1976

Expectations and the Behavior of Prices and Output under Fixed and Flexible Exchange Rates

David Laidler

Research Report 7620

EXPECTATIONS AND THE BEHAVIOR OF PRICES AND OUTPUT UNDER FIXED AND FLEXIBLE EXCHANGE RATES*

David Laidler

October 1976

*I am grateful to Robin Bade, Russell Boyer, Joel Fried, Peter Howitt, Clark Leith, and Michael Parkin for helpful comments and suggestions on an earlier draft of this paper. They are, nevertheless, not to be held responsible for its contents.

I. INTRODUCTION

The modern monetary approach to balance of payments theory under fixed exchange rates does not assign a central and active role to reserve flows in the international transmission of inflation. It views such flows as accommodating the behavior of the domestic money supply to variations in the inflation rate mainly brought about by other means. A direct price transfer mechanism, justified in earlier analysis by making the small open economy a price taker in world markets, at least for tradable goods, and in more recent work by having inflation expectations, and hence domestic price setting, influenced by the behavior of inflation in the rest of the world, has come to be regarded as the important channel whereby inflation is transmitted between open economies operating fixed exchange rates. Moreover, a considerable amount of empirical evidence consistent with the operation of such a mechanism has accumulated in recent years.[1]

This paper is first of all concerned with investigating what the existence of this other channel for the international transmission of inflation implies about the way in which a fixed exchange rate open economy interacts with the world economy. Secondly, it deals with what the existence of such a price-transfer mechanism implies about the view that a freely floating exchange rate provides complete insulation against nominal shocks orignating abroad. This view, after all, is based upon the hypothesis that, in severing the link between the domestic money supply and any foreign variables, such an exchange rate regime cuts off the only channel whereby such shocks can be imported. The analysis is carred out with the aid of a macroeconomic model which combines a version of the quantity theory of money with an expectations augmented Phillips curve and is adapted to the analysis of an open economy by permitting the balance of payments to affect the rate of monetary expansion and the world inflation rate to influence domestic inflation expectations.[2]

The model is first analyzed on the assumption that the exchange rate is irrevocably fixed, and its predictions for the long run are shown to conform to those of the monetary approach to balance of payments theory. In the short run, however, it is shown that there is scope for the domestic inflation rate to deviate from that ruling in the rest of the world, and for nominal shocks originating both at home (changes in the domestic credit expansion rate) and abroad (changes in the world inflation rate) to cause fluctuations to real income and employment. An assumption of complete exchange rate flexibility is then adopted and it is shown once again that the predictions of the model only conform to those of conventional monetary theory in the long run.[3] Specifically, only in the long run does a flexible exchange rate regime in general guarantee the insulation of the economy from nominal shocks arising in the rest of the world. In the short run, the extent to which a flexible exchange rate can insulate domestic output and inflation from the consequences of variations in the world inflation rate turns out to depend crucially upon how inflation expectations are formed. As to the economy's response to variations in the domestic monetary expansion rate, it is only in the long run that this shows itself solely in the form of a change in the domestic inflation rate. The nature of the short run responses of output and inflation to such a variation also depend upon the inflation expectations mechanism embodied in the model.

II. THE MODEL

The model with which our analysis is carried out is cast in log. linear terms; first time differences of variables, indicated by the symbol Δ, are thus proportional changes in their levels. The variables used, all logarithms, are as follows: M the nominal money stock; y the ratio of actual real income to that level compatible with the "natural" unemployment rate, and hence an excess demand proxy which takes a zero value when income is at its "natural" level; P the domestic price level; X the expected inflation rate, or equivalently the value that economic agents expect ΔP to take over the subsequent period; C the stock of domestic credit extended by the banking system; R the stock of foreign exchange reserves held by the banking system; π the price level ruling in the rest of the world; and E the price of a unit of foreign currency in terms of domestic currency. Time leads and lags are indicated by subscripts +1, -1, -2, etc., and when attached to expected values of variables, indicated by the superscript e, denote the time period <u>during which</u> expectations are formed, and not that <u>for which</u> they are formed. Thus $\Delta\pi^e_{-1}$ denotes the rate of inflation that, in period t-1, is expected to rule during period t in the world economy.

Setting aside for the moment the determination of the expected inflation rate, the model may be written as follows:

$$\Delta M = b\Delta y + \Delta P \qquad b > 0 \qquad (1)$$

$$\Delta P = gy + X_{-1} \qquad g > 0 \qquad (2)$$

$$\Delta M = (1-v)\ \Delta C + v\Delta R \qquad 0 \leq v \leq 1 \qquad (3)$$

$$\Delta R = n(E + \pi - P) \qquad n > 0 \qquad (4)$$

For the analysis of a fixed exchange rate regime we may choose our units of measurement so that the price of foreign exchange is unity. Thus its logarithm E becomes zero and vanishes from equation 4. To keep the analysis of a flexible exchange rate regime as simple as possible we assume that no foreign exchange reserves are held. On this assumption equation 3 becomes

$$\Delta M = \Delta C \qquad (3a)$$

and equation 4 may be rearranged as

$$E = P - \pi \qquad (4a)$$

Equation 1 is a first difference form of a demand for money function of a particularly simple kind, relevant to an economy in which the secular rate of growth of output is zero, and the opportunity cost of holding money does not affect the demand for it. The first assumption is innocuous enough and it would be a trivial matter to introduce an exogenously given secular growth rate into the analysis. In fact this does not affect any of the conclusions it yields. The second is more likely to be found objectionable and is justified in the following way. We are here interested in investigating the response of the economy to nominal shocks rather than in its response to real disturbances (which is not to say that real disturbances do not in fact raise important questions that are also worth asking) and a "vertical LM curve" framework is adequate for this purpose. Moreover, consider the flexible rate application of the model. To have purchasing power parity the sole determinant of the exchange rate (as equation 4a implies), and the quantity of money the sole determinant of the domestic level of aggregate nominal demand, produces a system in which we might expect the insulating properties of flexible exchange rates to be maximized. Thus any results generated within such a framework that raise doubts about those properties are of particular interest. In any event, one can extend the model to accommodate the possibility of real income being affected by domestically originating real shocks--IS curve shifts--at the cost of some extra analytic complexity but without changing the qualitative structure of the model in any basic way.[4]

Equation 2 is an expectations augmented Phillips curve or, as some prefer to call it, an aggregate supply curve. In giving the expected inflation rate a unit coefficient, it embodies the natural unemployment rate hypothesis. This hypothesis is controbersial but there is enough evidence in support of it to make its use in an exercise of the kind being carried on here defensible. Equation 3 is nothing more than an approximation to a balance sheet identity and one whose use is quite standard in analysis of monetary aspects of the operations of a fixed exchange rate system.

Equation 4 is an expression determining the balance of payments under fixed rates, and the exchange rate under flexible rates. It could be extended to include an absorption term as well as a relative price level term, and the consequences of doing so were in fact investigated in work not reported in this paper. To have an absorption term in equation 4 ensures that under flexible rates purchasing power parity only determines the exchange rate when the economy is in long-run full employment equilibrium, and though this property might lend some realism to the model, it does not in fact seem to alter its behavior in other respects in any important way, although it does add to the complexity of the analysis. As we have already noted in discussing the demand for money equation, by having purchasing power parity always determine the exchange rate, we maximize the potential insulating effects of flexible exchange rates. In the present context the omission of an absorption term from equation 4 is thus defensible on a number of grounds.

The most serious omission from the balance of payments equation is any analysis of capital account transactions. This is partly justified on the basis of achieving analytic simplicity, and partly on the grounds that, with capital account transactions ruled out, there can be no possibility that the behavior of speculators can adversely influence the behavior of the economy under a flexible exchange rate. Any results suggesting that a flexible regime is a less than perfect insulating device against changes in the world inflation rate are strengthened by not being based upon the possibility that speculators make errors in setting the rate; this possibility is already well understood.[5]

The behavior of inflation expectations is central to the analysis that We have as yet said nothing of the manner in which they are to be modelled because the exchange rate regime itself is one factor that is likely to affect the way in which agents form their expectations. We shall therefore begin our discussion of the model's properties under fixed exchange rates with a discussion of our hypothesis about the way in which expectations are formed.

III. THE MODEL WITH A FIXED EXCHANGE RATE

In the analysis which follows we are concerned with the long-run equilibrium properties of our model as well as with its behavior in disequilibrium. It is a characteristic of long-run equilibrium in an economic model that the expectations upon which agents base their behavior are in the event realized. In long-run equilibrium, expectations must be rational. If we abstract from intersectoral productivity growth differentials it is uncontroversial that, in the long run, the inflation rate of any small fixed exchange rate open economy must equal that of the world economy. Any hypothesis about how inflation expectations in such an economy are formed ought to reflect this.

To say that their percentage rates of change must be equal is not to characterize fully the long-run equilibrium relationship between the domestic and world <u>price levels</u>. Equation 4 says that the balance of payments depends upon relative price levels, and it is not the case that any value for the rate of change of nominal reserves is compatible with an economy being in full equilibrium. It seems reasonable to postulate that the monetary authorities of a stationary economy, such as we are modelling here, would seek to maintain a constant level of real foreign exchange reserves, and hence would act so as to generate a rate of nominal reserve inflow equal to the world rate of inflation.[6] If economic agents recognize this policy goal, then given their estimate of the world inflation rate $\Delta\pi^e$, they will expect the authorities to aim to establish a rate of change of nominal reserves equal to it, and hence to generate a relationship between the domestic and world price levels given by

$$P^e - \pi^e = -\frac{1}{n}\Delta\pi^e \tag{5}$$

Now clearly X, the expected rate of domestic price inflation may be written

$$X = P^e_{+1} - P \tag{6}$$

while π^e_{+1} the expected value for world prices in the next period may be written

$$\pi^e_{+1} = \pi + \Delta\pi^e \tag{7}$$

Substituting 5 and 7 into 6, we get,

$$X = \pi + a\Delta\pi^e - P \tag{8}$$

where

$$a \equiv (1 - \frac{1}{n}) \tag{9}$$

Thus we postulate that agents expect the domestic price level to move between the current and next periods by an amound sufficient to establish balance of payments equilibrium (defined in the sense of a zero rate of change of real reserves). To complete this model of the formation of inflation expectations we characterize expectations about the world inflation rate as being formed by a conventional first-order error learning process.

$$\Delta\pi^e = d\Delta\pi + (1-d)\Delta\pi^e_{-1} \qquad 0 < d < 1 \tag{10}$$

Now of course to introduce an element of adaptive expectations into our model inevitably imparts a somewhat mechanical air, that not everyone will find palatable, to the analysis that follows. It is important to be clear about which results are critically dependent upon this ingredient and which are not.

First, so long as we are careful about the experiments which are performed with the model, the use of error learning in equation 10 does not violate the requirement that expectations be rational in the long run. We shall confine our analysis to experiments in which the world inflation rate shifts from one level to another. In such a case, error learning does ensure that the actual and expected world inflation rates eventually become the same. The reader should be warned, however, that the model that we have here would not be well adapted to dealing for example with the consequences of a steady acceleration in the world inflation rate, because that variable's expected and actual values would not in that case converge on each other. Secondly, our analysis of the impact effects of changes in exogenous variables are in large measure independent of the error-learning hypotheis. Changes in nominal variables do have impact effects on real income in the analysis that follows, and that is because their consequences for the inflation rate are not immediately foreseen. However it is the unforeseen nature of these changes *per se* rather than that mistakes arise specifically from the use of error learning that dominates the nature of the impact effects that we shall analyze. On the other hand, the dynamics of the process whereby long-run equilibrium is restored after an exogenous shock, and in which expectations of inflation systematically deviate from their realized value, *are* heavily dependent upon the error-learning hypothesis. The reader who finds error learning unappealing will be much more skeptical about this element of what follows than of the rest of the analysis.

If we combine equations 1-4 with 8 and 10 we have a complete model of a fixed exchange rate open economy which yields, as a reduced form for income,

$$y = \frac{1}{b+g+vng}\{(1-v)\Delta C - (1-v)(1-d)\Delta C_{-1} + vn\Delta\pi - (1+ad + (1-d+ad)vn)\Delta\pi_{-1}$$

$$+ (1-d+ad)\Delta\pi_{-2} + [(2-d)(b+g) - (1-d)(vng)]y_{-1} - (1-d)(b+g)y_{-2}\} \qquad (11)$$

The relationship between the inflation rate and output implicit in the model is given by

$$\Delta P = gy - (1-d)gy_{-1} + (1+ad)\Delta\pi_{-1} - d(P_{-1} - \pi_{-2}) \qquad (12)$$

It can be shown that the model is stable and converges upon a steady state.[7] For constant values of the exogenous variables, and a constant value of y, equation 11 reduces to

$$y = \frac{1-v}{vng}(\Delta C - \Delta\pi) \qquad (11a)$$

which expression clearly has a value of zero when the domestic credit expansion rate is equal to the world rate of inflation.

Equation 12, under the same circumstances, becomes

$$\Delta P = dgy - d(P_{-1} - \pi_{-1}) + (1+ad)\Delta\pi \qquad (12a)$$

These results are easily interpreted. Equation 11a tells us that, if the world inflation rate increases, an economy whose authorities do not adjust the domestic credit expansion rate in order to maintain its real holdings of foreign exchange reserves constant, as agents expect them to do, will tend towards a state of chronic excess supply. Equation 12a tells us that, if the rate of inflation is to be constant under such circumstances, it must nevertheless be equal to the world rate, since that is the only way in which the term $(P_{-1} - \pi_{-1})$ can remain constant over time. Accompanying such imported "stagflation" will be a growing stock of real foreign exchange reserves, implying that the economy is paying more seignorage to the emitters of those reserves than it would in balance of payments equilibrium. In short, our model tells us that there are costs in trying to offset imported inflation by using monetary policy, but no benefits.

In equation 11 the impact multipliers of changes in the domestic credit expansion rate, and the world inflation rate, on domestic real income are non-zero. This of course is because the model does not permit changes in these exogenous variables to be foreseen, and any expectations scheme that gave the model this property would produce such results. They are not specifically dependent upon error learning being incorporated in the model. It is a different matter with the lagged impact effects in equation 11 and with the coefficients of the lagged income terms. Here as in the "Phillips Curve" set out in equation 12, the parameter d plays an important role. Equation 12 tells us about the manner in which, even in the short run, the behavior of the domestic inflation rate is heavily influenced by the world rate. Nevertheless it is worth noting that equation 12 is sufficiently similar to the reduced form of the expectations augmented Phillips curve which Cross and Laidler (1976) investigated empirically with a fair degree of success to suggest that those properties of this model which are heavily dependent upon error learning about the world inflation rate are, on empirical grounds, worth treating seriously.[8]

The properties of our model that we have just outlined seem close enough both to the standard predictions of the monetary theory of the balance of payments, at least in the long run, and to the stylized facts generated by the behavior of small open economies under the more or less fixed exchange rate Bretton Woods system to suggest that the same model, suitably modified, might give us some insight into aspects of the likely behavior of such economies under a flexible rate scheme. It is to the generation of predictions about such matters that we now turn.

IV. THE MODEL WITH A FLEXIBLE EXCHANGE RATE

An important premise of the analysis of this paper is that if inflation expectations are rational in the long run the way in which they are formed depends upon the exchange rate regime in force. Thus although the replacement of equation 4a is a necessary step in adapting our model to deal with a flexible exchange rate economy, it does not complete the process. We must also reconsider the manner in which we model the determination of X. The precise nature of the changes that we make here radically affect our model's properties.

One point can be made at the outset of the discussion, without our having to resort to any explicit manipulation of the model. If it is decided that the appropriate equation describing expectations formation for a flexible exchange rate economy includes only domestic variables--for example, the rate of monetary expansion, or past values of the domestic inflation rate--as arguments it is immediately implied that flexible exchange rates completely insulate the domestic economy from changes in the world inflation rate in both the short and long run.[9] In such a case the foreign price level appears only in the exchange rate equation. The domestic price level at any moment is then determined elsewhere in the model, so that, given its value, the exchange rate adapts immediately to changes in the foreign price level in order to maintain purchasing power parity.

For a flexible exchange rate economy in which the only domestic source of disturbance is a change in the rate of monetary expansion, it is clear that expectations formed with reference to the behavior of the domestic money supply could meet the criterion of long-run rationality, as indeed would a simple error-learning scheme applied to the domestic inflation rate provided the rate of monetary expansion fluctuated about a given average value over time. We cannot therefore rule out on a priori grounds the possibility that the traditional view of a flexible exchange rate's insulating powers is correct. What we can do is argue that expectations schemes that incorporate the behavior of world prices and the exchange rate are also capable of displaying long-run rationality and do at the same time have a degree of a priori plausibility about them. We can also show that such schemes would undermine the insulating powers of flexible rates in the short run. Questions about the extent of such powers thus become empirical in nature, and are to be answered, at least in part, by referring to evidence concerning the way in which expectations are in fact formed in economies operating such a regime.

The expected inflation rate that we incorporate in macro models such as the one we are analysing here is a convenient fiction. The "economy as a whole" does not form expectations about general price level movements. Individual agents form expectations, and they are mainly concerned, not with the behavior of the general price level per se but with that of the money prices ruling in the markets for particular goods and services. In a small open economy the behavior of the domestic currency prices for many goods and services will appear to participants in the relevant markets to be proximately determined by the behavior of thw world price of such goods, in terms of foreign currency, and the exchange rate. They may well find it easier to form their price expectations by observing these variables than by trying to forecast the general domestic price level by observing the behavior of the money supply and then trying to predict the relative price of the item with which they are particularly concerned. There is nothing a priori implausible about postulating that agents form their price expectations by looking at foreign prices and the exchange rate nor is there any reason to suppose that the average of such expectations about the rate of change of particular prices, which is what our expected rate of inflation for the economy as a whole amounts to, will in the long run be inconsistent with a domestic inflation rate determined solely by the domestic monetary expansion rate. Thus, we cannot rule out on a priori grounds the possibility that inflationary expectations in a flexible exchange rate economy are appropriately modelled as if directly influenced by the world inflation rate and the exchange rate.

For a fixed exchange rate economy we argued that a scheme which had the domestic price level expected to achieve a value compatible with balance of payments equilibrium was worthwhile analyzing. The analogue to such a scheme for a flexible rate would have the domestic price level expected to move by an amount sufficient to achieve purchasing power parity given the expected movement in the world inflation rate and the exchange rate.[10] However, equation 4a of our model tells us that purchasing power parity always rules, so that this boils down to having the expected rate of inflation equal to the sums of the expected world inflation rate and the expected change in the exchange rate. Our analysis of a fixed exchange rate regime involved a first-order error learning scheme applied to the world inflation rate, and we maintain that application here. The postulate about the generation of inflation expectations in a flexible exchange rate economy that underlies all the analysis that follows may be written

$$X = \Delta E^{e} + d\Delta\pi + (1 - d)\Delta\pi^{e}_{-1} \tag{13}$$

We will consider two alternatives to the formation of expectations about the exchange rate. First we will endow our agents with perfect foresight, so that

$$\Delta E^{e} = \Delta E_{+1} \tag{14}$$

and secondly we will consider the possibility that they error learn about its rate of change

$$\Delta E^{e} = h\Delta E + (1 - h)\Delta E^{e}_{-1} \quad . \tag{14a}$$

The perfect foresight case is particularly worth investigating because, although they are not explicitly present in our formal model, it is usually argued that the role of specialist foreign exchange dealers under flexible rates is to provide a hedge against exchange rate risk for other agents. If such dealers form even their short horizon expectations about the time path of the exchange rate rationally, and there is evidence that they do so, and if there exists a forward market in foreign exchange, then other agents can easily use the relationship between spot and forward rates to calculate at a trivial cost their own "rational" expectation about the time path of the exchange rate.[11] In a deterministic model such as we are analy ing here, rational expectations over a short, one period, horizon are equivalent to perfect foresight. In assuming perfect foresight about the exchange rate, therefore, we are postulating a state of affairs in which the most accurate information that we could conceive of as being provided by the activities of specialist dealers is available at zero cost to all agents. We are therefore setting up our model so as to rule out completely the possibility that any failings in the foreign exchange market could result in domestic problems.

With the world inflation rate and the domestic monetary expansion rates as exogenous variables, our model now consists of equations 1, 2, 4a, 13 and 14a and generates, as a reduced form for output, the following expression

$$y = (1 - d)y_{-1} + \frac{(1 - d)}{g} \Delta^2\pi . \tag{15}$$

Clearly for a steady world inflation rate our economy converges on full employment. The relationship between domestic inflation and output is given by

$$\Delta P = bdy_{-1} + \Delta M - \frac{b(1 - d)}{g} \Delta^2\pi \tag{16}$$

Obviously the rate of inflation in the steady state is given by the rate of monetary expansion, and the equilibrium rate of exchange rate change is therefore

$$\Delta E = \Delta M - \Delta\pi. \tag{17}$$

These results are easily interpreted. In the long run this economy operates with an inflation rate given by the rate of monetary expansion and the exchange rate provides complete insulation against changes in the world inflation rate. In the short run, however, matters are more complicated. Here, although variations in the rate of monetary expansion have all their effect on the inflation rate, even when output is not at its full employment level, a change in the world inflation rate does have short term repercussions both for output and the domestic inflation rate. A step up in the world inflation rate that is unforeseen, or merely underestimated, will, if it is combined with perfect foresight about the time path of the exchange rate, lead to an over-expansion of output and a temporary slowdown in the domestic inflation rate. This will be followed by a monotonic return to full employment output and a temporarily above equilibrium inflation rate.

Accurate information about the future course of the exchange rate can apparently prevent domestic monetary policy having consequences for real output, but it only insulates the economy against foreign shocks if it is accompanied by equally accurate information about the time path of foreign prices, as it is easy to show. Equation 4a tells us that perfect foresight about both the exchange rate and the foreign inflation rate are equivalent to perfect foresight about the domestic price level.

Let us now consider what happens to our model's properties when we postulate less than perfect foresight about the behavior of the exchange rate by replacing equation 14 with the error-learning scheme given by equation 14a. If we do this the reduced form of the model for output may be written

$$y = \frac{1}{b+g}\{\Delta^2 M + (h-d)\Delta^2\pi_{-1} + [(3-2d)b + (2-d-h)g]y_{-1} - [(3-2d)b + (1-d)(1-h)g]y_{-2} + (1-d)by_{-3}\} \quad (18)$$

while the output inflation relationship is given by

$$\Delta^2 P = gy - (2-d-h)gy_{-1} + (1-d)(1-h)gy_{-2} + (1-d)\Delta^2 P_{-1} - (h-d)\Delta^2\pi \quad (19)$$

Once more, the steady state value for y, for a constant rate of monetary expansion and a constant world inflation rate is zero, and it can be shown easily enough that our model always converges upon such a steady state, in which, by equation 1, the inflation rate is equal to the rate of monetary expansion.[12] In the long run, we once more have complete insulation of the economy from foreign nominal shocks. In the short run, we only have such insulation if agents learn about exchange rate changes at the same pace as they learn about changes in the foreign inflation rate. A more rapid adjustment to exchange rate changes leads to a temporary slowdown in domestic inflation and a corresponding over-expansion of output in response to a step up in the world inflation rate: this result echoes that developed above for the case of perfect foresight about the exchange rate, while its converse echoes the result we would obtain if we assumed perfect foresight about the world inflation rate, but not about the exchange rate.[13]

It is worth noting in passing that, although it is not immediately apparent from equations 18 and 19, the special case of this model in which h and d are equal is in fact equivalent to a familiar closed economy model in which inflationary expectations are formed by an error learning process applied to the domestic inflation rate. This becomes obvious when one inspects equation 4a:-- an error-learning scheme applied to either side of it will produce the same result.[14] This equivalence vanishes the moment an absorption term is included in the exchange rate equation; however the conclusion that equal but opposite errors about the world inflation rate and the rate of change of the exchange rate effectively insulate an open economy from changes in the world inflation rate survives such a modification to the model.

As it happens, there is a certain amount of evidence to suggest that the special case of this model where h and d are equal is not empirically relevant.[15] Thus, the model's properties in this case detract little from what seems to be a rather general conclusion to emerge from the analysis of this section of our paper: namely that, if, in an open economy operating a flexible exchange rate, economic agents form their expectations by taking account of the behavior of world prices and the exchange rate; and if they let those expectations influence their domestic pricing decisions, then even a completely smoothly operating exchange rate mechanism, which always maintains purchasing power parity, will still usually permit fluctuations in the world inflation rate to influence domestic variables in the short run.

V. CONCLUDING REMARKS

In this paper we have adapted a well known macroeconomic model to deal with aspects of the behavior of an open economy. In so adapting it we have highlighted the role which much recent work, both theoretical and empirical, suggests that the world price level plays in influencing domestic inflation expectations. Though it is usual to emphasize this factor in the presence of fixed exchange rates, we have argued that it is plausible that it might be at work under flexible exchange rates as well. We have then shown that, although familiar results, about a fixed exchange rate economy taking its inflation rate from the world economy and a flexible rate economy from its own rate of monetary expansion, follow as long-run predictions from our model, in the short run matters are more complex.

In the short run output can deviate from its full employment level under either exchange rate regime; domestic monetary policy can affect domestic output and inflation even under fixed rates, while under flexible rates changes in the world inflation rate can affect domestic output and inflation. It is particularly noteworthy that our results for a flexible rate economy have been produced in the presence of a foreign exchange market that always maintains purchasing power parity even in the short run, and in the absence of any interference from inappropriate speculative activity. Thus the case for the proposition that flexible rates provide insulation for a small economy against changes in the world inflation rate is weakened by our results, because the factors that are usually thought of as undermining that case are absent from our model.

The key element in all this, of course, has been the way in which we have modelled the formation of inflation expectations. As far as a fixed exchange rate economy is concerned we have both a priori and empirical reasons for supposing that our hypothesis about expectations is a relevant one. When it comes to the flexible rate case, we have empirical evidence neither for nor against the proposition that the expected inflation rate depends upon the world inflation rate and the exchange rate, rather than upon domestic variables.

We have argued only that an a priori plausible case can be made for either point of view. Since these alternative approaches to modelling expectations produce such different behavior in the model we have analyzed, empirical tests capable of discriminating between them would be well worth devising and performing.

FOOTNOTES

[1]The "price taker" assumption tends to be used in formal macro models, (cf. Johnson 1973, Parkin 1974 and Laidler 1975) while the role of expectations is stressed in empirical work on price formation. (cf. Parkin, Sumner and Ward 1976, Cross and Laidler 1976). The latter papers provide evidence for the importance of the mechanism in question.

[2]A number of workers more or less simultaneously and independently produced closed economy versions of this model. See, for example, Laidler 1973, Vanderkamp 1975, Black 1975, as far as published versions are concerned, and Dornbusch 1975 and Mussa 1975 for unpublished versions. Note that, in Laidler (1975) represents a first attempt at producing an open economy, fixed exchange rate, version of this model.

[3]No attempt is made in this paper to analyse the transition from one exchange rate regime to the other. On this issue, see Parkin 1976.

[4]Equation 1 could be replaced by a reduced form of an IS-LM type framework that would be written, with A autonomous expenditure.

$$\Delta y = \alpha(\Delta M - \Delta P) + \beta \, \Delta A$$

Moreover an expected inflation rate term can be included in such an equation without altering the model's qualitative behavior, although such an extension of the model makes its analysis more complex.

[5]It is not just destabilising speculation that can cause trouble, but any error on the part of speculators that leads them to set a disequilibrium exchange rate. cf. Dornbusch 1976.

[6]I am indebted to Joel Fried for suggesting that balance of payments equilibrium be characterized in this way.

[7]Proofs of stability of this, and other versions of the model are given in Appendix A.

[8]This model's qualitative behavior differs from that of the version presented in Laidler 1975 in one respect. In that earlier model it was possible that the impact effect of an increase in the world inflation rate might be to depress output. That result arose because such a change was permitted to affect both the money supply, and domestic price setting, in the period in which it occurred. Here, it influences only the money supply initially. This is purely a matter of a difference in the particular time structures adopted for the two models and the absence of this effect in the present case is not of significance.

Note that I have investigated the properties of the model used in this paper when the Cross-Laidler (1976) formulation of the Phillips curve is used. They do not differ in any important respect from those of this version of the model, except that, because the Cross-Laidler relationship contains no reference to relative <u>price levels</u> in forming expectations, the model always converges on full employment after a disturbance.

[9]It should go without saying that the way in which domestic monetary policy impinges upon output in the short run will depend upon the precise way in which expectations are thought to depend upon domestic variables.

[10]It is worth stating explicitly that, because the choice of units in which P and π are measured is arbitrary, the purchasing power parity under discussion here is of the relative rather than the absolute type.

[11] For empirical evidence in favour of the proposition that the processes discussed here are empirically relevant, at least in the case of the Weimar hyper-inflation, cf. Frenkel 1976.

[12] Cf. Appendix A for the proof of stability.

[13] Note that the perfect foresight case is not obtained by setting either d or h equal to unity, because X appears with a one-period time lag in the price formation equation.

[14] The reduced form of this model for income is

$$y = \frac{1}{b + g} \{\Delta^2 M_S + [2b + (1 - d)g]y_{-1} - by_{-2}\}$$

and the output inflation relationship is

$$\Delta^2 P = gy - (1 - d)gy_{-1}$$

To see the relationship between the above expressions and equations 21 and 22, take those expressions and then subtract, from each one, itself lagged one period and multiplied by (1 - d). This will yield equations 21 and 22 for the special case where h is equal to d.

[15] See Laidler (forthcoming) for some evidence on this matter.

APPENDIX A

The Stability of Various Versions of the Model

Various versions of our model yield as reduced forms for y third, second and first order difference equations. An equation of the form:

$$y = \alpha_1 y_{-1} - \alpha_2 y_{-2} + \alpha_3 y_{-3}$$

is stable if:

$$\alpha_1 - \alpha_2 + \alpha_3 < 1 \qquad \text{(I)}$$

$$-\alpha_1 - \alpha_2 - \alpha_3 < 1 \qquad \text{(II)}$$

$$|\alpha_3| < 1 \qquad \text{(III)}$$

$$\alpha_3(\alpha_3 - \alpha_1) + \alpha_2 < 1 \qquad \text{(IV)}$$

If we apply these conditions to equation (18), (II) and (III) are obviously met. (I) reduces to

$$\frac{b + g - dhg}{b + g} < 1$$

which is clearly true. (IV) reduces to

$$\frac{(b+g)^2 - g[d^2 b + g(h + d - hd)]}{(b+g)^2} < 1$$

which is also true. Thus equation (18) is stable.

Equation (11) is second order and the foregoing stability conditions, with $\alpha_3 = 0$, apply to it. (II) and (IV) are obviously met, while (I) reduces to

$$\frac{b + g + (1 - d)vng}{b + g + vng} < 1$$

which is clearly true. Thus equation (11) is stable.

Note that if an absorption term is allowed to appear in equations (4) and (4a), then the third-order system which has been analyzed here may turn out to be unstable if this term carries a coefficient that is very "large" relative to b and g. The model analysed in Laidler (1975) displayed a similar property.

Finally note that there seems nothing that can be said in general about the cyclical characteristics of either of the foregoing equations.

REFERENCES

Black, J. "A Dynamic Model of the Quantity Theory" in Parkin, J. M. and Nobay, A. R. (eds.), Current Economic Problems, Proceedings of the 1974 AUTE Conference, Cambridge, Cambridge University Press, 1975.

Cross, R. J. and Laidler, D. E. W. "Inflation, Excess Demand and Expectations in Fixed Exchange Rate Open Economies: Some Preliminary Empirical Results" in Parkin J. M. and Zis, G. (eds.), Inflation in the World Economy, Manchester, Manchester University Press, 1976.

Dornbusch, R. "Lecture Notes in Macroeconomics, Part V, Inflation and Employment," University of Chicago (mimeo), 1975.

________. "The Theory of Flexible Exchange Rates and Macroeconomic Policy," Scandinavian Journal of Economics 78 (2), 1976, pp. 255-275.

Frenkel, J. "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence," Scandinavian Journal of Economics 78 (2), 1976, pp. 200-224.

Johnson, H. G. "The Monetary Approach to Balance of Payments Theory" in Further Essays in Monetary Economics, London, Allen and Unwin, 1973.

Laidler, D. E. W. "The Influence of Money on Real Income and Inflation - A Simple Model With Some Empirical Evidence for the United States 1963-72"; Manchester School 41, December 1973, pp. 367-395. Ch. 7 of Essays in Money and Inflation, Manchester and Chicago, Manchester University Press and University of Chicago Press, 1975.

Laidler, D. E. W. "Price and Output Fluctuations in an Open Economy" Ch. 9 of Essays on Money and Inflation, Manchester and Chicago, Manchester University Press and University of Chicago Press, 1975.

________. "Alternative Explanations of and Policies Towards Inflation in Six Countries." Forthcoming in Brunner, K. and Meltzer, A. H., Proceedings of the Spring 1975 Carnegie-Mellon-Rochester Conference on Economic Policy, Supplement to the Journal of Monetary Economics.

Mussa, M. "Inflation, Recession and Stagflation in a Simple Macroeconomic Model," University of Rochester (mimeo), 1975.

Parkin, J. M. "Inflation, the Balance of Payments, Domestic Credit Expansion, and Exchange Rate Adjustments" in Aliber, R. Z., National Monetary Policies and the International Financial System, Chicago, University of Chicago Press, 1974.

________. "The Transition from Fixed Exchange Rates to Money Supply Targets," Journal of Money, Credit and Banking (forthcoming).

________, Sumner, M. T. and Ward, R. J. "The Effects of Excess Demand, Generalised Expectations and Wage-Price Controls on Wage Inflation in the U.K." in Brunner, K. and Meltzer, A. H. (eds.), Proceedings of the 1974 Rochester Conference on Wage Price Controls Supplement to the Journal of Monetary Economics, 1976.

Vanderkamp, J. "Inflation: A Simple Friedman Theory with a Phillips Twist," Journal of Monetary Economics 1 (1), 1975, pp. 117-22.