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The Analysis of Exchange Rate Movements:
Neutrality Results and the Role of Expectations

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Following a brief discussion of existing literature on the analysis of exchange rate movements (Section 1), this paper re-examines the conditions under which exchange rate movements have no effects on the real balance of trade in particular, and on the complete list of real economic variables in general (Section 2). Although these neutrality conditions do not hold in the world as we know it today, they do point to the types of institutional changes that would weaken the real impacts of devaluations over time (Section 3).

When the neutrality conditions do not hold, ex-ante exchange rate expectations have an important influence on the timing and magnitudes of the effects of devaluations. The correctness of exchange rate expectations can be quantified for use in empirical studies of the effects of exchange rate movements (Section 4).

When the role of anticipation is introduced, devaluations and revaluations are seen to share a common property with all other anticipated interventions in the private market, viz, they distribute income and wealth from the many to the few-- those with superior information receive capital gains at the (ultimate) expense of the rest of the community. These wealth effects may conceivably dwarf the contribution

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of other wealth effects to equilibrium outcomes, which suggests that the monetary approach to balance of payments theory needs augmentation to allow for the role of anticipation (Section 5).

1. A Brief Discussion of Existing Literature

The textbook analysis of discretionary exchange rate changes is typically conducted within a two-region partial equilibrium model of the trade balance, focusing on price elasticities and emphasizing the Marshall-Lerner conditions. Researchers at the International Monetary Fund have extended this elasticities approach to model and simulate the effects of exchange rate realignments within a multi-regional, multi-commodity framework.^{1/}

In recent years the conventional elasticities approach has encountered several challenges. A monetary model of the balance of payments has been extended by Dornbusch (1973) and others, who argue that the primary effects of devaluations derive from attendant changes in the real value of money or wealth. A separate but less formal challenge has been issued by Laffer (1974), who argues that nominal price adjustments following a devaluation will neutralize any impact on the real trade balance. These criticisms are in the tradition of much earlier arguments (see Meade and Russell, 1957) that the change in factor shares following a devaluation would be unacceptable and would be followed by wage increases designed to neutralize the real impact of devaluation.

^{1/} Armington has been a major contributor to this research, but see Artus and Rhomberg (1973) for a recent description.

In an unpublished paper, Henderson (1974) has further extended the analysis of devaluation to a two-country, short-run macroeconomic model with one good, two interest-bearing paper assets (securities) and two currencies. It is shown that when monetary authorities refrain from monetary expansion via open market sales of domestic securities following a devaluation, necessary and sufficient conditions for devaluation to leave the real trade balance unaffected are (1) perfectly flexible wages (full employment), (2) the absence of wealth effects on consumption, and (3) perfect substitutability between the securities issued in the two countries.^{2/}

2. A Generalized Statement of the Neutrality Conditions

In this section we present a generalized statement of the conditions under which a devaluation is neutral in a multi-country, long-run (or multi-period), multi-commodity, multi-asset world. We have in mind a modification and simple monetization of the abstract world of Arrow and Debreu (1954)^{3/}. Our argument rests on the claim that in an

^{2/} The sufficiency of these three conditions is suggested by the following arguments. With perfectly flexible wages (full employment) and one good, labor's equilibrium real income in each country is unaffected by an exchange rate change; and the absence of wealth effects on consumption then precludes any change in real consumer demands. With perfect substitutability between securities, exchange rate movements cannot cause equilibrium real interest rates to diverge internationally: there are no market forces to push investment demands in opposite directions in the two countries. Hence, there are no forces to push absorption in opposite directions in the two countries, so markets clear with no changes at all in real absorptions or the trade balance.

^{3/} The modification involves (1) a grouping of consumers and producers by country, (2) a grouping of commodities distinguished by time period, and (3) the introduction of marketable assets which yield real endowment (income) streams over time to their owners, payable by debtors. The first two alterations are trivial. The third alteration can be introduced without changing the topological properties (closedness and convexity) of the sets of feasible production plans and consumption vectors, and hence does not change the qualitative nature of the conditions that are sufficient for the existence of a competitive equilibrium.

m-country world with $m-1$ independent exchange rates in each of n -periods, if (1) all quantity-demand and quantity-supply functions -- including asset supply functions -- are homogeneous of degree zero in prices, if (2) competition eliminates the profitability of commodity arbitrage internationally, so that (ignoring tariffs, and transport costs) each commodity has equivalent common-currency prices in all countries, and if (3) a unique multi-period real equilibrium exists, then (4) the vector of prices, wages, interest rates and exchange rates consistent with real equilibrium has $m-1$ degrees of freedom for each time period, or one degree of freedom for each independent exchange rate.^{4/} Thus, we can conceive of

^{4/} The proof of this claim can be sketched verbally. Start with a closed economy. For the single-period case, it is well-known that the equilibrium price vector has exactly one degree of freedom -- the absolute price level is indeterminate. For the two-period case, the equilibrium vector of prices and interest rate has exactly two degrees of freedom -- the absolute price level in each period is indeterminate -- provided money supplies and other exogenous nominal variables are denominated in real or purchasing-power terms (i.e., homogeneous of degree zero in prices) and the nominal interest rate reflects the real rate of interest plus the rate of change in the absolute price level. For the n -period case, the equilibrium vector of prices and interest rates has exactly n degrees of freedom.

Now consider the n -period case with m countries. Under autarky, each country has an equilibrium vector of prices and interest rates with exactly n degrees of freedom. The movement to free trade adds $(m-1)n$ independent exchange rates to the list of price variables to be determined, but also changes the number of constraints on the equilibrium price vector. Each country now has a balance of payments identity in each period -- a net addition of mn constraints. (We are thinking in terms of a flexible exchange rate world, but official intervention is admissible as long as intervention functions are homogeneous of degree zero in prices.) For each tradeable good, the opening up of free trade eliminates the constraint that absorption equal production in each period (we are ignoring commodity storage over time, which complicates the argument but does not change the conclusions), while adding the constraint that absorption equal production for the world as a whole in each period -- a net elimination of $(m-1)nT$ constraints, where T is the number of tradeable goods; (for simplification, we are assuming the same T in each period). The elimination of these $(m-1)nT$ constraints is exactly offset by the addition of the constraints requiring in each period that the prices of each tradeable good in countries 2, ..., m equal the price of the same good in country 1 multiplied by the prices of currency 1 in terms of currencies 2, ..., m . Thus there are mn additional conditions and $(m-1)n$ additional variables, or a loss of n degrees of freedom as compared to the autarky case, leaving $n(m-1)$ degrees of freedom altogether.

an abstract world in which all real variables in the economy move along their unique equilibrium time paths independently of the time paths of exchange rates. Provided that all prices, wages and interest rates were perfectly flexible and conditions (1) - (3) were met, fluctuations in the time paths of exchange rates would be neutral (in the sense of having no effects on any real economic variables), and the nature of the exchange rate regime (fixed or flexible) would be a matter of indifference.

The conditions sufficient for neutrality here are analogous to Henderson's. Our conditions (2) and (3) are also assumed in the framework of Henderson's model, though not stated explicitly in his theorem. In our framework perfectly flexible prices, wages and interest rates, analogous to Henderson's perfectly flexible wages (full employment), are sufficient to clear all markets at the equilibrium relative price levels, independently of the time paths of exchange rates.

Our remaining condition of homogeneity is indirectly analogous to Henderson's conditions of perfectly substitutable securities and the absence of wealth effects. Zero degree homogeneity in prices of all quantity-demand and quantity-supply functions is a condition which is violated in reality to the extent that quantity-demands and quantity-supplies depend on real wealths, and to the extent that real wealths are not homogeneous of degree zero in prices. This homogeneity assumption seems reasonable only in a (fantasy) world in which money supplies and all other forms of debt are denominated in real terms or

purchasing power units, or one in which the government manages to expand the nominal money supply at precisely the rate of increase of prices. In such a world, real wealths are homogeneous of degree zero in prices. Henderson's conditions then hold: devaluations neither have wealth effects on consumption nor cause any divergence between real rates of interest on different assets.

3. Departures from the Neutrality Conditions

We have suggested that apart from conditions which most economists would probably accept as reasonable, sufficient conditions for the neutrality of devaluation in a multi-country, multi-period, multi-commodity, multi-asset world are (a) perfectly flexible prices, wages and interest rates, with (b) money supplies and all other forms of debt denominated in real terms. This conclusion extends from comparative static to dynamic models. Suppose, for example, that all debt was denominated in purchasing power units, and that relative prices were fixed (not necessarily at market-clearing levels) independently of exchange rates, through the indexing of commodity prices, wages, and interest rates. In such a world the dynamic paths of real variables would be unaffected by exchange rate movements (whether or not these movements were correctly foreseen), since the ultimate determinants of all real variables -- namely, relative prices and real wealths -- would be completely insulated from exchange rate movements. Such a world would insure not only the real values of financial assets, but also the real income streams of labor and physical capital and hence the real capitalized values of human and physical assets.

Needless to say, the conditions sufficient for the neutrality of devaluation do not apply to the world as we know it today. In reality, money supplies and most other forms of debt are **not** denominated in real terms, and devaluations have impacts on real wealth, as we discuss in Section 5 below. Moreover, many prices, wages and interest rates are sticky, and discretionary exchange rate adjustment has been viewed as a technique for adjusting relative prices across countries faster than would otherwise occur through market processes. (Floating the exchange rate can be viewed as a technique for making this adjustment automatic.) The stickiness of many interest rates is due to legal constraint. Wages are sticky because suppliers of labor, lacking perfect information and facing search and relocation costs, find themselves locked into firms and geographic regions. Many other prices are sticky because price-setting oligopolists have healthy profit margins to begin with, lack complete information about industry demand functions and the reaction functions of other oligopolists, and find it costly to reassess pricing strategies and advertise new prices as frequent intervals.

Having argued that the conditions sufficient for the neutrality of devaluation do not hold in the world as we know it today, we may nevertheless note tendencies in today's world toward institutional changes which may weaken the effectiveness of devaluations. Specifically, devaluations may become progressively more neutral over time with institutional changes toward market adjustment of prices currently the

subject of intervention, toward a more rational (or real) denomination of debt, toward a reduction in the immobility of labor and capital or an indexing of nominal factor payments, and consistently, toward greater competition (less price setting and more price taking) or more price indexing in product markets.

4. The Role of Expectations

In discussing the conditions under which a devaluation would be neutral, we have been suggesting without much sophistication that the time paths of real economic variables depend ultimately on relative prices and real wealths, rather than, more correctly, on ex ante expectations of relative prices and real wealths.^{5/} Implicitly our arguments have assumed that the conditions under which relative prices and real wealths are independent of exchange rates are also conditions under which ex ante expectations of relative prices and real wealths are independent of exchange rates. This assumption is consistent with the hypothesis of rational expectations.

For a world in which the neutrality conditions do not hold, however, ex ante expectations of relative prices and real wealths will indeed be quite sensitive to exchange rates, or more precisely, to exchange rate expectations. Provided that economic participants are able to act on the basis of their expectations, the effects of a devaluation may be quite sensitive to the degree to which it is anticipated.

^{5/} In addition to ex ante expectations held currently, past errors in ex ante expectations can lead to behavioral adjustment, thereby affecting current real economic variables.

This suggests that empirical work on the timing and magnitude of the effects of exchange rate movements should take into account the nature of exchange rate expectations. Three important properties of expectations have been discussed by Despres (1967): (i) the degree to which they prove correct *ex post*; (ii) the degree to which they are held uniformly by all economic participants; and (iii) the degree of precision or confidence with which they are held. The first property, correctness, is relevant to whether actions taken as a result of expectations prove to be optimal reactions *ex post*. The second property, uniformity, is relevant to the distribution effects of an expected or unexpected event, insofar as some economic participants may be caught more by surprise than others. The third property, precision, is relevant to the actions that risk-averse participants will choose to take on the basis of their expectations.

The uniformity and precision of expectations are difficult to quantify. The correctness of *ex-ante* exchange rate expectations at various distances (i.e., over various time intervals) can be quantified, however. Specifically, we can quantify errors in the exchange rate expectations held at various distances from *ex post* data on actual exchange rates, together with computations of the expected future spot rates consistent with *ex-ante* data on either forward exchange rates or international interest rate differentials.^{6/} Given the current spot

^{6/} See Porter (1971).

exchange rate, the spot rate expected to prevail on any specific date in the future can be quantified as differing from the current spot rate by a percentage equal to either the premium on forward exchange for delivery on the specified future date, or the difference in international interest rates attached to comparable securities maturing on the specified future date.^{7/} If we could hold constant all other factors governing the response of wealth and prices to devaluation, we might expect that the responses, or changes, of trade volumes and other real variables would (in absolute value) be increasing functions of the error in exchange rate expectations at any given distance.

Although we do not propose, in this paper, to fit expectations errors into an empirical model of the trade balance or the overall balance of payments (under an adjustable peg regime), it seems clear that both elasticities approaches and monetarist analyses can mislead if they fail to consider expectations errors.^{8/} With respect to

^{7/} It may be noted that small fluctuations over time in international interest differentials on a given maturity (e.g., 90 day bills) are consistent with large fluctuations over time in expected future exchange rates if spot exchange rates exhibit large fluctuations. Thus, perfect knowledge of the term structure of international interest rate differentials is consistent with highly imprecise expectations of future exchange rate levels; spot exchange rates may move substantially over short periods in performing their function of maintaining market clearance.

^{8/} Sophisticated macroeconomic models in use today do take expectations into explicit account, however, and have thereby initiated an important focus on expectations errors. See Shafer (1975) for example, who develops a simulation model in which real economic behavior depends on expectations of variables such as price levels, the ratios of market value to replacement cost for physical capital, consumer income and wealth, and exchange rates.

elasticities approaches, the timing of the first responses of suppliers and demanders to a devaluation depends on how their expectations develop; and although the adjustment of prices in response to expectations can in theory remove incentives to change any real variables, the presumption in fact is that both the timing and scale of real adjustments are influenced by expectations.

5. Anticipation and the Size of Wealth Effects

Monetarist analyses of devaluation must also be aware of pitfalls. To illustrate we consider the model of Dornbusch (1973), who argues that devaluation has a positive real wealth effect on foreigners (i.e. holders of the appreciated currency), and a negative real wealth effect on domestic residents (i.e., holders of the depreciated currency), which in the short run increases foreign spending relative to production while reducing domestic absorption relative to production. Thus, in the short run the wealth effects of devaluation serve to unambiguously improve the trade balance of the devaluing country.

But what if we modify this model to allow for anticipation? It is argued here that correct anticipation of any change in any official and adjustable peg (exchange or interest rate) will result in an increase in private wealth at the expense of the public sector. The expectation of revaluation induces the private sector to incur increased foreign liabilities, selling the foreign currency to the central bank until expectations have been validated. If the stock of foreign liabilities incurred in anticipation of a 100g per cent

revaluation is X , private holdings of base money will have increased by gX units as a result of actions taken in response to the expectation of revaluation. Whether there is a corresponding rise in real wealth of gX depends on whether the matching losses of the central bank are viewed as leading to a higher real tax burden. In the limiting case, where the government raises taxes to cover the losses of the central bank, and where taxpayers expect this, then anticipation of exchange rate changes does not involve a wealth effect. As an alternative case, the private sector may consider itself liable for paying off privately-held government bonds without simultaneously considering itself liable for high-powered money debt. In this case, whether or not a wealth effect results from the injection of the gX units of base money depends, from an alternative viewpoint, on whether taxpayers expect the stock of base money to remain permanently higher than it would have been in the absence of the revaluation. It should also be noted that Dornbusch's wealth effects would disappear if the private sector considered itself liable for both privately-held government bonds and high-powered money debt.

Anticipation of devaluation leads to similar results, except the ability to obtain foreign assets prior to devaluation may be constrained by official reserves. But if we assume symmetry, then the same gX is again there for the asking in the event of a fully anticipated devaluation. Whether the stock of base money actually rises by this amount (gX) depends upon whether the foreign assets are

reconverted into domestic currency after the devaluation. All we can say, in general, is that any correctly anticipated change in an official price, i.e. a price that is the subject of intervention, leads to an increase in real private wealth (abstracting from expected tax offsets), some proportion of which is in the form of an injection of base money.

The increase in private wealth that results from correctly anticipating exchange rate changes will be distributed among foreigners and nationals according to their relative degrees of foresight and ability to move funds across currencies. An increase in domestic wealth is likely to spill over into increased domestic demand, which would tend to worsen the domestic trade balance, whereas an increase in foreign wealth would have the reverse tendency. For the case in which the domestic wealth effect from anticipating devaluation dominated the foreign wealth effect, it is conceivable that the direct "Dornbusch" effect would be offset. With an anticipated revaluation, on the other hand, the direct wealth effect would be reinforced by the increased private wealth flowing from correct anticipation. The reverse is true when the foreign wealth effect from correct anticipation dominates the domestic wealth effect. Thus we find that where expectations are correct, the monetarist model may prove wrong in suggesting that a devaluation improves the balance of trade in the short run. A stronger conclusion is that empirical attempts to estimate the magnitudes of the wealth effects of devaluations can be seriously misled if they fail to capture the degree of anticipation.

6. Conclusions

The first several sections of this paper suggest that devaluations would be neutral in a world in which money supplies and all other forms of debt were denominated in purchasing power units, and in which prices, wages and interest rates were perfectly flexible. Although these conditions do not apply to the world as we know it today, they do point to the types of institutional changes that could be expected to reduce the real impacts of exchange rate changes -- namely, institutional changes toward market adjustment of prices currently the subject of intervention, toward a more rational (or real) denomination of debt, toward a reduction in the immobility of labor and capital or an increase (formal or informal) in the indexing of nominal factor payments, or toward greater competition (less price setting and more price taking) or an increase in price indexing in product markets.

When the neutrality conditions do not hold, the nature of ex ante exchange rate expectations has an important influence on the timing and magnitudes of the effects of devaluations. Three properties of exchange rate expectations can be distinguished: correctness, uniformity, and precision. Of these, the correctness of exchange rate expectations can be quantified and should be used as an explanatory variable in empirical studies of the effects of exchange rate movements.

We have also argued that the wealth effects which dominate monetarist analyses of devaluation may be quite sensitive to the extent to which the devaluation is anticipated. In the case of strong and

correct anticipations it is conceivable that the monetarist model may prove wrong in suggesting that a devaluation improves the balance of trade in the short run.

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