_1^h + D_2^h) +$$

$$+ (E_{12}^* - c_y^* E_2^*) + c_y^* \frac{1}{p_2^*} (p_1^* x_1^* + D_2^*) +$$

$$+ (E_{12}^o - c_y^o E_2^o) + c_y^o \frac{1}{p_2^o} (p_1^o x_1^o + D_2^o) .$$

We know that Δ is strictly positive, due to the assumption of gross substitutability. Hence, the effect on the intertemporal terms-of-trade, and thereby also on the other countries' consumption levels, depends entirely on the expression between brackets. Its sign reflects whether, at the old μ, the demand for first period goods is higher or lower in the home country. The sign of the first term obviously depends on the elasticity of expectations, as for unit elastic expectations $dp_2^h/p_2^h = dp_1^h/p_1^h$, while the second hinges on the relation between expected prices and monetary policy. Thus we cannot sign $d\mu$ without more information about expectations. As a benchmark, we will then use what may be termed rational expectations in the present model.

If we assume that agents know how prices are determined, i.e. according to the quantity theory, they will also know the expression for equilibrium future prices:

$$p_2^h \, x_2^h = M_2^h = M_1^h + D_2^h \tag{21}$$

Then consistent expectations would mean price expectations that were based on (21) and thus contingent upon expectations about D_2^h. We will call such expectations rational.

For any <u>given</u> (expected) value of x_2^h we can define the following relation between dp_2^h/p_2^h and dD_2^h/D_2^h , in response to the initial shock

$$\frac{dp_2^h}{p_2^h} = \left(\frac{dM_1^h}{M_1^h} + \frac{dD_2^h}{D_2^h}\,\frac{D_2^h}{M_1^h}\right) \Big/ \left(1 + \frac{D_2^h}{M_1^h}\right) \tag{22}$$

Indeed, substituting (22) and (19) into (20) and simplifying we find that the bracketed expression disappears, so $d\mu = 0$. It immediately follows that consumption patterns in all countries are unaffected.

So, rational expectations is a sufficient condition for money to be neutral under floating exchange rates in this world. The intuition behind this result is simple. As prices are determined according to the quantity theory, a current monetary shock leaves today's real resources unaffected. If agents have rational expectations they understand that future monetary changes will neither change their future real endowment. Accordingly they will not change their plans, so the real equilibrium remains unchanged.

It should perhaps be emphasised that we have not required agents to have perfect foresight. In fact, perfect foresight is just a special case of the above-defined rational expectations, that occurs where agents happen to pick the correct value of D_2^h.

In other words, if agents "know the true model" and make their forecasts by help of this model, we can allow them to make mistakes. Loosely speaking as long as agents believe that money is neutral, money is in fact neutral.

However, if expectations are not formed in such a way, money is not neutral. For inelastic price expectations, for example, in the sense that the expected dp_2^h/p_2^h is smaller than that given by (22), $d\mu < 0$. By (6) this then leads to a rise in c_1^h and a fall in c_1^* and c_1^o. In other words, the other countries provide more lending in response to the rise in the real interst rate. The trade balance of the home country thus deteriorates and the capital account improves by the same amount, while the opposite holds true for the other countries.

The interesting upshot is thus that although p_1^h, e_1^{h*} and e_1^{ho} change in proportion to the increase in M_1^h, this monetary disturbance may nevertheless have real effects on the other countries. This, of course, hinges upon the fact that the home country is big enough to affect μ (significantly). It is interesting to link this result to the discussion in the literature of whether a floating exchange rate insulates an economy from foreign shocks. When it comes to nominal shocks, this discussion has mainly been concerned with the conditions that determine whether a foreign price or inflation disturbance, taken as exogenous, spills over onto the domestic price level or inflation rate. Two main reasons for this to occur have been identified; erroneous exchange rate expectations and the prevalence of foreignly denominated assets in domestic portfolios. See Turnovsky (1979) and Van Duyne (1980) for analytical surveys.

To the extent that the impact of real variables has been discussed, a common conclusion seems to be that they are affected when the foreign disturbance spills over onto domestic prices.

What we have seen here is that real variables may well be affected, even if the exchange rate insulates the economy fully from the foreign price shock. We note that the source of non-insulation - erroneous expectations - is similar, though. (Also the other source mentioned above would be present here, had we not assumed away that there is debt outstanding at the beginning of the first period).

This illustrates the potential drawback of a partial equilibrium approach. The cause of what is taken as an exogenous shift may also have other effects, which are not apparent unless one works with a fully specified model.

Consider now, instead, a real disturbance. Say that there is an increase in productivity in the home country, so that $dx_1^h > 0$. Again we first determine the effect on current prices and exchange rates by differentiating (18) and (12). This gives

$$\frac{dp_1^h}{p_1^h} = \frac{de_1^{h*}}{e_1^{h*}} = \frac{de_1^{ho}}{e_1^{ho}} = -\frac{dx_1^h}{x_1^h} \quad . \tag{23}$$

Then we proceed, in the same way as above, to solve for the impact on intertemporal relative prices. After some manipulation we obtain

$$d\mu = \Delta^{-1}\left[(1 - c_y^h)\, dx_1^h + c_y^h\, \beta^h \frac{D_2^h}{p_1^h} \left((1 + \frac{p_1^h x_1^h}{D_h^2}) \frac{dp_2^h}{p_2^h} - \frac{dD_2^h}{D_2^h}\right)\right] . \tag{24}$$

The intertemporal terms-of-trade thus increase or decrease as the bracketed expression is positive or negative. It is positive to the extent that demand for current consumption in the home country is smaller than the increase in production, so that there is excess supply of goods at the old μ. The first term is positive but the second can go either way depending on expectations. Again we use rational expectations as a benchmark. We assume that home households expect the higher production level to extend into the future, and by (21) derive a relation like (22). Using that, (24) reduces to

$$d\mu = \Delta^{-1} \left[1 - c_y^h \left(1 + \beta^h \left(1 + \frac{D_2^h}{M_1^h}\right)\right)\right] dx_1^h \qquad (24')$$

The sign of (24') is also indeterminate, a priori. But the higher c_y^h, the more likely a fall in μ. For expectations that are not rational a high elasticity of price expectations tends in the same direction. If μ falls, c_1^* and c_1^o decrease, while current consumption increases in all countries if μ rises.[7] The effects on trade and capital balances, in the two cases, should be obvious.

Finally we will make a couple of comments on how the present model compares to the recent modelling of floating exchange rates in the literature. As prices are determined according to the quantity theory and there is only one good in this model, exchange rates are determined in the same way as in the simplistic "monetary approach" (see Bilson (1979) for a short exposition of this view). Indeed, by combination of (18) and (12) the exchange rate between the home and foreign country is

$$e_1^{h*} = \frac{M_1^h}{M_1^*} \; \frac{x_1^*}{x_1^h} \qquad , \qquad (25)$$

an expression similar to these in the monetary approach. In spite of that, monetary disturbances have an impact on real variables, unless agents have rational expectations. The casual treatment of the real side of the economy in the monetary approach may thus be interpreted as an implicit assumption of rational expectations.

The models contained in the so-called "asset market approach" offer more sophisticated explanations of exchange rate formation, which are typically based on agents' portfolio choices. The interrelation between these choices and agents' intertemporal consumption (and production) choices is, however, unsatisfactorily treated in these models. To set these models on a footing that is consistent with overall maximising behaviour at the individual level is a topic of future research. However, this is an ambitious task, because asset diversification implies that agents' decisions are influenced by (subjective) uncertainty and/or transactions costs.[8]

4. Currency Areas

We now look at the situation when the home and the foreign country have made a mutual agreement to fix their bilateral exchange rate. They are thus on a joint float against the rest of the world, forming what may be called a currency area. The currency area is incomplete, however, in that each country keeps its own currency and an independent MA. We postulate $e_1^{h*} = e_2^{h*} = e^{-h*}$, that is there are no expectations that the two MA's may fail to defend the fixed exchange rate in the future. Other assumptions are of course possible but will not be pursued here. For simplicity, set $e^{-h*} = 1$. In equilibrium then, the two countries will have the same current prices. Denote them by p_1^*. By the assumptions that price and exchange rate expectations be consistent and $e_2^{h*} = e^{-h*}$, the two countries are also expected to have the same future prices, denoted by p_2^*.

It is necessary to specify more precisely how the two MA's carry out the task of stabilizing the exchange rate. We will then adopt an assumption similar to that of Helpman (1979), in his treatment of a two-sided fixed exchange rate system. We assume that the MA's in the two countries jointly intervene in the foreign exchange market whenever one of the currencies is in excess demand. This happens when there is a (planned) surplus in the b-o-p of a country in the area. As MA^o does not intervene in the market, $b_1^o = 0$. So in equilibrium there must be a corresponding deficit and hence excess supply of domestic currency in the other area-country. The MA in the surplus country then issues new domestic money to cover the surplus. This is handed over to the MA in the deficit country who sells it at the fixed exchange rate and keeps the proceeds.

Hence there will be an injection into the system of the surplus country's currency and a corresponding withdrawal of the deficit country's currency as a result of the stabilisation operations. These operations can be thought of as a type of "swap" arrangement. If the MA's were instead to carry out the stabilisation operations with the help of reserve holdings in the form of their partner's currency, the outcome would have been exactly the same, as long as these reserves were sufficiently large. The present formulation of how MA^h and MA* stabilise $\bar{e}^{h*}$ is thus similar to the recent modelling of fixed exchange rates in the monetary approach to the balance of payments (MABOP).

Call the injections of home and foreign currency X^h and X*. Formally we then have

$$X_1^h = b_1^h = p_1^* x_1^h - M_1^h \qquad \text{and analogously.} \qquad (26)$$

As in the former section, we can interpret the RHS of (26) as either the beginning or end-of-period excess demand for home currency. As X_1^h is the injection of home currency we see that, indeed, the basic conclusion of the MABOP holds in equilibrium. This should not be a surprise, however, as we have assumed that there is Walrasian market clearing, and thus all excess demands, including the excess demand for money, must correspond to actual transactions.

We can now formulate the following equilibrium requirements in this exchange rate regime:

$$b_1^h + b_1^* = p_1^* x_1^h - M_1^h + p_1^* x_1^* - M_1^* = 0$$
$$b_1^o = p_1^o x_1^o - M_1^o = 0 \quad , \tag{27}$$

which together with (26) substitute (18) in the set of equilibrium conditions.

Thus, <u>a temporary equilibrium in the currency area regime is defined as a vector $(u, p_1, e_1^{ho}, \quad r, X_1, p_2, D_2)$ that fulfills (7) - (12) and (26) and (27).</u> (As before u, r and D_2 are vectors with three elements but p_1, p_2 and X_1 have only two elements). Because of the fixed exchange rate between the home and foreign country it follows trivially that, in equilibrium, $r^h = r^*$(see (5))and $e_1^{ho} = e_1^{*o}$ (see (12) and the following remark). By (27) prices are still determined according to the quantity theory, but for p_1^* this holds only at the level of the currency area.

We now turn to the comparative statics. In the general floating case the transimission of disturbances was the same, irrespective of where in the world they originated. In the present regime, as will soon be made clear, this is not the case.

Take first a monetary disturbance within the currency area, say $dD_1^h = dM_1^h > 0$. From (27) and (12), we solve for the effects on prices and exchange rates

$$\frac{dp_1^*}{p_1^*} = \frac{de_1^{ho}}{e_1^{ho}} = \frac{de_1^{*o}}{e_1^{*o}} = dD_1^h \left(\frac{1}{M_1^h + M_1^*}\right) \tag{28}$$

Going on, along the same lines as in the previous section, we then derive an expression for the change in relative prices

$$\begin{aligned} d\mu = - \Delta^{-1}\Big[\frac{1}{p_1^*} & \left(c_y^h\, dD_1^h - (c_y^h M_1^h + c_y^* M_1^*)\frac{dp_1^*}{p_1^*}\right. + \\ & + \beta^* \left(\frac{dp_1^*}{p_1^*} - \frac{dp_2^*}{p_2^*}\right)(c_y^h x_1^h + c_y^* x_1^*) + \\ & + \frac{\beta^*}{p_1^*}\left(c_y^h D_2^h \left(\frac{dD_2^h}{D_2^h} - \frac{dp_2^*}{p_2^*}\right) + c_y^* D_2^* \left(\frac{dD_2^*}{D_2^*} - \frac{dp_2^*}{p_2^*}\right)\right)\Big] \end{aligned} \tag{29}$$

As before, relative prices rise or fall according to whether demand for current consumption would decrease or increase if they were unchanged. If demand increases the whole bracketed expression is positive. We see that, as in the general floating case, expectations about future prices and monetary policy are crucial for the outcome. Here, however, variables in both area-members are involved.

We will also here use rational expectations, with a definition analogous to that in the former section, as a benchmark. It is then possible to establish the following result.

Rational expectations is not a sufficient conditons for monetary policy, in either of the area-countries, to be neutral, in the sense that $d\mu = 0$. Sufficient conditions for $d\mu = 0$ are rational expectations plus $c_y^h = c_y^*$.

The formal argument is given in appendix 1, but intuition is really enough. Under floating exchange rates the quantity theory determination of prices and rational expectations, mean that the current and expected future real value of a country's money endowment are both unchanged after a monetary disturbance. Here the same holds true for the currency area as a whole. However, the initial disturbance and the expected changes in monetary policies (to the extent that they are non-symmetric), both lead to a redistribution of purchasing power between the two member countries. Unless the marginal propensities to consume are equal, which there is no reason to expect a priori, this redistribution will lead to a change in aggregate demand and hence in relative prices.[9]

If $c_y^h > c_y^*$ for example, the intertemporal terms of trade would tend to fall. If expectations are not rational, inelastic price expectations (as compared to the rational ones) would also tend to lower μ.

So the rest of the world is insulated from the price effect of monetary disturbances via its floating exchange rate, as in the case of general floating. But, as we have seen, rational expectations is not longer a sufficient condition for real magnitudes to be unaffected in the rest of the world, when it floats against a currency area.

Irrespective of which way μ goes, the redistribution of purchasing power between the area members in general leads to an increase in c_1^h relative to c_1^*. We also note that in contrast to the general floating case, c_1^* and c_1^o may change in different directions. Especially when $d\mu > 0$, there is a high probability for this to occur.

Finally, we know that the b-o-p of the home country unambiguously deteriorates, as from (26) and (28):

$$db_1^h = dX_1^h = (\frac{p_1^* x_1^h}{M_1^h + M_1^*} - 1)\ dD_1^h < 0 \ . \tag{30}$$

Accordingly, there is a withdrawal of home money, and a corresponding injection of foreign money into circulation. The effects on the trade and capital accounts are easily determined in the different possible cases mentioned above.

It is worth noting that the effects of a change in $\bar{e}^{h*}$ would be identical to monetary disturbances of the type we have studied (provided that the new $\bar{e}^{h*}$ is also expected to prevail in the future). If we drop the assumption that $\bar{e}^{h*} = 1$ and express all home country variables in foreign currency, we see immediately that a devaluation of the home currency (a rise in $\bar{e}^{h*}$) by x%, is exactly analogous to a decrease in M_1^h by x%.

Let us briefly look at the effects of a monetary disturbance in the rest of the world. We will not dwell upon the formal derivations, as it is straightforward to show that the results exactly corroborate those obtained under general floating. In particular, the common floating rate insulates the area members from the resulting price disturbance, and thus from (26), $dX_1^h = 0$, so there is no need for intervention in the foreign exchange market. This result holds whether the intertemporal terms-of-trade change or not, that is, irrespective of how expectations are formed.

Instead, consider real disturbances within the currency area. Say, as in the floating case, that we have $dx_1^h > 0$. The impact on current prices and exchange rates is

$$\frac{dp_1^*}{p_1^*} = \frac{de_1^{ho}}{e_1^{ho}} = \frac{de_1^{*o}}{e_1^{*o}} = - dx_1^h \left(\frac{1}{x_1^h + x_1^*}\right) \tag{31}$$

The expression for the change in μ is readily derived, but is of little interest as it involves too many forces to permit any generalized results. We gain no extra insights by invoking rational expectations. What we can say is that c_1^h increases, and that c_1^* and c_1^o may both rise or fall. Like above, the changes in c_1^* and c_1^o may be of opposite sign.

We also know that b_1^h necessarily improves and hence that the home money stock in circulation increases (the opposite holds for the foreign country), as from (31) and (26)

$$db_1^h = dX_1^h = p_1^* \left(1 - \frac{x_1^h}{x_1^h + x_1^*}\right) \ dx_1^h > 0 \tag{32}$$

For a real disturbance with its provenance in the rest of the world, the results are again similar to the general floating case.

To summarize, the transmission of disturbances in a world with a currency area is asymmetric. Disturbances originating outside the area transmit to the member countries via relative prices as under floating rates. Monetary disturbances have no impact at all if expectations are rational. Disturbances inside the currency area impinge on the rest of the world via relative prices. However, unlike the case of general floating, rational expectations are not sufficient to guarantee that monetary disturbances leave relative prices unchanged. The reason is that all disturbances that change the common price level in the currency area lead to a redistribution of purchasing power between its members. As a consequence, such disturbances will also result in b-o-p adjustments within the area and corresponding changes in national money stocks.

From the area members' point of view, the present setting can be described as an intersection between globally fixed exchange rates and general floating. This is similar to the finding in Persson (1980). In that paper, the framework of analysis is a simpler model without capital mobility and a much more restrictive treatment of expectations. Several of the results derived here, notably that money need not be neutral and that disturbances in one of the area countries may affect consumption levels in the other countries in opposite ways, was therefore absent in that framework.

There is a qualification to the above results, however, in that they presuppose the countries to be of a comparable size. The smaller the home country, say, the less it can influence μ, as under general floating. Also, the smaller it is in comparison with the foreign country the less do home disturbances affect p_1^* (see (28) and (31)). In the limiting "small country" case, which has been studied extensively in the literature, all non-domestic variables are parametric to the home country.

On this assumption, the home country disturbances studied above would affect only c_1^h, b_1^h and its composition. The results in this case, which the reader can easily work out, remind much of those in the small-country version of the MABOP.[10]

Closing this section we comment on the result that all monetary disturbances lead to a redistribution of purchasing power within the currency area. Effectively, it is like the surplus country making a transfer to the deficit country.[11] Our assumption about how the exchange rate is stabilized clarifies this. Indeed, the new money issued in the surplus country and transferred to the MA of the deficit country is necessary to make valid, in this monetary economy, the excess demand for foreign goods and assets inheret in a planned deficit in the b-o-p.

These comments indicate that the coordination of monetary policies and future changes in, as well as the initial level of, the common exchange rate, should be matters of strategic discussion among countries that plan to set up a currency area.

5. One-sided pegs

The final exchange rate arrangement to be considered in this paper is when the home country takes a one-sided action to peg its exchange rate to the foreign currency. Hence, MA^h is the only MA that intervenes in the foreign exchange market. In specifying how MA^h makes these interventions, we will adopt the same assumption as Helpman (1979).

As in the former section we assume $e_1^{h*} = e_2^{h*} = e^{-h*} = 1$. So in equilibrium, the home country will necessarily have the same price level as the foreign country p_1^*. The comments about p_2^* in the former section apply also here.

It is necessary that MA^h intervenes in the market, whenever foreign currency is in excess demand or supply. We assume that when MA^h needs to sell foreign currency, it <u>borrows</u> it in the international capital market (sells bonds denominated in foreign currency). When MA^h instead buys foreign currency, it uses newly issued home money and <u>lends</u> out the proceeds (buys foreign bonds). Thus MA^h transacts with the private sector abroad, in carrying out these stabilization operations.

The described procedure can be said to approximate the behaviour of central banks that manage a fixed exchange rate with the help of interest bearing reserves. The institutional difference from the regime in the former section is thus, no only that MA^h acts on its own, but also that it carries foreign debt or assets to the second period. These institutional differences (both are needed) lead to the following important corollary, which clearly distinguishes the present regime from the currency area, from an analytical point of view. Although the actions from MA^h lead to injections and withdrawals of home money from circulation, there are no changes in the money stocks of the other countries. This means that b-o-p adjustments in this regime lead to a change in the world money stock in circulation.

Formally, denoting as before the injections of home money with X^h, we have the following equilibrium conditons:

$$b_1^h = p_1^* x_1^h - M_1^h = X_1^h = -B^{m*}$$

$$b_1^* = p_1^* x_1^* - M_1^* = 0 \qquad (33)$$

$$b^o = p_1^o x_1^o - M_1^o = 0$$

where B^{m*} is the amount of borrowing MA^h engages in when carrying out its interventions. (We must now think of B^{h*} in the equilibrium condition for the capital market - the second row of (9), section 2 - as being the sum of B^{m*} and B^{p*}, say, the amount of home households borrowing in foreign currency). The two latter relations determine prices in the foreign country and the rest of the world, while the first obviously determines the amount of home money in circulation.

A temporary equilibrium with a one-sided peg can be defined as a vector $(u, p_1, e_1^{ho}, r, X_1^h, p_2, D_2)$ which satisfies equations (7) - (12) and (33). (u, r and D_2 are three-element vectors; while p_1 and p_2 have two elements). By the same reasons as in the currency area regime, $e_1^{ho} = e_1^{*o}$ and $r^h = r^*$.

The comparative static effects in this regime are again asymmetric. Actually, the transmission of disturbances is different for each place of origin. In order not to get overly taxonomic, we will therefore discuss the effects of monetary disturbances only. The analysis of real disturbances, which presents no complications, is left to the reader.

As before, we start by assuming $dD_1^h > 0$. By (33) there is no impact at all on the current prices facing home consumers, as these are entirely determined in the foreign country, independently of the size of the home country. Instead we have

$$dX_1^h = - dB^{m*} = - dD_1^h \quad , \tag{34}$$

that is, the whole increase in money transfers "spills out" via the b-o-p.

We proceed to the change in the intertemporal terms-of-trade. It is

$$d\mu = - \Delta^{-1} \left[c_y^h \frac{1}{p_1^*} \left(dD_1^h + \beta^* D_2^h \left(\frac{dD_2^h}{D_2^h} - \frac{dp_2^*}{p_2^*} \right) \right) \right] \quad , \tag{35}$$

with the same caveat about the home country's size, as in the other regimes. As expectations are decisive also here, we will once again resort to rational expectations.

Rational <u>price</u> expectations would here, from a relation like (21), simply mean $dp_2^*/p_2^* = 0$, unless D_2^* would be affected by dD_1^h , which we rule out by assumption. Then (35) would reduce to

$$d\mu = - \Delta^{-1} \left[c_y^h \frac{1}{p_1^*} \left(dD_1^h + \beta^* dD_2^h \right) \right] , \qquad (36)$$

which should have a negative sign if dD_2^h is not sufficiently contractive to overcompensate the increase in the overall endowment resulting from dD_1^h .

One can however claim that such expectations are incomplete, in that no restrictions have been put on D_2^h. There is no guarantee that all D_2^h are consistent with equilibrium in the second period, which seems a reasonable requirement for expectations to be rational. One equilibrium requirement for the second period is that MA^h would not end up in debt when financial transactions are settled in the beginning of the second period. Indeed, as is shown in Appendix B, this condition puts an upper limit on D_2^h , which is given by the following transfer (tax) formula

$$D_2^h \leq p_2^* x_2^h - M_1^h - r^* B^{m*} , \qquad (37)$$

where p_2^* is a rationally expected value.

When (32) is fulfilled with equality MA^h ends up with an exactly balanced budget. If the inequality holds its end up with positive holdings or foreign currency. Now, assume that home consumers know (37) and believe it to be fulfilled with equality. Differentiate and insert $dD_1^h = dM_1^h$ and (34). This gives $dD_2^h = - \left({}^1/(1 + r^*) \right) dD_1^h = - \left({}^1/\beta^* \right) dD_1^h$. Then it follows immediately from (36) that $d\mu = 0$.

The explanation of this is intuitively appealing. If home consumers expect MA^h to carry out its future monetary policy to balance the budget for its stabilization operations, then they are effectively subject to the same budget constraint as under floating rates with rational expectations. This claim is proven in Appendix B. In the other countries agents act like under floating rates. We can thus state the following result:

If home households expect (37) to be fulfilled with equality, the allocation of consumption in the world economy under a one-sided peg must be the same as under general floating, provided that agents have rational expectations. This result is related to, and can be seen as an extension of, the findings in Helpman (1979). He analyzes a world of two countries by help of an intertemporal general equilibrium model where agents have perfect foresight. He then shows that the allocation of consumption in a one-sided peg, where the budget that arises from exchange rate stabilization is constrained to end up exactly balanced, coincides with that under floating rates (cf the comments in section 3 on the relation between perfect foresight and the rational expectations considered here).

Of course, under these restrictive assumptions about expectations the comparative static effects in this regime must be the same as under floating rates. In particular, as was shown in Section 3, monetary disturbances have no effect on real variables.

For other expectations this does not hold, though. If $dD_2^h > -\left({}^1/\beta^*\right) dD_1^h$, for example, maybe because agents neglect MA^h's intertemporal budget in their expectations, there will be excess demand on the goods markets at the old relative prices. Accordingly $d\mu < 0$. So c_1^h increases, while c_1^* and c_1^o both decrease.

If instead there is a monetary disturbance in the foreign country, $dD_1^* > 0$, the effect on μ is

$$d\mu \equiv -\Delta^{-1}\left[c_y^h\left[-\frac{M_1^h}{p_1^*}\frac{dp_1^*}{p_1^*} + \beta^* x_1^h\left(\frac{dp_1^*}{p_1^*} - \frac{dp_2^*}{p_2^*}\right) + \beta^*\frac{D_2^h}{p_1^*}\left(\frac{dD_2^h}{D_2^h} - \frac{dp_2^*}{p_2^*}\right)\right] + \right.$$

$$\left. + c_y^*\left[\beta^* x_1^*\left(\frac{dp_1^*}{p_1^*} - \frac{dp_2^*}{p_2^*}\right) + \beta^* D_2^*\left(\frac{dD_2^*}{D_2^*} - \frac{dp_2^*}{p_2^*}\right)\right]\right] \qquad (38)$$

It is easily verified that $d\mu = 0$, under the conditions discussed above. If there are rational expectations the second bracketed expression is zero, by a relation analogous to (22), and if (37) holds with equality the first bracketed expression is also zero by use of (33). The reader can use this as a benchmark and work out the effects in some of the other possible cases. He will then find that here, unlike the case of dD_1^h, the effects on current consumption in the non-disturbance countries may well go in different directions.

For a monetary shock in the rest of the world, finally, the effects are also in this regime the same as under general floating. There is thus no need for MA^h to intervene in the foreign exchange market.

The transmission of disturbances is thus asymmetric with one-sided pegs as well as with a currency area in the world economy. There are, however, important differences between the two regimes. In particular, the redistribution of purchasing power that was an important part of the adjustment mechanism in the currency area, is not present here. The reason is that in this regime the world money stock need not stay constant after a disturbance.

This suggests that it is crucial in which way one models how the task of exchange rate stabilization is carried out. For example, in the present model, leaving aside its realism, the conclusions regarding the home country's possibility to affect its consumption with monetary policy or a devaluation is entirely different in the two cases considered here. In the currency area this is definitely possible, while in the one-sided peg it is possible only to the extent that home consumers don't expect future monetary policy to adjust so as to balance MA^h's intertemporal budget. Also, the conditons which make real variables in the rest of the world insulated from monetary disturbances are different in the two cases.

The particular feature of the present model which makes it possible to derive these differences between the two regimes is the explicit distinction between money and wealth. In simplier models where money is the only asset, these differences do not occur (see Persson 1980)). This indicates that one should treat with caution also other results in international monetary theory that are derived from models where money and wealth are taken as synonyms.

6. Final remarks

As the paper is long, we end with some general remarks rather than with a summary of the results.

First, we hope to have domonstrated that neither the analysis of general floating nor the analysis of globally fixed exchange rates can be applied without qualifications to intermediate exchange rate regimes.

Second, as discussed at the end of the former section, the precise specification of how the stabilization of a fixed exchange rate is carried out is critical for the results. Therefore, one has to be careful in specifying which type of "fixed exchange rates" any particular analysis applies to.

Finally, the model presented in this paper offers a consistent framework of analysis, but clearly has its limitations. For example, the assumption of Walrasian market clearing is an extreme one. It would be interesting to relax this assumption and thus allow for prices to be sticky in labour and/or goods markets. The appropriate approach would then be the analysis of a temporary equilibrium with rationing applied to open economies, as in Dixit (1978) and a number of consecutive papers. This is one of several possible directions of future research on intermediate exchange rate regimes.

Appendix A

The rational expectations relation between future prices and monetary policies, which is the counterpart to (22), in the currency area regime reads

$$\frac{dp_2^*}{p_2^*} = \left(\frac{1}{M_1^h + M_1^*} \left(dD_1^h + dD_2^h + dD_2^*\right) \right) \Big/ \left(1 + \frac{D_2^h + D_2^*}{M_1^h + M_1^*} \right) .$$

After the substitution of this expression and (28), in (29), straightforward, although tedious, manipulation gives

$$\begin{aligned} d\mu = - \Delta^{-1} \Bigg[& \left[\frac{1}{p_1^*} \left[\left(c_y^h - \left(c_y^h \frac{M_1^h}{M_1^h + M_1^*} + c_y^* \frac{M_1^h}{M_1^h + M_1^*} \right) \right) dD^h \right] \right] + \\ & + \Gamma^{-1} \beta^* \Bigg[\frac{dD_1^h}{M_1^h + M_1^*} \left(\left(\frac{D_2^h + D_2^*}{M_1^h + M_1^*} \right) p_1^* \left(c_y^h x_1^h + c_y^* x_1^* \right) - \left(c_y^h D_2^h + c_2^* D_2^* \right) \right) + \\ & + \left(\left(c_y^h dD_2^h + c_y^* dD_2^h \right) - \left(\frac{dD_2^h + dD_2^*}{M_1^h + M_1^*} \right) p_1^* \left(c_y^h x_1^h + c_y^* x_1^* \right) \right) + \\ & + \left(\left(c_y^h dD_2^h + c_y^* dD_2^* \right) \frac{D_2^h + D_2^*}{M_1^h + M_1^*} - \left(c_y^h D_2^h + c_y^* D_2^* \right) \frac{dD_2^h + dD_2^*}{M_1^h + M_1^*} \right) \Bigg] \Bigg] \end{aligned}$$

where $\Gamma \equiv 1 + \left(\frac{D_2^h + D_2^*}{M_1^h + M_1^*} \right)$ and Δ is defined as in the text.

We know that $p_1^* (x_1^h + x_1^*) = M_1^h + M_1^*$ by (27). It is then clear that the whole bracketed expression reduces to zero, so $d\mu = 0$, when $c_y^h = c_y^*$. When $c_y^h \neq c_y^*$, however, this is generally <u>not</u> the case. The reader can verify this by substituting, for example, $c_y^h = 2c_y^*$ in the above expression.

Appendix B

We first derive the transfer/tax formula that ensures that MA^h does not end up in debt in period 2.

In a (rationally expected) equilibrium in the second period all home money would be spent on home goods. That is

$$p_2^* x_2^h - (\bar{M}^h + D_1^h + X_1^h + D_2^h + X_2^h) = 0 \qquad \text{or}$$

$$-D_2^h = (\bar{M}^h + D_1^h) - p_2^* x_2^h + X_1^h + X_2^h \quad .$$

If MA^h shall be able to pay back its first period borrowing plus interest, it is necessary that

$$X_2^h \geq (1 + r^*)\ B^{m*} \qquad \text{or}$$

$$X_2^h + X_1^h \geq - r^* X_1^h$$

that is, we must have

$$-D_2^h \geq (\bar{M}^h + D_1^h) - p_2^* x_2^h - r^* X_1^h \qquad \text{or}$$

$$D_2^h \leq p_2^* x_2^h - M_1^h + r^* X_1^h \qquad \text{(B1)}$$

We will now argue that when this formula is expected to hold with equality, the budget constraint for home consumers coincides with that under floating rates and rational expectations.

In the latter case we have

$$p_1^h x_1^h = \bar{M}^h + D_1^h = M_1^h$$ and

$$p_2^h x_2^h = M_2^h + D_2^h = p_1^h x_1^h + D_2^h$$

Substituting these expressions in the intertemporal budget constraint (2), applied to floating rates, we arrive at

$$p_1^h c_1^h + \beta^h p_2^h c_2^h = p_1^h x_1^h + \beta^h p_2^h x_2^h$$ or

$$c_1^h + \mu c_2^h = x_1^h + \mu x_2^h$$

Now, assume that in the one-sided peg regime (B1) holds with equality. Substitute the RHS of (B1) for D_2^h in (2), applied to this regime. This gives

$$p_1^* c_1^h + \beta^* p_2^* c_2^h = M_1^h + \beta^* (p_1^* x_1^h + p_2^* x_2^h - M_1^h + r^* X_1^h) ,$$

or by use of (33)

$$p_1^* c_1^h + \beta^* p_2^* c_2^h = M_1^h + \frac{1}{1+r^*} (p_1^* x_1^h + p_2^* x_2^h - M_1^h + r^*(p_1^* x_1^h - M_1^h) =$$

$$= p_1^* x_1^h + \beta^* p_2^* x_2^h$$ or

$$c_1^h + \mu c_2^h = x_1^h + \mu x_2^h ,$$

which proves the above proposition.

Footnotes

1. For a discussion of the optimal choice of baskets see Flanders and Helpman (1979) and Branson and Katseli-Papaefstratiou (1980). De Grauwe and Peeters (1978) is one of several papers that discuss problems in connection with the EMS.

2. An early attempt to model the working of a currency area by use of the IS-LM approach is in Arndt (1973). A recent study along the same lines, but with different assumptions of capital mobility is Ellis (1980).

3. In equilibrium the two constraints in (1), and (2) will both be fulfilled with equality. Then $B^h = p_1^h c_1^h + m^h - M^h + D_1^h$. Obviously, if the two constraints in (1) hold, then (2) holds as well. It is easy to show also the converse, as long as the interest is non-negative (see the comments below).

4. Many authors, following the arguments in Hicks' (1939) original treatment of temporary equilibrium, have taken expected prices to depend on current (and past) prices only. This seems unnecessary restrictive, however. In line with the approach e.g. in Grandmont (1977) we also let other "signals" influence prices.

5. Existence is then guaranteed by a certain inelasticity of expectations. More precisely, at least some agents' expectations functions must be bounded. See Grandmont (1980, section 5).

6. There is in fact one (quite unlikely) combination of circumstances that would make existence a problem in the present model. It would occur if there was a strong tendency for excess supply of goods (preferences strongly biased towards c_2 in all countries) and <u>all</u> households expected future prices to be lower than current prices even when these approach zero. To rule out such a possibility we could assume that at least one of the functions in (10) is bounded below. (This is a much weaker assumption than our assumption that $r > 0$ in all countries).

7. As a curiousity, the paradoxical case of "immiserizing growth" - c_1^h falls - can occur only for explosive expectations of monetary policy couplied with very inelastic price expectations.

8. Helpman and Razin (1980) make a first attempt to discuss the properties of different exchange rate regimes under uncertainty in a framework. They analyse agents' choice of financial and real variables in a fully specified general equilibrium model.

9. This reasoning is somewhat related to that in Dornbusch (1973), who discusses the effects of monetary changes under globally fixed exchange rates. There a devaluation, for example, may change the atemporal terms-of-trade because it changes expenditure levels at home and abroad and marginal propensities to spend on different goods may be different.

10. Strictly, this partial equilibrium assumption cannot hold in this model, however. For example, if c_1^h increases and production is unchanged, this has to be made room for via a rise in p_1 or a fall in μ .

11. This interpretation is now new. Apart from Helpman (1979), also Dornbusch (1973) characterizes b-o-p deficits with the transfer metaphor.

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