An Analysis of Devaluation

by

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Customarily treatments of devaluation are classified into one or more of three distinct groups: the older elasticities approach (e.g, Robinson[22] or Metzler [19]) in which the focus is on the effects of devaluation on relative prices and thus on the demands and supplies of imports and exports, the absorption approach (Alexander[1]) where changes in aggregate incomes and expenditures occupy center stage, and the newer financial asset approach (Johnson [8], McKinnon [16]) where the monetary nature of the problem is emphasized and attention is directed towards the balance of payments as a whole as opposed to merely the balance of trade. Though controversy has hardly been absent (Alexander[1, 2], Machlup [14,15]) it is generally recognized that the various approaches are to a large extent complementary and many syntheses exist (Brown [3], Harberger[5], Meade [17], Alexander [2], Johnson [7], Tsiang[23], Pearce [21]). The purpose of the present paper is not to examine the relationship between these various treatments (nor, heaven forbid, to propose a fourth), but rather to investigate a problem common to them all.

The devaluation problem differs fundamentally from the earlier classical treatment of the balance of payments in that it has to do with the disequilibrium of an economic system. The method is (usually) one of comparative statics, but the

states being compared are of less than full equilibrium and the act being investigated is one of deliberate policy. From this two implications for the analysis of devaluation immediately emerge. First one must be clear as to just what parts of the economic system are not in equilibrium, why equilibrium has not been attained, what stability conditions are implied by the state the system has attained, and what the policy environment is. Second, since the lack of equilibrium implies a state of flux, one must be explicit about the dynamic features of the model and investigate both the longer run (in addition to the impact) effects of a devaluation and also how the economy would develop in the absence of devaluation. Despite references to rigid wages and prices these features have to a surprising degree been lacking in the literature. One particular aspect of this has been the frequent criticism (see, e.g., Harberger[6], Tsiang [23], or Kemp [12]) that the monetary features of various treatments of the problem were not sufficiently specified, particularly by the earlier elasticity-absorption writers. But the lack is more general than that.

Perhaps a few examples would be useful. Relative rates of inflation clearly influence countries' balances of payments and, especially since inflation is also often thought of as a disequilibrium phenomenon, it would seem to be both natural

and necessary to look at the relationship between the two. Similarly the relation between devaluation and changes in national levels of economic capacity or rates of growth should be of interest in some contexts. Such a consideration perhaps seems of a too-long-run nature when one is confronted with a sudden balance of payments crisis, but people do now think in terms of years when considering devaluation to affect the trade balance so that such effects should not be ignored (cf. British post-war experience). Finally the proposition that devaluation improves the balance of payments is frequently taken to be equivalent to the stability of the foreign exchange market with floating exchange rates. But it is far from clear exactly what the relationship between these two problems is (for example, the effects of a devaluation on the balance of payments work themselves out gradually over time whereas the foreign exchange market, when left to itself, clears almost instantaneously) or how sensitive this relationship is to the policy environment or to the nature of the disequilibrium considered in the devaluation case.

Of course these questions, and other examples like them, have not been ignored in the literature, and I hardly claim to be supplying definitive answers now. Rather my objective is to develop a general framework for the analysis of devaluation in which such questions arise in a natural way.

To begin with it is convenient to restrict attention to

a less than completely general case. I shall restrict myself to the elasticities-absorption approach and shall look only at the balance of trade, assuming away all international capital flows (other than those necessary to settle a trade imbalance). This evades some interesting questions and is admittedly inadequate to properly deal with some of the features that emerge below. But there are compelling reasons for taking this approach. The basic results are now well known and, thanks largely to the monumental work of Meade [17,18], the central features of this approach have been worked out in a logically complete, generally accepted way. Thus this will make it easier to relate my work to the literature. Also the balance of trade is important. It is a major portion of the balance of payments, of course, but, as recent experience once again indicates, it is often of major practical importance in its own right.

I. THE GENERAL FRAMEWORK

Before actually considering the process or effects of exchange rate changes under various policy regimes, I shall present in some detail the framework underlying all the subsequent inquiries.

Denote by Y the capacity level of home production (Y can be thought of as that level of output which is compatible with price stability) and by u the equilibrium (in a sense to be made clear presently) fraction of capacity output produced. Asterisks always refer to the foreign country. The total domestic demands for domestic goods and for foreign goods

respectively, for both consumption and investment purposes, are determined by the levels of domestic prices P, foreign prices Q R, domestic equilibrium income u Y P, domestic rate of interest i, and domestic output capacity Y: $D = D(P, Q R, u Y P, i, Y)$ and $M = M(P, Q R, u Y P, i, Y)$. Here Q denotes the foreign price level in terms of foreign currency and R the exchange rate. Similar functions exist for the foreign country: $D^* = D^*(\frac{P}{R}, Q, u^*QY^*, i^* Y^*)$ and $M^* = M^*(\frac{P}{R}, Q, u^* QY^*, i^*, Y^*)$. The marginal propensities to save (i.e., to refrain from expenditure in any form) can be defined as $S = 1 - P D_3 - Q R M_3$ and $S^* = 1 - Q D_3^* - \frac{P}{R} M^*_3$. For convenience P, Q and R will always be taken as initally equal to unity.

I assume that prices change gradually so that, within the short run, price levels can be taken as given, the short run equilibrium determining the rates of inflation. The short run equilibrium levels of operations are those levels which equate the demand and supply of national output both at home and abroad.

(1) $$D(P, QR, uPY, i, Y) + M^*(\frac{P}{R}, Q, u^*QY^*, i^*, Y^*) - u Y = 0$$

(2) $$D^*(\frac{P}{R}, Q, u^*QY^*, i^*, Y^*) + M(P, QR, uPY, i, Y) - u^*Y^* = 0$$

The actual level of operations at home will equal either the value of u given by (1) and (2) or the maximum feasible level

of operations, whichever is smaller, and similarly abroad. If the equilibrium level of u is low, there is slack in the economy with an excess supply of labor (though it will not be necessary to explicitly look at the labor market). The corresponding excess demand for current output (i.e., the output that the unemployed workers would demand in exchange for their labor services) does not make itself effective as unemployed workers receive no wages. Planned investment and saving are realized and the price level is falling as firms competitively reduce their prices in the face of idle capacity (and similarly for wages). If on the other hand u is high, the economy is operating at full capacity but firms are experiencing unintended inventory decumulation due to high sales and inability to find sufficient workers. As a result they raise prices (and wages).[1] Accordingly I shall write

$$\dot{P}/P = u - 1 \tag{3}$$

$$\dot{Q}/Q = u^* - 1. \tag{4}$$

(3) and (4) represent the process of adjustment to long run equilibrium (in part) as the economy moves from one short run equilibrium to another. The effects of changing expectations will be ignored for simplicity and, more generally, these equations do not depict long run Phillips curves.

As I shall abstact from international investment and captal movements, the home balance of payments surplus B in terms

of domestic currency must satisfy

(5) $$P M^* - QRM - B = 0.$$

Note that substitution of (5) into (1) yields the fundamental expression that is the focus of the absorption approach: the balance of payments surplus equals the excess of domestic production over domestic absorption or expenditure.

The citizens of each country hold their wealth in the form of domestic money and domestic securities. The short run demand for money m depends upon the real rate of interest, the level of money income, and the stock β of securities ($m + \beta$ being equal to net private wealth in money terms):

(6) $$m = f\ (i,\ uYP,\ \beta)$$

(7) $$m^* = f^*\ (i^*,\ u^*Y^*Q,\ \beta^*).$$

The functions f and f* may be assumed to be homogeneous of degree one in the last two arguments. If the government is not creating new 'outside' financial assets, the total increase in holdings of money and securities equals the total supply of new financial assets due to the balance of payments surplus and planned investment (financed by new security issues):

(8) $$\dot{\beta} + \dot{m} - P\ I\ (i,\ Y) - B = 0$$

(9) $$\dot{\beta}^* + \dot{m}^* - Q\ I^*\ (i\ ,\ Y^*) + \frac{B}{R} = 0$$

where I (i,Y) denotes the planned increase of output capacity. I shall usually abstract from the government deficit, but open market operations may be undertaken. Finally new investment increases the level of capacity output.[2]

(10) $\dot{Y} = I\ (i,\ Y)$

(11) $\dot{Y}^* = I^*\ (i^*,\ Y^*)$.

The rate of interest and the level of output capacity directly affect expenditure primarily through their influence on investment. Thus it is reasonable to suppose that $I_1 = D_4 + M_4 \frac{RQ}{P}$ and $I_2 = D_5 + M_5 \frac{RQ}{P}$ and similarly for the foreign country.

Within the short run period the price levels and the levels of capacity output can be taken as fixed, although they change as the economy moves from one short run equilibrium to another. The short run values of the levels of output and of inflation, the rates of interest, the balance of payments, the exchange rate, and of the changes in the output capacities and (usually) the holdings of money and securities are all determined by the conditions of short run equilibrium. Of these fourteen variables three will be given by the particular policy regime under consideration and the remaining eleven determined by equations (1)-(11).

II. A "KEYNESIAN NEUTRAL" MONETARY POLICY

A. Pegged Exchange Rate

In this section I assume that the authorities in each country peg the rate of interest and, by common agreement, the exchange rate. Thus R, i, and i* can be treated as constants, though they might be changed from time to time at the discretion of the authorities. Under this regime (1) and (2)

can be solved in isolation for u and u*, and the remaining variables are then determined directly by (3) - (11). In this case the monetary details are of little importance, but the authorities can be supposed to be supplying outside assets to the system, i.e., $\dot{m}$ and $\dot{m}^*$ can be zero in (8) and (9) with the short run values of m and m* determined by (6) and (7). The short run equilibrium of this model is essentially simply the 'Keynesian model' analyzed by Harberger in his classic paper [5]. Thus I will be brief when discussing the details of the short run equilibrium.

A preliminary order of business is the delineation of conditions under which the equilibrium is stable in both the short and longer run. Consider first the problem of whether the short run equilibrium given by (1) - (11) is actually stable <u>within</u> the short run period. Assume that firms increase or reduce their scale of operations according as demand for their output exceeds or falls short of supply:

$$\dot{u} = D + M^* - u\,Y$$

$$\dot{u}^* = D^* + M - u^*\,Y^*.$$

It is easily seen that this dynamic system is stable, with u and u* converging to the solution of (1) and (2), if and only if

$$S + S^* + M_3 + M_3^* > 0$$

$$J = SS^* + SM_3^* + S^*M_3 > 0$$

which necessarily hold if the marginal propensities to save are both positive and the marginal propensities to spend on domestic goods both less than unity.

Consider now the question of longer run stability. Harberger (and later Tsiang) went on to generalize his analysis by allowing the price level to be an increasing function of output and found that his basic results were qualitatively little affected, and Tsiang later argued that this feature of a variable price level made it impossible to neatly decompose the effect of a devaluation into an initial elasticity effect and a secondary absorption damping multiplier free of elasticity terms. To examine the influence of price changes within the present alternative framework it is necessary to consider the behavior of the economy as it moves from one short run equilibrium to another and so on.

Assume that D and M are homogeneous of degree zero in prices and income, and denote the terms of trade by $p = P/QR$, initially set equal to unity. Then from (3) and (4), if the exchange rate is pegged, $\dot{p}/p = u-u^*$ where u and u* are given by the conditions of short run equilibrium:

(1') $D(p,1, upY, i, Y) + M^* (p, 1, u^*Y^*, i^*, Y^*) - uY = 0.$

(2') $D^*(p, 1, u^*Y^*, i^*, Y^*) + M (p, 1, puY, i, Y) - u^* Y^*$

It will be convenient to first follow Harberger and note the comparative statics effect of a change in the terms of trade on the short run equilibrium. Differentiation of (1') and (2') leads to (see also footnote 15 of Harberger), if all prices initially equal unity,

$$(12)\quad \frac{p}{u}\frac{du}{dp} = \frac{\alpha}{J}\left[(\mu + k\epsilon^*)\, M_3^* - (k\mu^* + \epsilon)\,(M_3^* + S^*)\right]$$

$$(13)\quad \frac{p}{u^*}\frac{du^*}{dp} = \frac{\alpha^*}{kJ}\left[(\mu + k\epsilon^*)\,(M_3 + S) - (k\mu^* + \epsilon)\, M_3\right]$$

where α denotes the average propensity to import, k denotes the ratio of home exports to imports (and thus equals unity if the balance of payments is zero), and where $\mu = -M_2/M$, $\mu^* = -M^*_I / M^*$, $\epsilon = D_2/M$, and $\epsilon^* = D_1^*/M^*$. I assume that home and foreign goods and gross substitutes so that μ, μ^*, ϵ, and ϵ^* are positive. Thus (12) and (13) imply that if the short run equilibrium is stable, more favorable terms of trade are associated with lower levels of activity if the foreign marginal propensity to save is high enough, and that this association must always hold for at least one of the two countries.

Short run equilibrium determines the levels of activity and rates of inflation which alter the terms of trade, determining a new short run equilibrium and so forth. The evolution of the system over time is given by

$$\dot{p}/p = u - u^*$$

$$\dot{Y} = I\ (i,\ Y)$$

$$\dot{Y}^* = I^*\ (i^*,\ Y^*)$$

where u and u* are the solutions of (1') and (2') and thus functions of p, Y, and Y*. Now with the rates of interest pegged it is clearly the case that $\partial\dot{Y}/\partial Y^* = \partial\dot{Y}/\partial Y = \partial\dot{Y}^*/\partial p = 0$. $\partial\dot{Y}/\partial Y = I_2'$ and $\alpha\dot{Y}^*/\alpha Y^* = I^*_2$. Thus, assuming that I_2 and I_2^*, are negative, the necessary and sufficient conditions for the local stability of this dynamic system easily reduce to $\partial\dot{p}/\partial p < 0$ in a neighborhood of the long run equilibrium.[3] Using (12) and (13) differentiation of $\dot{p}/p = u - u^*$ leads to

$$\frac{J}{\alpha\alpha^*}\ \frac{\partial\dot{p}}{\partial p} \equiv \frac{u\bar{J}}{M} = (\mu + k\epsilon^*)\left[\frac{M_3^*}{\alpha^*} - \frac{u^*}{k}\left(\frac{M_3}{\alpha} + \frac{S}{\alpha}\right)\right] - (\mu^* k + \epsilon)$$

$$\left[u\left(\frac{M^*_3}{\alpha^*} + \frac{S^*}{\alpha^*}\right) - \frac{u^*}{k}\ \frac{M_3}{\alpha}\right].$$

Following the literature in assuming that hoarding depends only on real income, it can be shown[4] that $\epsilon = \mu - e$, where e denotes the income elasticity of domestic expenditure on both home and foreign goods. Also if the world economy is in long run equilibrium, $u = u^*$ and $I\ (i, Y) = 0 = I^*\ (i^*, Y^*)$ implying that the average propensity to save equals zero so that $e = 1 - S$. Thus in a neighborhood of the longer run equilibrium

$$\frac{J}{u\alpha\alpha^*}\ \frac{\partial\dot{p}}{\partial p} = \frac{1}{k}\ (k - 1 + kS - S^*)^2 - \frac{S}{k\alpha}\ (\mu + k\mu^* - k + k S^*)$$

$$- \frac{S^*}{\alpha^*}\ (\mu + k\mu^* - k + k S),$$

which reduces to $-(S - S^*)^2 - \frac{S}{\alpha}(\mu + \mu^* - 1 + S^*) - \frac{S^*}{\alpha^*}$

$(\mu + \mu^* - 1 + S)$ if the balance of payments is zero. Thus

if the short run equilibrium is stable so that $J > 0$ stability of the long run equilibrium in the $k = 1$ case becomes equivalent to the elasticity condition

$$\mu + \mu^* > 1 - \frac{S^2 + \gamma S S^* + S^{*2}}{\frac{S}{\alpha} + \frac{S^*}{\alpha^*}}$$

where $\gamma = (D+D^*)/M$ denotes the ratio of total world domestic expenditure to world trade. Thus if the marginal propensities to save are positive, the Marshall-Lerner condition is a sufficient, though not necessary, condition for the longer run stability of the system.

I turn now to the effects of devaluation. Let b denote the balance of payments surplus in terms of foreign goods:

(14) $b = B/RQ = p\, M^*(p, 1, u^* Y^*, i^*, Y^*) - M(p, 1, puY, i, Y)$.

A change in R instantaneously alters the terms of trade by a like amount as the price levels are fixed in the short run. Thus $du/dR = -du/dp$ and $du^*/dR = -du^*/dp$ so that the short run effects of devaluation on the levels of activity are given by (12) and (13). As shown by Harberger [5] devaluation must improve the short run trade balance if the import elasticities exceed a critical sum, since from (12), (13), and (14) if b initially equals zero.

$$\frac{db}{dR} = \frac{SS^*}{J}\left[\mu + \mu^* - 1 - \frac{M_3}{S}(1 + \epsilon - \mu) - \frac{M_3^*}{S^*}(1 + \epsilon^* - \mu^*)\right] M$$

or

$$\frac{db}{dR} = \frac{SS^*}{J}\left[\mu + \mu^* - 1 - \frac{M_3}{S}(1 - e) - \frac{M_3^*}{S^*}(1 - e^*)\right] M$$

if hoarding is determined by real income. Recall that the term in brackets differs from the familiar Marshall - Lerner condition because of the terms of trade effect on real income (see Harberger [5] on Laursen and Metzler [13]). The short run effect of a devaluation can be considered to consist of an initial elasticities effect (the term in brackets) multiplied by a secondary absorption damping factor (SS*/J) independent of elasticities. Note that the conditions of short run and long run stability help to make these effects both positive but are not sufficient to ensure it. That is, it is possible for the sum of the import elasticities to exceed the critical value necessary for long run stability while falling short of the value necessary to improve the trade balance and it is also possible for the short run stability condition to be met while $S\ S^* < 0$.

Consider now the longer run effects of a devaluation. If the long run equilibrium is stable, then $\dot{p} = 0$ means that in that equilibrium $u = u^*$. Thus the long run values of $u = u^*$ and p are given by the solution of (1') and (2') where u is set equal to u^*; (14) then gives the long run balance of payments surplus. It is immediately apparent from this that the equilibrium values of p, $u = u^*$ and b do not depend on the exchange rate. Thus with interest rates pegged in both countries devaluation can have only a temporary effect

on the balance of payments (expressed in units of foreign goods) or on the levels of economic activity. Any initial improvement must eventually disappear as a result of induced price movements at home and abroad. That is, the very elasticity condition which ensures the short run success of a devaluation also guarantees, by necessarily satisfying the weaker elasticity condition for long run stability, its longer term impotence.[5]

In a world with pegged exchange and interest rates there are in the long run two policy targets, the balance of payments and the common level of economic activity, and two available instruments: the levels of interest rates in the two countries. The actual level of the exchange rate, the third instrument, is immaterial in the long run. There are thus two methods by which a country in such a world can permanently affect its balance of payments: a change in its rate of interest and a continuous change (as opposed to a once and for all change) in the exchange rate. I shall consider each in turn.

The short run effects of a change in the domestic interest rate can be deduced from the conditions of short run equilibrium, (1'), (2'), and (14). Thus

$$\frac{du}{di} = \frac{M_4 M_3^* + D_4 (M_3^* + S^*)}{Y J}$$

$$\frac{du^*}{di} = \frac{D_4 M_3 + M_4 (M_3 + S)}{Y^* J}$$

$$\frac{db}{di} - \frac{S^*}{J} [D_4 M_3 + M_4 (S + M_3)]$$

Assuming that M_4 and D_4 are negative, it is apparent that an increase in the domestic rate of interest will in the short run lower the level of economic activity both at home and abroad and improve the balance of trade provided that the marginal propensities to save and to import are positive.

Long run equilibrium is determined by the conditions (1'), and (2'), $I(i, Y) = 0$, $I^*(i^*, Y^*) = 0$, and $u = u^*$. Differentiation of these equations leads to the following expressions for the longer run effects of a permanent change in the domestic interest rate:

(15) $$\frac{dp}{di} = \frac{G}{J} [u \frac{J}{\alpha^*} + \delta (\frac{S}{k\alpha} + \frac{S^*}{\alpha^*})]$$

(16) $$\frac{du}{di} = \frac{du^*}{di} = \frac{uG}{kJ} [u S (\mu + \mu^* - k + kS^*) + (\delta + uM_3)(1-S-k+kS^*)]$$

$$\frac{dY}{di} = G$$

$$\frac{dY^*}{di} = 0$$

where $G = - \frac{I_1}{I_2} = - \frac{M_4 + D_4}{M_5 + D_5}$ and $\delta = \frac{M_5 D_4 - M_4 D_5}{M_4 + D_4}$.

Differentiation of (14) and substitution of the above expressions gives the long run impact on the balance of trade:

$$(17) \qquad \frac{db}{di} = \frac{u\ M\ S\ S^*\ G}{\alpha^*\ \bar{J}} \left[1 + M_3 + M_3^* + \delta \left(\frac{\alpha + \alpha^*}{u\alpha}\right) - \mu - \mu^*\right]$$

(I have set k = 1 in the expression for db/di, so that this refers to the case where trade is initially in balance). The term δ in the above expressions measures the extent to which the demand for imports is relatively more sensitive to the rate of interest than to the level of capacity, with respect to the demand for domestic goods. If one deems such comparative differences to be minor, δ can be reasonably assumed to equal zero. In this case $db/di < 0$ if and only if $\mu + \mu^* > 1 + M_3 + M_3^*$ since $G < 0$ if we assume that M_5 and D_5 are negative and since stability of the long run equilibrium requires $\bar{J} < 0$. Now the condition that devaluation improve the trade balance in the short run reduces to $\mu + \mu^* > 1 + M_3 + M_3^*$ when the average propensity to save equals zero (as assumed by Harberger and Tsiang among others). Thus the proposition that devaluation improve the trade balance in the short run is equivalent to the proposition that a permanent increase in the rate of interest worsen the trade balance in the long run.

As seen above an increase in the rate of interest will normally improve the trade balance in the short run; this is

perhaps the intuitive result. But if the elasticity condition is met, this initial improvement will deteriorate over time and ultimately be reversed. This is because with a permanently higher rate of interest the level of capacity must ultimately be lower than it otherwise would be as the higher cost of borrowing makes firms less willing to hold assets. The lower level of capacity reduces the domestic demand for goods, including imports, thereby improving the terms of trade. Thus from (15), still supposing $\delta = 0$, $dp/di = u\ G\ J/\bar{J}\ \alpha^*$ so that stability of the short run and long run equilibria guarantee an ultimate improvement in the terms of trade. This improvement will worsen the trade balance if and only if the sum of the elasticities exceeds the critical value. In this case the foreign level of income will be ultimately increased and domestic income reduced, since from (16), if $\delta = 0$ and $k = 1$,

$$\frac{d(u^*Y^*)}{di} = Y^* \frac{du}{di} = \frac{u\ M\ S\ G}{\alpha^*\ \bar{J}} \left(\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S}\right)$$

$$\frac{d(uY)}{di} = u\ G + Y \frac{du}{di} = -\frac{u\ M\ S^*\ G}{\alpha^*\ \bar{J}} \left(\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S^*}\right).$$

The implications of a $\delta \neq 0$ for the above discussion can be deduced from (15), (16), and (17).

It should be apparent that the long run effects discussed above depend crucially upon a permanent change in the real,

as opposed to nominal, rate of interest and upon the sensitivity of the level of capacity to this interest rate.

The above analysis yields the familiar prescription that a devaluation to be successful should be accompanied by an appropriate monetary policy. But there are two important differences. First, it is exchange rate policy which in the short run eases the burden on monetary policy, rather than vice versa; a permanent improvement in the trade balance requires a permanent change in the rate of interest and is independent of the exchange rate. Second, a long run improvement in the trade balance requires an expansionary monetary policy rather than a contractionary one. Thus in this environment exchange rate policy and monetary policy would normally tug in opposite directions at least in the short run; the implied role of a devaluation is to counteract the undesirable initial effects of a lower interest rate. If the devaluation initially improves the trade balance, that fact guarantees that as time goes on both the influence of the devaluation will disappear and that of the permanent interest rate reduction will become favorable.

If the rate of interest cannot be adjusted for balance of payments policy purposes, the exchange rate must be used. Since a once and for all devaluation will have no long run

impact, devaluation must be used repeatedly. That is, the exchange rate must be altered continuously, so that the policy instrument under consideration is $\dot{R}/R$, denoted by r. This alternative resembles to a degree some of the crawling peg proposals and, more closely yet policies adopted by some Latin American countries in recent years.

It follows at once from (3) and (4) that $\dot{p}/p = u - u^* - r$. Thus in long run equilibrium $r = u - u^*$ so that

$$\frac{dp}{dr} = \frac{1}{\frac{du}{dp} - \frac{du^*}{dp}} = \frac{M}{\bar{uJ}} .$$

Stability of the long run equilibrium, with pegged exchange and interest rates is thereby equivalent to the proposition that a steady depreciation of the exchange rate ultimately worsens the terms of trade. As a consequence of this such a policy can be shown to have results that are qualitatively identical in the long run to those of a permanent reduction in the rate of interest (if $\delta = 0$).

Since $u = u^* + r$ in long run equilibrium, a policy of steady depreciation is necessarily 'beggar-my-neighbor' in the sense that it will increase domestic employment relative to foreign. But what about absolute levels? Long run equilibrium is described by (1'), and (2'), and $u = u^* + r$. Since

the interest rates are pegged the levels of capacity can also be taken as fixed across long run equilibria. Differentiating the equations of equilibrium and (14) and solving with $b = 0$ initially for simplicity, gives

$$\frac{d(uY)}{dr} = Y\frac{du}{dr} = -\frac{u\,S^*}{J\,\bar{J}}\left[\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S^*}\right]$$

$$\frac{d(u^*Y^*)}{dr} = Y^*\left[\frac{du}{dr} - 1\right] = \frac{uS}{J\bar{J}}\left[\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S}\right]$$

$$\frac{db}{dr} = -\frac{u\,S\,S^*}{J\,\bar{J}}\left[\mu + \mu^* - 1 - M_3 - M_s^*\right].$$

Steady depreciation and a reduction in the interest rate would of course be expected to have identical short run effects on international capital flows, i.e. on the international equilibrium allocation of liquid capital. But they also have qualitatively identical effects on the long run equilibrium of the international economy when capital movements are assumed away, provided that $\delta = 0$.

B. A Floating Exchange Rate

Suppose now that the exchange rate is allowed to float so as to clear the foreign exchange market, but that the rates of interest are still pegged by the respective authorities. From the nature of the foreign exchange market it seems reasonable to me to suppose [6] that R adjusts rapidly relative even to the short run variables u and u*. Thus I shall suppose

that b = 0 throughout the short run adjustment process:

$$\frac{\dot{u}}{u} = D + M^* - u\,Y$$

$$\frac{\dot{u}^*}{u^*} = D^* + M - u^*\,Y^*$$

$$0 = M - p\,M^*.$$

It is easily seen that this process is locally stable if and only if

$$\frac{S\,S^*\,(\mu + \mu^* - 1 - \frac{M_3}{S}(1-e) - \frac{M_3^*}{S^*}(1 - e^*)}{\mu + \mu^* - 1} > 0$$

and

$$\frac{S\,Y\,(1 - \frac{M_3}{S}(1 - e)) + S^*\,Y^*\,(1 - \frac{M_3^*}{S^*}(1 - e^*))}{\mu + \mu^* - 1} > 0,$$

when hoarding depends only on real income. Thus if the home and foreign marginal propensities to save are positive and exceed $M_3\,(1 - e)$ and $M_3^*\,(1 - e^*)$ respectively, the stability conditions reduce to $\mu + \mu^* > 1 + \frac{M_3}{S}(1 - e) + \frac{M_2^*}{S^*}(1 - e^*)$ so that the short run equilibrium with a floating exchange rate is stable if and only if devaluation improves the short run trade balance in the case of pegged rates. But note that the equivalence is with the stability of the short run world

equilibrium as a whole rather than with the short run stability of the foreign exchange market itself which requires only the weaker Marshall - Lerner condition.

The short run equilibrium will evolve over time in response to the induced changes in home and foreign capacity. But if, as is customary in devaluation analysis, the initial equilibrium is taken to be one where Y and Y* are not changing, then the longer run behavior of the world economy with a floating rate is quite simple compared to the case of a fixed rate. For the short run equilibrium is described by (1'), (2'), and $b = 0$ which determine u, u*, and p. For the economy to remain in short run equilibrium over time with interest rates and capacity levels fixed these three variables can not change, so that the dynamic behavior is simply $r = \dot{P}/P - \dot{Q}/Q = u - u^*$. Thus with Keynesian neutral monetary policy there is no real distinction to be made between the long run and the short under a regime of floating exchange rates.

To sum up, suppose that interest rates are pegged, that the world economy is in stable (short run and long run) equilibrium, that trade is initially balanced, and that hoarding depends only on real income. Then $\mu + \mu^* > 1 + M_3 + M_3^*$ is a necessary and sufficient condition for the following equivalent propositions:

(a) Devaluation will improve the trade balance in the short run.

(b) A permanent reduction in the real rate of interest will ultimately permanently improve the trade balance (if $\delta = 0$).

(c) Steady devaluation over time will permanently improve the trade balance.

(d) The world economy will be stable if the exchange rate is allowed to float.

The elasticity condition is also sufficient (but not necessary) for the following further propositions.

(e) With a pegged exchange rate the longer run equilibrium is stable.

(f) Devaluation can have only a transitory effect on the trade balance.

(g) A permanent reduction in the real rate of interest will ultimately increase domestic income and lower foreign income (if $\delta = 0$).

(h) A steady depreciation of the exchange rate will permanently increase domestic income and lower foreign income.

Propositions(g) and (h) are equivalent.

III. 'FINE TUNING' THE UTILIZATION LEVELS

A. Pegged Exchange Rate

I should now like to examine the consequences of exchange rate policy when it is assumed that domestic monetary policy in both countries is addressed directly to maintaining desired levels of activity. The analysis of the previous section is relevent to this problem if such monetary policy takes the form of maintaining interest rate levels which in practice can be adjusted only infrequently. I am concerned now with the polar opposite case of 'fine tuning': within the short run period both governments conduct monetary policy so that in short run equilibrium u and u* attain specified target values.

This brings the present analysis close to the classical case of full employment and to one of the monetary policy situations analyzed by Meade [18]. With the levels of activity fixed, both the absorption type effects associated with changes in the level of income and the features discussed in the previous section associated with the disequilibrium adjustment process can be expected to be absent.

With a pegged exchange rate this policy regime gives rise to a familiar problem of international consistency: if policy goals in the two countries call for unequal rates of inflation the real terms of trade will steadily change over time, causing competitive conditions and the balance of payments to continuously

shift. I accordingly suppose that policies in the two countries are consistent in the sense that r is set equal to $u - u^*$. In particular little will be lost by supposing that $u = u^*$ so that the exchange rate can be pegged to some constant value over time.

Short run equilibrium can be represented by (1'), (2'), (10), and (11). The variables Y and Y* are given by history, u and u* by policy, and p is given by both and remains constant over time. The short run equilibrium values of i and i* are determined simultaneously by (1') and (2') and the world economy evolves over time as output capacities in the two countries expand as indicated by (10) and (11).

The nature of the adjustment process towards such an equilibrium within the short run period depends upon the way in which the authorities in the two countries attempt to implement their desired policies. Presumably there are target values $\bar{u}$ and $\bar{u}^*$ which the authorities wish to achieve, and they adjust their policy instruments <u>within</u> the short run period according as to how the actual instantaneous values of u and u* compare with the target values. I shall take the interest rates themselves to be these instruments. For example at any point in time the authorities could offer to buy and sell securities without limit at the desired rate. In this case the total private wealth in money terms, $m + \beta$, would

be given by history and (6) and (7) would determine its instantaneous composition.

The adjustment process within the short run period can therefore be represented by

$$(18) \qquad \dot{i} = u - \bar{u}$$

$$\dot{i}^* = u^* - \bar{u}^*$$

where u and u* are determined at each instant by (1') and (2') for the momentarily given values of i and i*. I should emphasize that this process reflects discretionary action by the authorities rather than the automatic working of the market.

It is easily seen that this short run process is locally stable, so that u and u* converge to $\bar{u}$ and $\bar{u}^*$ and i and i* converge to the solutions of (1') and (2') for $u = \bar{u}$ and $u^* = \bar{u}^*$, if and only if

$$N > 0$$

$$[\, M_3 \,(M_4^* + D_4^*) + S\, D_4^* + M_3^* \,(M_4 + D_4) + S^*\, D_4 \,]\, /J \;\; > 0$$

where $N = D_4\, D_4^* - M_4\, M_4^*$, the Jacobian of (1') and (2') with respect to i and i*. Thus if the marginal propensities to save and to import are positive, the stability of this process is equivalent to $N > 0$.

The condition $N > 0$ essentially means that, at unchanged levels of income, expenditure on domestic goods is more sensitive to changes in the rate of interest than is expenditure on imports. I shall assume $N > 0$ henceforth.

This assumption perhaps seems plausible enough since many types of expenditure particularly sensitive to interest rates, such as construction, contain few imported components. Nevertheless one can easily imagine questionable situations, such as large scale trade in capital goods involving countries with high average propensities to import. Note that if $N > 0$ the implication emerges that each country should gear its monetary policy to foreign conditions rather than domestic (not that each country should conduct its policy in a perverse fashion, such as setting $\dot{i} = \bar{u} - u$). This is an example of Mundell's [20] principle of effective market classification.

Assuming that the short run equilibrium has been attained with $u = \bar{u}$ and $u^* = \bar{u}^*$, differentiation of (1') and (2') gives

$$\frac{di}{dp} = M \left[D_4^* \left(\epsilon + k \mu^*\right) + M_4^* \left(k \epsilon^* + \mu\right] / N \right.$$

and

$$\frac{di^*}{dp} = -M \left[D_4 \left(k \epsilon^* + \mu\right) + M_4 \left(\epsilon + k \mu^*\right) \right] / N.$$

Thus the proposition that an improvement in the terms of trade must be accompanied by a reduction in the rate of interest to keep the level of domestic activity unchanged is equivalent to the assumption $N > 0$ and thus necessary and sufficient for the assignment (18) to be appropriate.

Consider now the short run effect of devaluation on the balance of trade in this policy environment. If hoarding depends only on real income and if b = 0 initially, then (1'), (2'), and (14) lead to

$$\frac{db}{dR} = -\frac{db}{dp} = M\ (\mu + \mu^* - 1 + \zeta + \zeta^*)\ (M_4 + D_4)\ (M_4^* + D_4^*)\ /\ N$$

where $\zeta = S\ M_4 / (M_4 + D_4) > 0$. Thus if $N > 0$ the success of a devaluation hinges on whether $\mu + \mu^*$ exceeds the critical value $1 - \zeta - \zeta^*$. This result differs from that of the previous section in a number of ways.

First, as in Meade [18], the absorption multiplier and the terms of trade effect through real income changes on the elasticity condition are both absent. These clearly reflect the assumption that u and u* are determined by policy in the short run equilibrium. But there are also two further differences which in addition differ from Meade's condition, $(\mu + \mu^* - 1) / (1 - M_3 - M_3^*) > 0$ in the present notation. These are due to the construction of the expenditure functions. Meade employs a two stage approach whereby expenditure on imports (and domestic goods) depends only on relative prices and aggregate expenditure (not income) and so is influenced by other variables such as interest rates only indirectly. The absence of the term $1 - M_3 - M_3^*$ in the present case reflects the assumption that M and D depend on incomes rather than aggregate expenditures [7] while the presence of $\zeta + \zeta^*$ reflects the direct

construction of the D and M functions. This accounts for the secondary multiplier $(M_4 + D_4)\ (M_4^* + D_4^*) / N$.

In conclusion, if $N > 0$, the critical value which the sum of the elasticities must exceed for a successful (in the short run) devaluation is less than unity when both monetary authorities pursue policies of fine tuning. In particular the critical sum is lower in this case than in the case of a Keynesian neutral monetary policy.

As regards the longer run effects of devaluation, the induced changes in price levels discussed in the previous section will of course be absent under the present policy regime; devaluation will simply cause a once and for all change in p. However distinct long run effects will still be present because the changes in interest rates necessitated by a 'fine tuning' policy will cause the capacity levels in the two countries to develop differently over time.

The long run equilibrium of the world economy is given by (1'), (2'), (14), $I\ (i, Y) = 0$, and $I^*\ (i^*, Y^*) = 0$ where p, u, and u* are given by policy and i, i*, Y, Y* and b by the solution of these five equations. Assuming that hoarding depends only on real income, that $\delta = \delta^* = 0$, that $b = 0$ initially, and for simplicity that $u = u^* = 1$, these equations yield the long run effects of devaluation:

$$\frac{di}{dR} = -\frac{di}{dp} = \frac{1}{G}\frac{dY}{dR} = S^*M\left(\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S^*}\right) / G\,J$$

$$\frac{di^*}{dR} = -\frac{di^*}{dp} = \frac{1}{G^*}\frac{dY^*}{dR} = S\,M\left(\mu + \mu^* - 1 - M_3 - M_3^* + \frac{J}{S}\right) / G^*\,J.$$

Thus subject to a rather weak elasticity condition, the long run effects on interest rates will be in the opposite direction to the short run effects. From (14)

$$\frac{db}{dR} = M\,(\mu + \mu^* - 1) - G\,(\delta + M_3)\frac{di}{dR} + G^*\,(\delta^* + M_3^*)\frac{di^*}{dR}.$$

If $\delta = \delta^* = 0$ this reduces to

$$\frac{db}{dR} = M\,\frac{S\,S^*}{J}\,(\mu + \mu^* - 1 - M_3 - M_3^*).$$

Thus the long run effect of devaluation on the trade balance under the 'fine tuning' regime is identical to the short run effect with pegged interest rates. This is because the same income adjustments ultimately occur. As capacity levels gradually change so do incomes, since the authorities peg utilization levels. If $N > 0$ devaluation has a potent short term effect as $\mu + \mu^*$ need only exceed a term less than unity and the multiplier $(M_4 + D_4)\,(M_4^* + D_4^*) / N$ exceeds unity. But as capacity levels change the elasticity condition gradually becomes more stringent until, in the long run, the same income changes brought about in the Keynesian neutral case by short run variations in employment levels have been fully accomplished here by gradual variations in capacity levels. The end result can differ only to the extent that interest rates and

capacity levels have significantly asymmetric relative effects on demands for imports and dometic goods, i. e., if δ and δ^* differ from zero significantly.

B. A Flexible Exchange Rate

If the exchange rate is allowed to find its own level so as to always clear the market for foreign exchange, short run equilibrium is depicted by (1'), (2'), (10), and (11) with the addition of the condition that trade balance, $p M^* - M = o$, and with p now a variable to be determined in the short run. The question that naturally arises is whether the short run equilibrium can be attained by a process whereby monetary authorities in both countries adjust the rate of interest according to how actual activity differs from the target level, on the assumption that the exchange rate is sufficiently flexible to cause trade to always balance.[8]

Within the course of this adjustment process,

$$\dot{i} = u - \bar{u}$$

$$\dot{i}^* = u^* - \bar{u}^*$$

where at each point in time u and u* are determined, with p, by (1'), (2'), and $p M^* - M = 0$, for the given instantaneous values of i and i*. The stability conditions for this process reduce to

$$(\mu + \mu^* - 1 - M_3 - M_3^*)\ (M_4 + D_4)\ (M_4^* + D_4^*)(\mu+\mu^*-1+\zeta+\zeta^*)>0$$

and

$$\frac{Y^*M_4\ \zeta^*(\mu + \mu^* - 1 - M_3^* + \zeta) + YM_4^*\ \zeta\ (\mu + \mu^* - 1 - M_3 + \zeta^*)}{\zeta\ \zeta^*\ (\mu + \mu^* - 1 - M_3 - M_3^*)} < 0$$

Thus if the marginal propensities to save and to import are positive, then, with $\mu + \mu^* > 1$ required for the stability of the foreign exchange market, the stability of the adjustment process is equivalent to the condition $\mu + \mu^* > 1 + M_3 + M_3^*$. Two features deserve emphasis. First, the condition $N > 0$ that was crucial to the convergence of this process when the exchange rate was pegged no longer plays a role when the exchange rate becomes flexible. In this sense the stability of this policy regime is strengthened. Second, stability in the short run with a flexible exchange rate is equivalent to the proposition that devaluation improve the trade balance, not in the same short run, but rather over the long run (or in the short run if interest rates are pegged).

IV. CONSTANT MONEY SUPPLIES

In previous sections the money supply was assumed to be perfectly elastically controlled by the authorities so as to attain specified real conditions. As pointed out by Tsiang, this severely limits the influence of monetary factors on the analysis. Following Tsiang, I now assume that the authorities behave so as to keep the money supply constant, an assumption that somewhat increases the role of monetary factors.

Short run equilibrium is given by (1'), (2'), (6) and (7) which simultaneously determine u, u*, i and i*. With $\dot{m}$ and

$\dot{m}^*$ set equal to zero, (8) and (9) then give $\dot{\beta}$ and $\dot{\beta}^*$. That is, in this policy environment, the authorities exactly neutralize the balance of payments effects on the money supplies by open market operations so as to allow the total stock of assets in each country to nevertheless change in response to both economic growth and the trade balance.

Assume that within the short run period i and i* instantaneously adjust so as to clear the money markets while u and u* adjust according to $\dot{u} = D + M^* - u\,Y$ and $\dot{u}^* = D^* + M - u^*\,Y^*$. Then the short run equilibrium is locally stable if and only if

$$(D_4\,H - S - M_3)\,Y + (D_4^*\,H^* - S^* - M_3^*)\,Y^* < 0$$

and

$$J^* = NHH^* + J - H\,[(D_4 + M_4)\,M_3^* + D_4\,S^*] - H^*\,[(D_4^* + M_4^*)M_3 + D_4^*S] > 0$$

where $H = -f_2/f_1 = \frac{1}{Y}\,\frac{\partial i}{\partial m} > 0$. Thus stability is ensured unless N is very negative.

Now from (14),

$$\frac{db}{dR} = -\frac{d\,b}{d\,p} = M^*\,(\mu/k + \mu^* - 1) - M_3^*\,Y^*\,\frac{du^*}{dp} - M_4^*\,\frac{di^*}{dp} + M_3\,Y\,\frac{du}{dp} + M_4\,\frac{di}{dp}.$$

If b = o initially and if hoarding depends only on real income, then differentiation of the equations of short run equilibrium and substitution yields

$$\frac{db}{dR} = \frac{M\ (M_4+D_4)\ (M_4^*+D_4^*)\ H\ H^*\ \sigma}{J^*}\left[\mu+\mu^*-1-M_3-M_3^*+\frac{\zeta+\zeta^*+M_3+M_3^*-\zeta\ \zeta^*(M_4H+M_4^*H^*)}{\sigma}\right]$$

where $\sigma = 1 + \zeta\ \zeta^* - \zeta\ M_4^*\ H^* - \zeta^*\ M_4\ H$. The implied elasticity condition is clearly weaker than that required for devaluation to be successful in the short run when interest rates are pegged or in the long run when activity levels are pegged. However (if the marginal propensities to save are less than unity so that $\zeta < 1$ and $\zeta^* < 1$) it is stronger than that required for devaluation to be successful in the short run when activity levels are fixed.

As the world economy moves from one short run equilibrium to another, its behavior over time is described by (3), (4), (8), (9), (10), and (11) with R, M, and M* given by policy and with u, u*, i, and i* determined in each period by the equations of short run equilibrium for the instantaneously given values of the historically changing variables P, Q, Y, Y*, β, and β^*. It is immediately apparent from these expressions that long run equilibrium with $\dot{Y}$, $\dot{Y}^*$, $\dot{\beta}$, and $\dot{\beta}^*$ all equal to zero necessarily implies B = 0. Thus in full long run equilibrium the automatic adjustment process will cause trade to balance if the authorities in both countries always exactly neutralize the effects of surpluses and deficits in the sense of holding the money supplies constant. The adjustment is through real effects operating gradually over time. Thus in this case, as

with constant interest rates, devaluation is essentially a short run policy tool.[9]

Partly for this reason I will not now examine when such a long run equilibrium must in fact be stable. Because of the large number of variables such an analysis would be lengthy. Also many questions of interest would require more than the local techniques employed thus far in this paper. For example, is it possible for the world economy to converge to a quasi-equilibrium in which Y and Y* are constant but in which there is a steady imbalance of trade with the stock of securities steadily increasing in one country and steadily decreasing in the other? Of course if the authorities in each country peg the stock of securities as well as money all quasi-equilibria will be characterized by balanced trade.

V. CONCLUDING REMARKS

A common thread through the above analysis is that to be permanently effective a devaluation must succeed in appropriately changing the real rates of interest. When policy explicitly prevents such adjustments,the devaluation can have only transient effects (and even these are equivalent to the proposition that a permanent change in interest rates would be effective) and at the other extreme, when policy involves keeping the money supplies constant (or, better yet, not fully neutralizing the effects of deficits or surpluses), the automatic adjustment

mechanism will ultimately restore equilibrium without the need for exchange rate variations so that devaluation becomes again a tool for short run purposes.

The conclusions that emerge when the role of nontraded goods is examined (e.g. Pearce [21], Kemp [11]) are related to the point that the essential question in the elasticity-absorption approach is whether devaluation will appropriately influence the real rate of interest, i.e. the relative price of domestic assets in terms of internationally traded commodities. Pearce, for example, observes " t may well be that currency depreciation succeeds in practice more because it decreases the price of non-traded goods relatively than because it affects the real terms of trade."

As regards possible extensions, numerous additional exercises suggest themselves in the course of the present analysis. So do additional features that could be looked at such as a more detailed and satisfactory treatment of the short run behavior of the foreign exchange market or a more elaborate development of the adjustment equations (3) and (4), by introducing expectations. assymmetries between over-and under- employment situations. etc. But such changes. though imparting a more realistic flavor to the analysis, seem unlikely to lead to major changes in the results (though the long run stability could be expected to be sensitive to the expectations format).

Of more central importance would be the extension to international capital movements. But it should also be added that the above analysis indicates that a thorough look at the elasticity - absorption treatment of the trade balance can lead to conclusions that one would associate with a more explicitly monetary treatment.

Footnotes

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1 See Ethier [4] for a more detailed explanation of a somewhat similar but more elaborate closed model. a discussion of its properties, and references to the relevent macroeconomic literature.

2 It would be more realistic to take realized investment as something less than planned investment when the equilibrium level of u cannot be attained. But little would appear to be gained by the complication

3 See. e.g., Gantmacher [25] for a treatment of the Routh - Hurwitz conditions for stability.

4 See Harberger [5], Spraos [24], Jones [9], and Tsiang [23] for a discussion of this point. Jones contains a particularly elegant derivation.

5 It is frequently observed that quite some time may be necessary in practice for the impact of a devaluation to be observed because of leads and lags in commercial payments, a reluctance to change price quotations, a delay in switching sources of supply, and the like. It should be emphasized that such factors have been assumed away here and do not constitute the difference between the long run and the short. Rather they would be a basis for the assertion that in practice what I have termed the short run effects would be delayed or muted or would simply exert a declining influence on the path towards the long run effects.

6 Note that the condition for stability of the 'very short run' adjustment process $\dot{R}/R = bQ$ with all variables but R held constant is but the familiar Marshall - Lerner condition $\mu + \mu^* > 1$. Some may reject this distinction between the adjustment speeds of R and of u and u* and thus prefer to replace $b = 0$ with $\dot{R}/R = b\,Q$. This case can be shown to be not fundamentally different from the above in that it leads to the same stability condition. This is fortunate since the abstraction from capital movements would clearly be serious if the short run stability of the foreign exchange market in itself were an important question.

7 For a discussion of this aspect of Meade's model see Jones [10] and Tsiang [23].

8 As above the stability condition for the foreign exchange market by itself is $\mu + \mu^* > 1$. See footnote 5.

9 The long run is distinguished from the short by adjustments in price levels and capacity levels (as well as sometimes in stocks of financial assets). But it will be observed that the various policy regimes differ in that with pegged interest rates the price adjustments are crucial, with fine tuning the capacity adjustments play the vital role, and in this section both are central.

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