

Exchange Rates: Real and Monetary Factors

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Précis: In this paper we explore several alternative models of the exchange rate which highlight the role played by real and monetary factors in exchange rate determination, and the short-and long-run effects of exchange rate changes on real output. In the first model, attention is focused on the role of purchasing power parity (PPP) with flexible prices *and* a variable *real* exchange rate. The second model introduces sticky prices and replaces PPP with interest rate parity as the key short-run link to the international economy. The third model introduces a multi-sector production structure and explores the implications of Marshallian dynamics whereby capital stocks adjust only slowly. Finally, some conclusions about the role of stabilisation policy are offered.

I INTRODUCTION

Fifteen years ago academic economists were outspoken advocates of flexible exchange rates. In a profession not known for its ability to agree, the near-unanimity of that view was striking. Today, it is even more so in light of the experience with flexible exchange rates since their widespread adoption during the past decade.

The performance of the flexible exchange rate system has proven unsatisfactory in a number of ways. Exchange rate variability in the 1970s has been large by any standard, and in particular has been larger than traditional models of exchange rate determination can explain. Levels of economic activity and inflation in various countries remain closely linked; the much heralded "policy independence" thought to be provided by flexible rates seems illusory. Governments have been unable to resist influencing exchange rate developments so that "managed floats" and "dirty fixes" have become

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the order of the day. Exchange rates have been virtually impossible to forecast inducing suspicions of severe resources misallocation caused by unforeseen exchange rate fluctuations; even forward exchange rates have proven to be poor predictors, leading to widespread claims of market inefficiencies.

This paper outlines some recent developments in exchange rate theory that, at least in part, have occurred in response to some of the above developments. We organise the discussion around three principles of exchange rate modelling: purchasing power parity (PPP), interest rate parity (IRP), and the relationship between the exchange rate and the terms of trade. In Section II we provide some background to the role of real and monetary factors in exchange rate determination. Sections III and IV present two specific models of exchange rate determination which emphasise short- and long-run distinctions and the interaction between exchange rates and real activity. Section V provides some brief concluding comments.

II PURCHASING POWER PARITY

The purchasing power parity relationship is depicted in the so-called "relative" form (in terms of logarithms) by

$$p_t = e_t + p_t^f - k_t \quad (1)$$

where p and p^f are the domestic and foreign price levels respectively, e is the nominal exchange rate defined as the domestic currency price of foreign exchange, and k can be interpreted as the *real* exchange rate. Given a choice of aggregates defining the price indices p and p^f , k is just that value which makes Equation (1) true. Much of the discussion below focuses on the behaviour of k .

Equation (1) is the starting point for many discussions of the exchange rate and is a central building block for most open economy macro models. Paul Samuelson (1964) once quipped that to many analysts PPP appears to be "both a trivial truism of arbitrage and besides quite untrue". More precisely, it seems that the consensus view on PPP can be summed up in the following two statements:

- (A) PPP does not hold in the short run;
- (B) PPP is a good approximation in the long run.

In terms of Equation (1), these statements suggest that observed variations in k will be transitory, with observed k_t fluctuating around some constant equilibrium value, k^* . Henceforth we shall use the term Naïve PPP to describe Equation (1) combined with the hypothesis that k is constant in the long run.

While evidence in support of (A) seems incontrovertible, it appears that the two statements (A) and (B) together constitute a seriously misleading view. The force of (B), of course, is that Naïve PPP is a good basis for forming expectations, and many forecasting models base their predictions on convergence towards a relationship like that depicted in Equation (1) with $k = k^*$. Traders betting on PPP have tended to lose a lot of money over the past decade for two reasons. First, even if k converges to k^* in the long run, Equation (1) does not form a useful basis for *exchange rate* forecasts unless one also has a sound basis for predicting relative inflation rates; convergence of k to k^* is consistent with an infinite number of paths of e , each accompanied by a different path of $(p-p^f)$. Second, data from at least the latter part of the 1970s have *not* shown strong tendencies for convergence of k to some constant k^* ; "deviations" from PPP have been substantial *and* persistent.

The key problem with the position summarised in (A) and (B) is that it tends to treat PPP as an *arbitrage* condition; i.e., as the operation of the law-of-one price, even though Equation (1) is usually expressed in terms of price indexes relating to fairly broad aggregations of goods. In fact, PPP should be interpreted as a *comparative statics* result arising from a monetary disturbance and embodying the essential feature of *monetary neutrality*. A neutral monetary disturbance alters no relative prices; any change in domestic prices must be accompanied by offsetting changes in the exchange rate so as to preserve the equilibrium relative price of domestic goods in terms of foreign goods.¹

The failure of Naïve PPP to conform to the data of the 1970s is simply a reflection of the fact that exchange rates in the 1970s were subjected to many real shocks which at the same time altered equilibrium relative prices. We now turn to a brief discussion of two exchange rate models which illustrate this point and which can be used to cast some light on the recent exchange rate experience of several countries.

III A MONETARY MODEL WITH SLOW PRICE-ADJUSTMENT AND RATIONAL SPECULATORS: SHORT-RUN OVERSHOOTING

One rationale for departures from PPP is that goods prices are "sticky" and adjust only slowly. Sluggish price adjustment, of course, does not in

1. A monetary disturbance can have non-neutral effects in the short run, and hence form the basis for statements (A) and (B). However, as discussed in Section III below, Naïve application of Equation (1) even in that circumstance can be misleading; variations in k can still be systematic. Additional confusion can arise when such monetary disturbances are confused with real disturbances which permanently alter k , as discussed in Section IV below. For further discussion of the role of real structure and PPP, see Jones and Purvis (1981).

itself require deviations of k from k^* since e is free to adjust to maintain Equation (1). However, the popular view is that in the short run the exchange rate responds to capital flows, and only in the long run through adjustment in p (or p^f) does k converge to k^* . Hence in this tradition PPP is dropped as the short-run linkage to the rest of the world and replaced with a capital market equilibrium condition, usually in the form of an interest rate parity (IRP) condition. In terms of Equation (1), the approach is to take p (and p^f) as predetermined, and to explain short-term movements in e , and hence k , via IRP.

Models combining the Keynesian macro tradition of slow price adjustment with exchange rate flexibility have recently become popular; see especially Dornbusch (1976), Frankel (1979), or Mussa (1982). The sluggishness of prices allows some room for the monetary authorities to influence *real* money balances and thereby manipulate domestic interest rates. This is expressed in Equation (2), obtained by inverting a simple money demand function in which desired real balances are negatively related to nominal interest rates (where b is the inverse of the partial interest elasticity of the demand for money) and in which, for simplicity, the role of real income is ignored.

$$i = b(p - m), b > 0 \quad (2)$$

Manipulation of the interest rate by domestic monetary authorities will, however, have both foreign and domestic consequences, the former via international capital mobility and the latter via aggregate demand. Let us examine each in turn, and then consider their interaction.

The assumption of slow price adjustment having ruled out PPP as the international linkage, focus is now on uncovered interest rate parity (IRP):

$$i = i^f + x \quad (3)$$

where x is the *expected* rate of change of the exchange rate. According to Equation (3), the domestic interest rate can exceed that prevailing in world markets only if there is simultaneously an expectation of depreciation of the home currency. While Equation (3) will not, in practice, hold exactly, IRP does have more empirical support than PPP and hence is potentially useful as an organising principle.

Assume that exchange rate expectations are formed regressively:

$$x = a(e^* - e), a > 0 \quad (4)$$

where e^* is the long-run equilibrium exchange rate towards which the actual

exchange rate is expected to converge.

Combining Equations (3) and (4) yields a relationship between the current spot exchange rate and the domestic interest rate which must hold if the condition of international arbitrage is to hold. This relation,

$$i + ae = i^f + ae^* \quad (5)$$

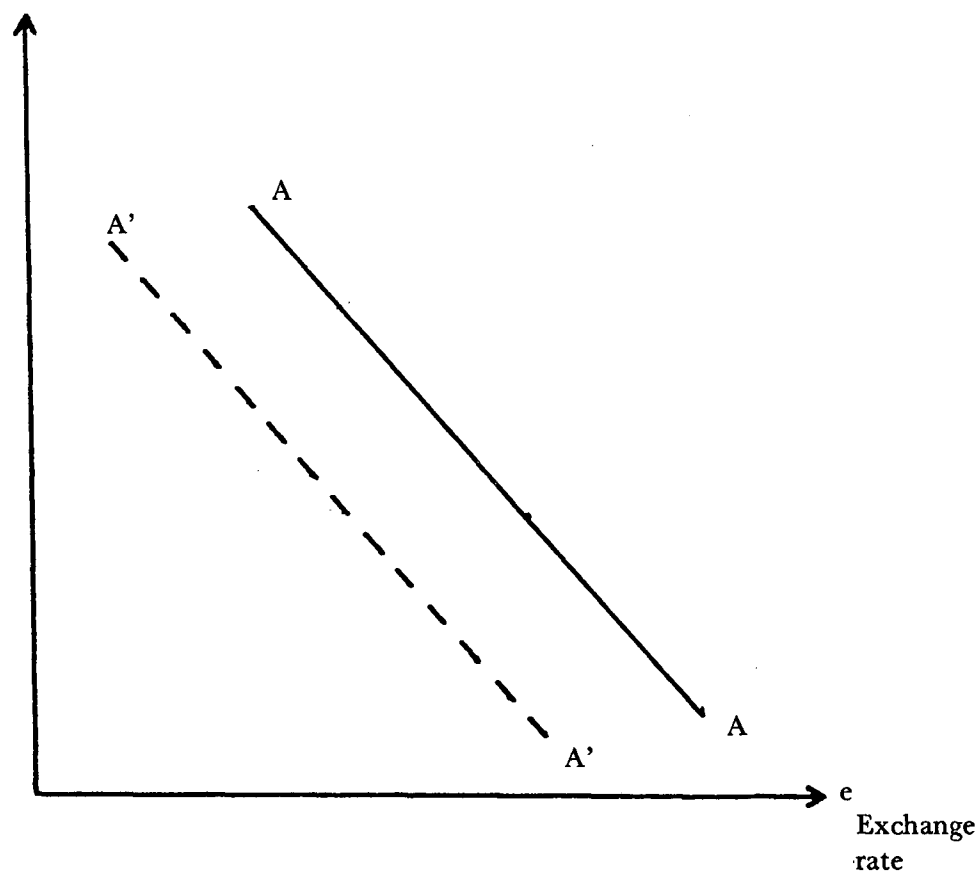
states that the current market values of the domestic interest rate and the exchange rate must be linearly related in exactly the same manner as are the foreign interest rate and the long-run equilibrium exchange rate.

Equation (5) is illustrated by the negatively sloped line AA in Figure 1.

Figure 1: *International interest arbitrage*

Interest rates

i, i^f



The position of the AA curve is, from Equation (5), contingent on the given foreign interest rate and the given long-run equilibrium value of the exchange rate. In particular, a decrease in e^* (i.e., an expected long-run appreciation of the home currency) reduces the current value of the exchange rate that corresponds to any interest differential; this is illustrated by the dashed line A'A' in Figure 1.

Abstracting from conditions of inflation, long-run equilibrium occurs when $i = i^f$ and, using Equations (3) and (5), when $x = 0$ and $e = e^*$.² This is depicted at E_0 in Figure 2 where AA is as in Figure 1 and, from Equation (5), the initial equilibrium exchange rate e^* can be read off AA at the point E_0 where $i = i^f$.

Suppose this long-run equilibrium were disturbed by a once-for-all decrease in the nominal money supply. On impact, with domestic prices fixed, the decrease in liquidity causes an increase in the domestic interest rate, as shown by the dotted line i_1 in Figure 2. From Equation (3) this must be accompanied by an expectation of depreciation of the domestic currency; in turn, from Equation (4), this means that the current value of the exchange rate must be below its long-run value. But by the homogeneity postulate a decrease in the domestic money supply leads to an equi-proportionate long-run appreciation; hence the AA curve shifts left to A'A'. That is, in terms of Equation (1), the monetary disturbance does not alter the long-run value of k ; hence, for a given value of p^f , e and p must fall proportionately to the change in m .

The long-run equilibrium moved from E_0 to E_1 and the equilibrium exchange rate falls from e_0^* to e_1^* . In the short run, however, domestic interest rates rise to i_1 and short-run equilibrium is established at Z with an exchange rate of $e_1 < e_1^*$. *There is overshooting; the short-run fall in the exchange rate is larger than the long-run fall.*

Algebraically, using $de^*/dm = 1$ and $di/dm = -b$ (from Equation (2)), we get from Equation (5):

$$de/dm = (a + b)/a > 1$$

which establishes the overshooting result.³

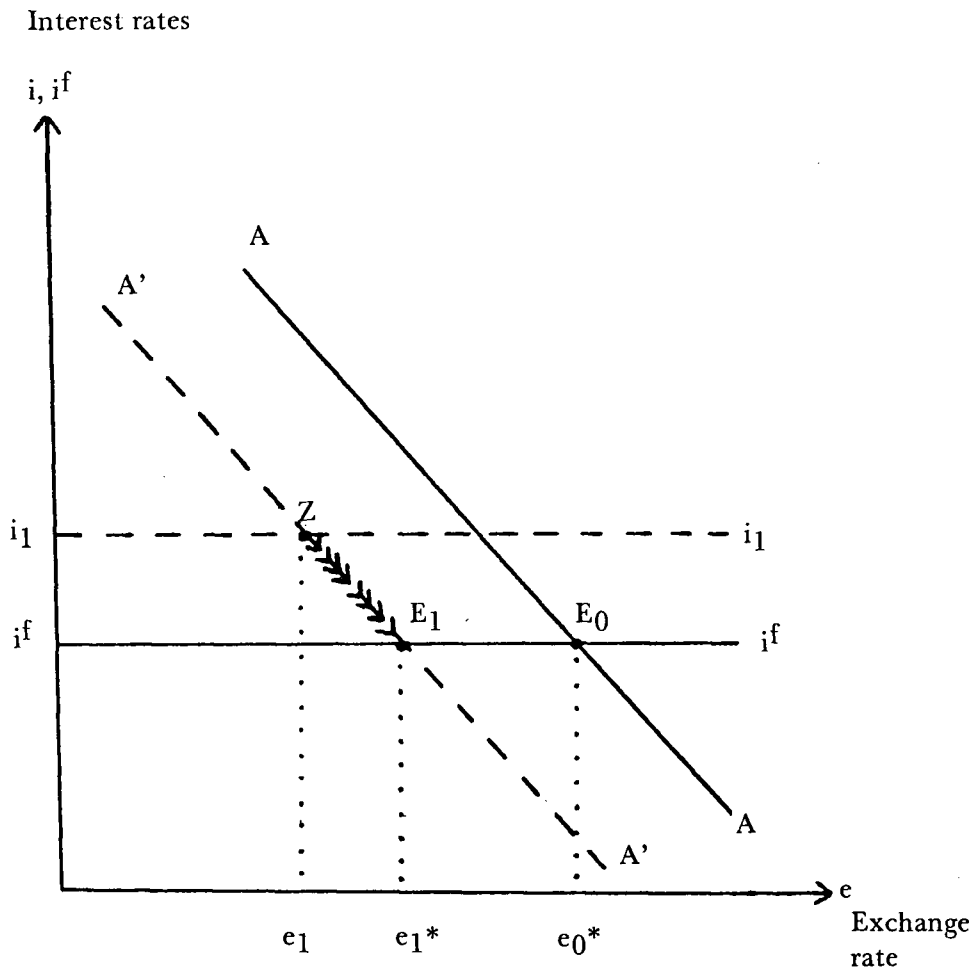
Overshooting is caused by the combined requirements that monetary contraction lead both to a long-run appreciation and to short-run expected

2. A spread between e and e^* reflects the existence of a *real* interest rate differential; with inflation, nominal interest rates will differ by the inflation differential even in long-run equilibrium with $e = e^*$.

3. Further, at Z, p exceeds its long-run value, so k^* exceeds k by the sum of the divergence in p and e from their long-run values.

depreciation. The basic story is that rational speculators will set the current spot price of foreign exchange in a manner consistent with expected future increases in that price; those increases, however, move the price towards a target *below* the “pre-policy” level so that on impact the spot exchange rate falls not only with respect to its initial value but also in relation to its new long-run value.

Figure 2: *Exchange rate determination*



Consider now the domestic repercussions of the short-run equilibrium established at Z . Domestic interest rates have risen and there has been a sharp real appreciation (e has fallen, p has not yet changed). Both lead to a

reduction in aggregate demand for domestic output, and hence lead to recession and unemployment.

The dynamics can be completed by recognising that the excess supply of domestic goods which occurs at Z leads to a gradual domestic deflation. As p falls, liquidity rises and, from Equation (2), i falls; adjustment is along $A'A'$ from Z to E_1 , as indicated by the arrows. The gradual fall in p is accompanied by a gradual *rise* in e . At E_1 , $i = \bar{i}^f$ so by Equation (2) we know $dp = dm$; there is long-run neutrality and aggregate demand is restored to its original level.⁴

This model has considerable appeal for a number of reasons, including:

- (i) It is one explanation of the high variability of exchange rates since it predicts that the variance of the exchange rate will exceed the variance of underlying fundamentals (i.e., the money supply);
- (ii) it is consistent with both statements (A) and (B) in the above discussion on Naïve PPP;
- (iii) it predicts dynamic adjustment whereby $(p-p^f)$ and e will be negatively correlated in contrast to the positive correlation predicted by naïve PPP – cf., the German experience in the late 1970s and the UK experience at the start of the 1980s;
- (iv) it predicts sharp movements in real exchange rates $(e-p)$ since the nominal exchange rate moves quickly relative to the price level; and
- (v) it provides a systematic analysis of the costs – in terms of systematic short-run non-neutralities – of pursuing monetary disinflation in an open, flexible-exchange-rate economy.

Despite these features, this model and others like it have had difficulty explaining some recent experience. Although there is evidence that the model illuminates the recent behaviour of Sterling (Niehans 1980) and the Mark (Frankel 1979), the model has not proved especially informative for a number of other currencies. For example, a recent study by Backus (1981) indicates, first, that the model and its basic extensions does not explain the variability of the Canadian-US exchange rate; on the other hand, although there are large persistent deviations from PPP, the Canada-US evidence is consistent with long-run monetary neutrality and PPP.

To this point, the model has ignored the role of real disturbances; as a

4. As Dornbusch (1976) shows, a solution consistent with perfect foresight ($\dot{x} = de/dt$) can be obtained; the size of a will depend on the speed of adjustment of prices and on other parameters. For overshooting, $a > 0$ is all that is required. The analysis can also be readily extended to incorporate the influence on money demand of variable domestic real income dependent upon real interest and exchange rates; as can be seen from Equations (3) and (4) monetary contraction still leads to overshooting as long as it causes domestic interest rates to rise.

consequence all movements in k have been interpreted as transitory in nature. An interesting alternative is to interpret movements in k as, at least in part, permanent changes resulting from real disturbances. In the remainder of this paper we outline approaches which indicate the potential role for considering real disturbances in this regard.

IV SECTORAL ADJUSTMENT AND EXCHANGE RATE DYNAMICS

Buiter and Purvis (1981) have shown that, in the context of the model outlined in Section III above, real disturbances which raise the demand for money can lead to qualitatively similar exchange rate dynamics. Hence, for example, the discovery of North Sea Oil – by raising income and wealth – provides an explanation of the appreciation of Sterling alternative to the contractionary monetary policy introduced by the Thatcher government. Further, and more interestingly, these exchange rate effects could offset any direct stimulation such real shocks might contain for domestic output. Although the direct effects of such a discovery on the demand for British manufactures would be positive, it is possible (although not inevitable) that the decline in demand caused by the real appreciation could swamp the direct effect; North Sea Oil is a potential candidate for explaining UK de-industrialisation.

In the Buiter-Purvis analysis, the oil discovery gives rise to a change in the long-run real exchange rate, k^* . But it also causes a deviation of observed k from k^* due to sluggish price adjustment. The instantaneous change in k is, therefore, in part a permanent real change and in part a transitory monetary change due to the excess demand for money that prevails at initial price of home goods.

The Buiter-Purvis analysis thus puts up a “real explanation” alternative to the “Mrs. Thatcher” explanation of combined real appreciation and de-industrialisation. However, while the real exchange rate can permanently change in the Buiter-Purvis framework, the *output* effects are seen to be temporary as there are no resource allocation implications of the oil discovery and subsequent permanent relative price change; there is no long-run de-industrialisation. We turn now to an alternative model that allows for real output effects in the long run.

Figure 3 presents a schematic outline of a model developed by Neary and Purvis (1981). When prices are flexible, the dynamics of the model are conditioned only on the real-adjustment involved in changing the capital stocks in the benzene and manufacturing sectors. Monetary policy is neutral; the focus is on real disturbances and on the real exchange rate (now interpreted as the price of traded goods in terms of non-traded goods). By construction, this is the inverse of the real wage in terms of manufacturing

goods; a real appreciation is equivalent to a rise in the real manufacturing wage rate.

The consequences of a resource boom can now be readily seen. A "North Sea Oil discovery" has demand repercussions only in the service sector, and hence leads on impact to a real appreciation. The real appreciation caused by the increased demand for services is equivalent to a real wage increase as labour is bid into services and drawn out of manufacturing. Manufacturing output declines.

Figure 3: Schematics of Neary-Purvis model

Pricing	Good	Factors used in production	Factor characteristic
Traded, world prices given	Benzene	natural resource, v	specific
		capital, K_B	fixed in SR, variable in LR
	Manufacturers	capital, K_M	
Non-traded	Services	labour, L_M	variable and mobile even in SR
		labour, L_S	

The return to capital in manufacturing falls as a result of the exodus of labour; the return to capital in benzene rises as a result of the increased availability of the natural resources. These changes in turn set in motion forces which cause K_M to shrink and K_B to rise; the former gives rise to a reduced demand for labour and hence to a fall in the real wage; i.e., to a real depreciation. Hence there is again *overshooting*, this time in response to real disturbances and caused by real inertia. Again the change in the real exchange rate reflects a change in k ; the initial change in k is partially a permanent change in k^* and partially a transitory deviation of observed k from k^* .

In the long run, manufacturing output will shrink while that of services and benzene rises. There is likely both real and nominal appreciation; Naïve PPP will *not* be expected to prevail even in the long run since equilibrium relative prices will have changed. The de-industrialisation reflected in lower manu-

facturing output is not a "Dutch disease" problem but rather an *income-increasing* response to the shift in comparative advantage caused by the resource discovery.

V CONCLUDING COMMENTS

This paper has outlined the relationship between deviations from purchasing power parity, short-run exchange rate overshooting, and the role of real exchange rate dynamics in structural adjustment in an open economy.

The Buiters-Purvis framework focuses on "macroeconomic" implications of real disturbances. These effects emerge from the presence of "sticky prices" in the face of a disturbance which raises desired real balances. If the increase in real balances is achieved through domestic deflation, temporary but potentially severe recession can ensue. The obvious message is that if de-industrialisation occurs due to this combination of sticky prices and flexible exchange rates, then accommodating monetary policy can be used to rationalise the existing price level and hence avoid the macroeconomic recession.

Of course, this policy prescription abstracts from the problem of disentangling permanent from transitory changes in k . In the Buiters-Purvis framework, output behaviour would be a guide to policymakers, but this is not true in the Neary-Purvis framework where the fall in output in the "traditional sector" is not necessarily a signal for expansionary policy.

The Neary-Purvis paper focuses on a situation where the real disturbance can have permanent output effects, and there is no role for accommodating aggregate demand policy. In this framework de-industrialisation is an equilibrium phenomenon, operating through *factor markets*, rather than a disequilibrium phenomenon operating through the *foreign exchange* and *money* markets. De-industrialisation can then be an appropriate response to shifting comparative advantage. As discussed in Neary-Purvis (1982), using accommodating policy in the mistaken belief that the exchange rate should be stabilised could inhibit the adjustment process.

Two extensions seem worth noting. One is allowing for the presence of inflation. As shown in Buiters-Purvis, the Dornbusch analysis and our own generalise completely to an inflationary environment. The linkages become slightly more complex and the distinction between nominal and real interest rates must be made, but the principles remain the same. Further, the motivation for some of the analysis becomes stronger since contractionary monetary policy at an initial equilibrium position is now more interesting since such policy is addressed to lowering the inflation rate rather than the price level.

A second extension is to allow for real shocks in the form of changes

in the relative price of manufactured goods in terms of natural resources. Much of the above analysis goes through since such relative price changes also lead to changes in real income and wealth. However, allowance must also be made for additional short- and long-run effects due to the role of resources as intermediate goods.

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