

1978

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Citation of this paper:

Burton, David. "Expectations and a Small Flexible Exchange Rate Open Economy." Department of Economics Research Reports, 7819. London, ON: Department of Economics, University of Western Ontario (1978).

2069

RESEARCH REPORT 7819
EXPECTATIONS AND A SMALL FLEXIBLE
EXCHANGE RATE OPEN ECONOMY

by

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May, 1978

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I wish to thank Geoffrey Kingston, David Laidler and Michael Parkin for numerous helpful comments on an earlier draft of the paper. The financial assistance of the Canada Council is also gratefully acknowledged.

Burton, D.--"Expectations and a Small Flexible Exchange Rate Open Economy"

ABSTRACT

The paper examines the effects of domestic policy and foreign shocks on a small flexible exchange rate open economy. When information about the exchange rate is available sooner than other variables in the system, an increase in government expenditure or the money stock may cause a reduction in output, if expectations are formed adaptively. When expectations are rational, single deviations of actual from expected values of exogenous variables cannot occur; rather such deviations must be in combinations which satisfy a linear constraint. In both cases output is not insulated from unexpected changes in the world price level.

I. INTRODUCTION

The paper develops a simple model of a small open economy with a flexible exchange rate. It is in many respects the perfect capital mobility counterpart of the zero mobility model of Laidler (1977) and is similar in structure to models by Dornbusch (1976) and Parkin (1977). In the context of the model the effects of monetary and fiscal policy and real and nominal shocks arising abroad are analyzed under two assumptions about the way expectations of prices and the exchange rate are formed. The sensitivity of these results to the information available when expectations are formed is also examined.¹

The hypotheses about expectations considered are: (1) that they are based solely on the series of past values of the variable in question and for simplicity it is assumed that they are formed by a first-order error-learning process; and (2) that they are formed rationally. Under the first hypothesis, expectations do not respond directly to actual and expected policy changes. In contrast, if expectations of future values of endogenous variables are formed rationally, they depend on all future values of exogenous variables in a way which takes into account the structure of the model. Consequently, expected changes in exogenous variables have a direct impact on nominal variables in the system. This offers an explanation of the sensitivity of exchange rates to policy announcements and rumors.

Attention is also focussed on the information available to economic agents when they form their expectations. In particular, the implications of information about the exchange rate being available sooner than either information on domestic and world price indices and domestic policy variables are considered. When expectations are formed adaptively this asymmetry in information introduces the possibility that an increase in government expenditure,

or the rate of monetary expansion, may have a perverse effect on output. In the rational expectations case, it imposes the restriction that the expected values of exogenous variables on which the expectations of the current price of the home good are based, are consistent with the actual value of the exchange rate. This implies that a deviation of only one exogenous variable from its expected value cannot occur, and that such deviations must be in combinations which satisfy a linear constraint. In both the rational and adaptive expectations cases this difference in information has important implications for the degree to which the economy is insulated from changes in the world inflation rate.

Section II sets out the model and the assumptions underlying its structure are discussed. In Sections III and IV the effects of policy and other shocks in the adaptive and rational expectations cases, respectively, are analyzed. Finally, in Section V the behavior of the exchange rate in response to an expansion in the money supply, when expectations are rational, is contrasted with the exchange rate dynamics of Dornbusch (1976).

II. THE MODEL

The model is set in discrete time and beginning-of-period asset equilibrium is assumed.² There are two goods, one produced domestically and one foreign produced, both of which are traded and which are imperfect substitutes.³ The home country is small in the market for foreign goods and is a price taker. There are two assets: money and bonds, and perfect capital mobility is assumed, so that domestic and foreign bonds are perfect substitutes. In addition, the home country is assumed to be small in relation to the world bond market and so takes the world nominal interest rate as given. In contrast, there is zero currency substitution.

The equations of the model, leaving aside for the time being the question of the way expectations are formed, are listed below. All variables are in natural logarithms, except where indicated, so that first differences of variables, denoted by Δ , are an approximation to proportional rates of change in their levels. Variables with both a subscript and a superscript are expected rather than actual values; the subscript indicates the date at which the expectation is formed and the superscript the number of periods between the date of formation and the period for which it is formed. For example, P_{t-1}^2 is the expectation of P formed at the end of period $t-1$, for period $t+1$.

$$y_t = \frac{1}{a}(P_t - P_{t-1}^1) \quad a > 0 \quad (2.1)$$

$$y_t = X_t - f(P_t - E_t - \pi_t) - g[r_t - (P_{t-1}^2 - P_{t-1}^1)] \quad f, g > 0 \quad (2.2)$$

$$r_t = i_t + (\pi_{t-1}^2 - \pi_{t-1}^1) + (E_{t-1}^2 - E_t) \quad (2.3)$$

$$M_t = A + b(Y_t^* + y_t) + P_{It} - cr_t \quad b, c > 0 \quad (2.4)$$

$$P_{It} = zP_t + (1 - z)(\pi_t + E_t) \quad 0 < z < 1 \quad (2.5)$$

where: M = the nominal money stock; $y = Y - Y^*$, Y = the level of income and Y^* = the full employment level of income; P = the price index for domestically produced goods; π = the price index for foreign produced goods; P_I = the domestic price index; E = the domestic price of foreign currency; r = the domestic nominal interest rate; i = the world real interest rate; X is a composite variable whose nature is explained below; and A is a constant.

Equation (2.1) is an expectations augmented Phillips curve which embodies the natural rate hypothesis. The interpretation of this relationship

adopted here is that of an aggregate supply relationship of the Lucas (1973) variety. According to this story, firms obtain information about the price of their product faster than they obtain information about prices in general. In particular, at time t , firms know the price of their own product but do not have information on the price level and have to base decisions on an expectation formed at the end of the previous period. An unexpected increase in the price index of domestic goods is interpreted by firms as a rise in the relative price of their own good and results in an increase in supply.

Equation (2.2) is a log linear IS curve, in which demand for the domestic good depends on real income in terms of the domestic good, the expected real interest rate and the relative price of the domestic and foreign goods.⁴ The constant X includes fiscal policy variables as well as a shift parameter for world demand for the home good: an increase in X may be interpreted as a rise in government expenditure, a reduction in taxation or an increase in world demand.⁵ Consistent with the formulation of the aggregate supply relationship, it is assumed that agents do not know the current price index and have to base decisions on its expectation formed at the end of the previous period; hence P_{t-1}^1 rather than P_t appears in the expected real interest rate term. Actual relative prices, however, influence current consumption decisions, since economic agents are assumed to instantly perceive relative price changes of the goods they consume.

Equation (2.3) embodies the assumption of perfect capital mobility, so that international arbitrage maintains the domestic nominal interest rate equal to the world nominal rate plus the expected change in the exchange rate. It is assumed that agents obtain knowledge of the price index of foreign as well as of domestically produced goods with a one-period lag and so the expectations of the foreign price index formed at the end of the previous

period appear in (2.3). The exchange rate, however, is a single price, information about which can be obtained instantly at almost zero cost and so it seems reasonable to include its actual rather than expected value in (2.3). If information about the exchange rate is available instantly, however, its current value should be included in the information set on which expectations are based. For example, this implies that the expectation of the current price of the domestic good, P_{t-1}^1 , is based on information available at the end of period $t-1$, together with E_t . The implications of the difference in information about the exchange rate and price indices are explored in Sections III and IV. Equation (2.4) is a conventional demand for money function, which incorporates the assumption that monetary equilibrium is maintained continuously.⁶ The money supply is given by the well-known accounting identity in which the monetary base is equal to domestic credit plus foreign exchange reserves. Under a flexible exchange rate regime the exchange rate adjusts to hold foreign exchange reserves constant and changes in the domestic money stock result only from changes in domestic credit. Equation (2.5) is a log-linearized domestic price index.

Finally, the government's budget constraint is implicit in the model since perfect capital mobility allows the assumption that the portion of the government's budget deficit not financed by money creation is financed by sales of bonds.

III. ADAPTIVE EXPECTATIONS

In this section we look at the impact effects of domestic and foreign shocks in the case where the information on which expectations of the price of the home good and the exchange rate consists only of the single series of their respective past values. For simplicity it is assumed that

expectations about rates of change of these variables are formed by a first-order error-learning process. It is also assumed that expectations about the world price level are governed by the same mechanism. Given this particular assumption about expectations it seems sensible, when looking at the long-run properties of the model, to follow the suggestion of Laidler (1977) and conduct only policy experiments for which expectations exhibit long-run rationality. For example, in this case it is legitimate, provided the system is stable, to examine the long-run consequences of an increase in world inflation from one constant rate to another.

The structural equations of the model embody the assumption that information about the domestic and world price indices is available with a one period lag, whereas knowledge of the exchange rate is obtained instantly. In order to investigate the consequences of this asymmetry in information, we consider first the case where information about all three variables is available with a one period lag.

Under this assumption the impact on first period effects of changes in exogenous variables on the level of income are independent of the way expectations are formed and are as follows,

$$\frac{\Delta y}{\Delta^2 M} = \frac{f}{(1 - z) + f(a + b)} \quad (3.1)$$

$$\frac{\Delta y}{\Delta i} = \frac{cf - g(1 - z)}{(1 - z) + f(a + b)} \quad (3.2)$$

$$\frac{\Delta y}{\Delta X} = \frac{(1 - z)}{(1 - z) + f(a + b)} \quad (3.3)$$

$$\frac{\Delta y}{\Delta^2 \pi} = 0 \quad (3.4)$$

The impact of a change in any exogenous variable depends on the creation of an unanticipated change in the price of the domestic good. Thus the effect of an increase in the rate of monetary expansion is positive, because maintenance of monetary equilibrium requires a rise in the rate of inflation of the domestic good. From (3.2) it follows that the first period effect of a rise in the world real rate of interest is positive if,

$$cf > g(1 - z) \quad (3.5)$$

which holds when its effect via the demand for money, which tends to increase the price of the domestic good, outweighs that via aggregate demand which acts in the opposite direction.

The first period effect of a rise in the world inflation rate is zero, because it is exactly offset by an increase in the rate of appreciation of the exchange rate. The second period outcome is contingent on the way expectations about world inflation and the exchange rate respond to their offsetting first period changes. When these expectations are formed adaptively and given by

$$E_{t-1}^2 - E_{t-1}^1 = e(E_{t-1} - E_{t-2}) + (1 - e)(E_{t-2}^1 - E_{t-2}) \quad (3.6)$$

and

$$\pi_{t-1}^2 - \pi_{t-1}^1 = d(\pi_{t-1} - \pi_{t-2}) + (1 - d)(\pi_{t-2}^1 - \pi_{t-2}) , \quad (3.7)$$

the second period effect of an increase in the world inflation rate is

$$\frac{\Delta y}{\Delta \pi} = \frac{-(1 - z)g(d - e) + fc(d - e)}{(1 - z) + f(a + b)} , \quad (3.8)$$

which is non-zero if $d \neq e$.

Consider the case where $d > e$, so that the expected world inflation rate adjusts by more than the expected change in the exchange rate. This implies that in the second period the nominal interest rate rises and the effect on the level of income therefore depends on condition (3.5).

The impact multipliers for the exchange rate take on their expected signs and are as follows:

$$\frac{\Delta^2 E}{\Delta^2 M} = \frac{1 + af}{(1 - z) + f(a + b)} > 0 \quad (3.9)$$

$$\frac{\Delta^2 E}{\Delta X} = \frac{-(az + b)}{(1 - z) + f(a + b)} < 0 \quad (3.10)$$

$$\frac{\Delta^2 E}{\Delta i} = \frac{g(az + b) + c(1 + af)}{(1 - z) + f(a + b)} > 0 \quad (3.11)$$

$$\frac{\Delta^2 E}{\Delta^2 \pi} = -1 \quad (3.12)$$

The above results are now compared with those derived under the alternative assumption that information about the exchange rate is obtained instantly rather than with a one period lag. The relevant expected rate of change in the exchange rate is therefore,

$$E_t^1 - E_t = h(E_t - E_{t-1}) + (1 - h)(E_{t-1}^1 - E_{t-1}) \quad 0 < h < 1 \quad (3.7a)$$

and the coefficient, h , enters into the determination of the impact multipliers.

The first period effects of changes in exogenous variables are,

$$\frac{\Delta y}{\Delta^2 M} = \frac{f - gh}{D} \quad (3.1a)$$

$$\frac{\Delta y}{\Delta i} = \frac{cf - g(1 - z)}{D} \quad (3.2a)$$

$$\frac{\Delta y}{\Delta X} = \frac{1 - z - ch}{D} \quad (3.3a)$$

$$\frac{\Delta y}{\Delta^2 \pi} = \frac{h[g(1 - z) - fc]}{D} \quad (3.4a)$$

$$\frac{\Delta^2 E}{\Delta^2 M} = \frac{1 + af}{D} \quad (3.9a)$$

$$\frac{\Delta^2 E}{\Delta X} = \frac{-(az + b)}{D} \quad (3.10a)$$

$$\frac{\Delta^2 E}{\Delta i} = \frac{g(az + b) + c(1 + af)}{D} \quad (3.11a)$$

$$\frac{\Delta^2 E}{\Delta^2 \pi} = \frac{-(1 - z) + f(a + b)}{D} \quad (3.12a)$$

$$D = (1 - z - ch) + f(a + b) - gh(b + az) - afch$$

The sign of D is ambiguous and so are the signs of all the impact multipliers. The root cause of this ambiguity is: that changes in ΔE now affect the expected rate of change of the exchange rate instantly, whereas changes in $\Delta \pi$ and ΔP affect their corresponding expected values with a one-period lag. It follows that all shocks to the system change the nominal and expected real rates of interest in the same direction, because of their effect on ΔE . The combined result of changes in these two rates of interest is ambiguous, however, since the effect of the former via the demand for money and the latter's direct impact on expenditure act in different directions on the price of the domestic good and hence on output. For example, a rise in the rate of increase of the money stock may now cause a fall in the level of output. For ease of exposition it is assumed that the economy is initially in a steady state, in which the rates of change of P , π , M and E are all equal to zero. In the case in which output falls, an expansion of the money supply causes an increase in the consumer price index and a depreciation of the exchange rate. The latter results in an increase in the nominal interest rate, which both reduces the demand for money and cuts back demand for the domestic good. The reduction in demand for the home good requires a fall in its relative price; and if this effect is strong and the effect on the demand for money of the rise in the nominal rate is small, this may lead to a reduction in the price and hence output of the domestic good. It is also the case that the domestic economy is no longer insulated from nominal shocks arising abroad (3.4a), even

if world inflation and exchange rate expectations adapt with the same coefficient. This again stems from the asymmetric effect of changes in the exchange rate and world prices on their respective future expected values.

As far as the long run is concerned, provided the policy experiments conducted satisfy the criterion of long run rationality suggested above,⁷ the properties of the system under both assumptions about information are as follows: output is at its full employment level; the domestic inflation rate is equal to the rate of monetary expansion; and the rate of change of the exchange rate is equal to the difference between the rates of change of domestic and foreign price levels.

IV. RATIONAL EXPECTATIONS

Attention is now turned to the version of the model where it is assumed that expectations are formed rationally. This implies that the expectation of the value of an endogenous variable in some period $t+i$, formed at time t , is its mathematical expectation at t , given the model and the information available at t . For simplicity, the model does not have a stochastic structure, although the inclusion of error terms into the structural equations would merely introduce an error term--a weighted average of the structural form errors--into the reduced-form equations. The evolution of each exogenous variable is assumed to be a random process, the exact nature of which is not important for the results derived below.

The case in which information about the exchange rate is obtained instantly is now considered. For simplicity it is first assumed that the expectation of the exchange rate in period $t-1$ is based only on information available at the end of period $t-1$: E_t is excluded from the information set. The implications of introducing the current value of the exchange rate,

E_t , into the information set, however, are discussed below. Combining equations (2.1) to (2.5) yields the following reduced forms for the price of the domestic good and the exchange rate,

$$P_t = \alpha P_{t-1}^1 + \beta P_{t-1}^2 - \delta E_{t-1}^2 + \gamma V_t \quad (4.1)$$

$$E_t = \phi P_{t-1}^1 - \chi P_{t-1}^2 + \rho E_{t-1}^2 + W V_t \quad (4.2)$$

where the coefficients are given in Appendix A.

Shifting (4.1) and (4.2) forward k periods and taking conditional expectations at time t , we can derive expressions for P_t^k and E_t^k , (4.3) and (4.4), which are second-order non-homogeneous difference equations in the superscripts.

$$P_t^k = P_t^{k+1} \frac{(1 + \beta - \alpha\rho - \delta\phi)}{1 - \alpha} + P_t^{k+2} \frac{(\delta\chi - \beta\rho)}{1 - \alpha} + \frac{\gamma}{1 - \alpha} V_t^k - \frac{(\delta W + \beta\gamma)}{1 - \alpha} V_t^{k+1} \quad (4.3)$$

$$E_t^k = E_t^{k+1} = \frac{(\beta - \phi + \rho(1 - \alpha))}{1 - \alpha} + E_t^{k+2} \frac{(\chi\delta - \beta\delta)}{1 - \alpha} + \frac{(W(1 - \alpha) + \phi\gamma)}{1 - \alpha} V_t^k - \frac{(W\beta + \chi\gamma)}{1 - \alpha} V_t^{k+1} \quad (4.4)$$

The forward looking solutions to (4.3) and (4.4) are given by (4.5) and (4.6) respectively,

$$P_t^k = \left[1 - \frac{(1 + \beta - \alpha\rho - \delta\phi)}{1 - \alpha} F - \frac{(\delta\chi - \beta\rho)}{1 - \alpha} F^2 \right]^{-1} \left[\frac{\gamma}{1 - \alpha} V_t^k - \frac{(\delta W + \beta\gamma)}{1 - \alpha} V_t^{k+1} \right] \quad (4.5)$$

$$E_t^k = \left[1 - \frac{(\beta - \phi + \rho(1 - \alpha))}{1 - \alpha} F - \frac{(\chi\delta - \beta\delta)}{1 - \alpha} F^2 \right]^{-1} \left[\frac{(W(1 - \alpha) + \phi\gamma)}{1 - \alpha} V_t^k - \frac{(W\beta + \chi\gamma)}{1 - \alpha} V_t^{k+1} \right] \quad (4.6)$$

where F is the forward shift operator in the superscripts. The general solution to the homogeneous equation disappears from the solution to the complete equation, when we impose the terminal condition that P_t^k is bounded.⁸

Equations (4.5) and (4.6) imply that expected future values of the price of domestic goods and the exchange rate, and from (4.1) and (4.2) also their current values, depend on all future expected values of the exogenous variables. In particular, this offers an explanation of the sensitivity of exchange rates to information about the future course of government policy.

The expression for domestic output is,

$$y_t = \frac{\gamma}{a} (v_t - v_{t-1}^1) \quad , \quad (4.7)$$

in which deviations from full employment output only occur when actual and expected values of exogenous variables differ. The multipliers on deviations from expected values of the world price level and the world real interest rate, are the same and given by (4.8); and those attached to deviations of the money stock and the composite variable X from their expected values, by (4.9) and (4.10) respectively,

$$\frac{fc - g(1 - z)}{D_1} > 0 \quad , \quad \text{iff } fc > g(1 - z) \quad (4.8)$$

$$\frac{f + g}{D_1} > 0 \quad (4.9)$$

$$\frac{1 - z + c}{D_1} > 0 \quad . \quad (4.10)$$

These multipliers differ from the impact multipliers (3.1a) to (3.4a), derived from the equivalent adaptive expectations version of the model. This stems from the difference in the way unexpected changes in the exchange rate affect the rational and adaptive expectations models. In the latter, an increase in the rate of change of the exchange rate causes a rise in the nominal

interest rate. In contrast, in the rational expectations case, unexpected values for the exogenous variables which cause the exchange rate to be above the value consistent with the expected values of the exogenous variables, also cause a fall in the nominal interest rate. It is this difference which removes the ambiguity in the sign of the impact multipliers. For example, consider the case of an unexpected increase in the money supply. This results in an unexpected increase in the domestic price index, part of which is contributed by a rise in the exchange rate. The corresponding interest rate effect serves to increase demand for the domestic good, which rules out the possibility that its price falls below its expected value and thus guarantees an increase in output. It also implies that the domestic economy is not insulated from the effects of an unexpected increase in the world inflation rate.

The problem with the above analysis is that agents are being allowed to ignore the information contained in the current value of the exchange rate. They can form an expectation of E_t at the end of period $t-1$, E_{t-1}^1 , based on the same information as their expectation of the domestic price index, P_{t-1}^1 . In cases where actual and expected values of exogenous variables differ, E_t also differs from E_{t-1}^1 . But in the results discussed above, it is assumed that either this discrepancy passes unnoticed, or that agents do not revise other expectations when it is discovered.

If we include E_t in the information set on which expectations are founded, this places the restriction on expected values of the current exogenous variables that they satisfy the condition, $E_t = E_{t-1}^1$. From equation (4.2), this implies,

$$WV_{t-1}^1 = WV_t, \quad (4.11)$$

so that the expected values of exogenous variables lie on a hyperplane defined by V_t and the parameters of W . If we impose the further restriction

that the actual and expected world real interest rates are equal, which can be justified on the grounds that it is part of the instantly observable world nominal interest rate, then X_{t-1}^1 , M_{t-1}^1 and π_{t-1}^1 lie on a plane described by X_t, π_t, V_t and the corresponding parameters in W . This means, for example, if the actual and expected values of the money supply differ, there must be an offsetting linear combination of discrepancies of actual and expected values of X and π such that (4.11) is satisfied.

This does not rule out, of course, the possibility of a discrepancy between actual and expected values of the price of the domestic good, and hence of a deviation of output from its natural rate. The expected values of exogenous variables for which $P_t = P_{t-1}^1$ lie on the plane given by,

$$\gamma V_{t-1}^1 = \gamma V_t \quad (4.12)$$

The planes of (4.11) and (4.12) intersect on a line along which the expected and actual values of the exogenous variables are equal. At other points on the plane, (4.11), $P_t \neq P_{t-1}^1$ and output differs from its full employment level.

It follows that it is no longer relevant to consider impact multipliers which relate to the deviation of a single exogenous variable from its expected value. Instead, the relevant multipliers are those for combinations of such deviations which satisfy (4.11). This leaves unanswered however the question of which combination of exogenous variables agents will choose. The criterion suggested here is that agents choose values which maximize the joint probability density function of the exogenous variables subject to the constraint (4.11).

Consider the simple case where the random variables π_t , M_t and X_t , henceforth V_{1t} , V_{2t} and V_{3t} , are given by

$$V_{it} = \bar{V}_{it} + U_{it}, \quad i = 1, \dots, 3 \quad (4.13)$$

where the U_{it} are independent and normally distributed with zero means and variance σ_i^2 . The logarithm of their joint density function is therefore,

$$\sum_{i=1}^3 \log f_i(V_i^e) \quad (4.14)$$

where $V_i^e \equiv V_{it-1}^1$ and $f_i(V_i)$ is the density function of the normal distribution with mean \bar{V}_i and variance σ_i^2 . In the absence of the information contained in the current value of the exchange rate, this is maximized when $V_i^e = \bar{V}_i$, for all i . Knowledge of the current value of the exchange rate, however, implies the constraint (4.11), which we rewrite as,

$$\sum_{i=1}^3 w_i V_i^e = \sum_{i=3}^3 w_i V_i = K \quad (4.15)$$

And according to the criterion suggested above, agents maximize the Lagrangian

$$L = \sum_{i=1}^3 \log f_i(V_i^e) - \lambda \left[\sum_{i=1}^3 w_i V_i^e - K \right] \quad (4.16)$$

for which the first-order conditions are,

$$\frac{2(V_i^e - \bar{V}_i)}{\sigma_i^2} - \lambda w_i = 0, \quad i = 1, \dots, 3 \quad (4.17)$$

$$\sum_{i=1}^3 w_i V_i^e = K \quad (4.18)$$

Equations (4.17) provide the condition,

$$\frac{(V_i^e - \bar{V}_i)}{(V_j^e - \bar{V}_j)} = \frac{\sigma_i^2 w_i}{\sigma_j^2 w_j} \quad (4.19)$$

which says that the ratio of the deviations of expected values of any two exogenous variables from their means is equal to the weighted ratio of their variances, where the weights are the coefficients with which the variables

affect the exchange rate. So given the weights, the higher the variance of an exogenous variable the greater the deviation of its expected value from its mean. Equations (4.17) and (4.18) can be solved to yield explicit solutions for V_i^e .

Finally, under the alternative assumption that information about the exchange rate is obtained with a one period lag, the impact multipliers on deviations of M , X and π from their expected values are given by (3.1), (3.3) and (3.4) respectively, from the equivalent adaptive expectations version of the model. In particular, (3.4) implies that the economy is insulated from unexpected as well as expected changes in the world price level.

V. EXCHANGE RATE DYNAMICS

In this section the implications of the rational expectations version of the model for exchange rate behavior are contrasted with the exchange rate dynamics of Dornbusch (1976). The result in Dornbusch which has been the object of some attention is: an increase in the money supply, which is expected to persist, results in a rise in output⁹ and an increase in the exchange rate to a value which may be above or below its equilibrium level. The exchange rate then converges smoothly to its long-run equilibrium value as the price of the domestic good, in response to an excess of output over its full employment level, also converges to its new long-run equilibrium value. This result holds even when expectations are formed rationally.

In the model in this paper, when expectations are formed rationally, an expected increase in the money supply, which is expected to persist, has no effect on output; and if its announcement and implementation take place simultaneously, the exchange rate and price level move at once to their long-run equilibrium levels. An unexpected increase in the money supply¹⁰

results in a rise in output and an increase in the exchange rate to a value which may be above or below its long-run equilibrium one: a result which is identical to the impact effect in Dornbusch. However, once the change in monetary policy is discovered both the exchange rate and the price level adjust at once to their new equilibrium values.

The Dornbusch model and the one in this paper are similar in structure and both assume perfect capital mobility. There are, however, a number of differences. The first and crucial one is that Dornbusch incorporates a simple Phillip's curve, or price adjustment equation, into his model rather than the expectations augmented variant, equation (2.1), in this paper. The assumption, therefore, is that either the expected inflation rate is always zero, and hence is formed anything but rationally, or that it plays no role in price determination. Second, and consistent with this, the nominal rather than expected real interest rate appears in the aggregate demand equation. Third, Dornbusch initially assumes that the expected rate of change of the exchange rate is proportional to the difference between its actual and long-run equilibrium values. He later shows that there is a value of the constant of proportionality, which is a function of the parameters of the model, such that the realized and expected changes in the exchange rate are the same, so that expectations are rational. This, however, ignores the implications for the exchange rate expectations of expected future changes in the money stock. Finally, the price of the home good rather than the domestic price index is included in the demand for money function.

We are now in a position to explain Dornbusch's exchange rate dynamics. At the instant the increase in the money supply occurs the price of the home good, henceforth the price level, is fixed, although the long-run equilibrium values of both the price level and the exchange rate are

raised. Maintenance of equilibrium in the money market is, therefore, thrown on the exchange rate, which rises causing an increase in the level of income via its effect on aggregate demand. Whether the exchange rate increases to a value above or below its long-run equilibrium level (and hence whether or not the nominal interest rate falls or rises) depends on the strength of the effect of the increase in income on the demand for money. The exchange rate and the price level then adjust smoothly to their long-run equilibrium values as the latter responds to the increase in output above its full employment level.

As suggested above, the feature of Dornbusch's model which explains the difference between the above exchange rate dynamics and those implied by the model in this paper, is the absence of the expected inflation rate from the price adjustment equation. It is the exclusion of this variable which prevents prices from adjusting directly to known and expected changes in the money supply when expectations are formed rationally.

VI. CONCLUSIONS

In this paper the effects of domestic policy and shocks arising in the rest of the world on a simple model of small flexible exchange rate open economy have been analyzed under different assumptions about expectations formation. When expectations are rational the expected and current values of both prices and the exchange rate depend on all future values of exogenous variables. This offers an explanation of the sensitivity of the exchange rate to information about future government policy. It also implies that the level of income responds only to unexpected policy measures.

The results under both rational and adaptive expectations are sensitive to the information available to decision makers. If the exchange rate

is known instantly the impact multipliers differ substantially from the case where information about the exchange rate, like information about domestic and foreign price indices, is available with a one-period lag. In particular, when expectations are formed adaptively, the possibility of an increase in the rate of monetary expansion and an increase in government expenditure having perverse effects on output in the short run is introduced. And in the case where expectations are rational, deviations of actual from expected values of exogenous variables must satisfy a linear constraint; and it is suggested that agents choose those values which maximize the joint probability density function of the exogenous variables subject to this constraint. It is also the case that domestic output is no longer insulated from the effects of an unexpected rise in the world inflation rate.

REFERENCES

- Barro, R. J., "A Stochastic Equilibrium Model of an Open Economy Under Flexible Exchange Rates," Quarterly Journal of Economics, vol. XCII (February 1978): 149-164.
- Boyer, R. S., "Commodity Markets and Bond Markets in a Small Fixed Exchange Rate Economy," Canadian Journal of Economics, vol. 8, no. 1 (February 1975): 1-23.
- _____, "Devaluation and Portfolio Balance," American Economic Review, vol. 67, no. 2 (February 1977): 54-63.
- Buiter, W. H. and Woglom, G., "On Two Specifications of Asset Equilibrium in Macroeconomic Models: A Note," Journal of Political Economy, vol. 85, no. 2 (April 1977): 395-400.
- Dornbusch, R., "Devaluation Money and Non-Traded Goods," American Economic Review, vol. 63 (December 1973): 871-880.
- _____, "A Portfolio Balance Model of an Open Economy," Journal of Monetary Economics, vol. 1, no. 1 (January 1975): 3-20.
- _____, "Expectations and Exchange Rate Dynamics," Journal of Political Economy, vol. 84, no. 6 (December 1976): 1161-1176.
- Foley, D. K., "On Two Specifications of Asset Equilibrium in Macroeconomic Models," Journal of Political Economy, vol. 83, no. 2 (April 1975): 303-324.
- Jonson, P. D., "Money and Economic Activity in the Open Economy: The United Kingdom, 1880-1970," Journal of Political Economy, vol. 84, no. 5 (October 1976): 979-1012.
- Kingston, G. H. and Turnovsky, S. J., "A Small Economy in an Inflationary World: Monetary and Fiscal Policies Under Fixed Exchange Rates," Economic Journal, vol. 88 (March 1978): 18-43.

- Laidler, D., "Expectations and the Behavior of Prices and Output Under Flexible Exchange Rates," Economica 44 (November 1977): 327-336.
- Lucas, R. E., "Some International Evidence on Output-Inflation Tradeoffs," American Economic Review, vol. 63 (June 1973): 326-334.
- Parkin, J. M., "The Transition from Fixed Exchange Rates to Money Supply Targets," Journal of Money, Credit and Banking, vol. 9, no. 1 (February 1977): 228-242.
- Sargent, T. J. and Wallace, N., "The Stability of Models of Money and Growth with Perfect Foresight," Econometrica, vol. 41, no. 6 (November 1973): 1043-1048.
- Shiller, R. J., "Rational Expectations and the Dynamic Structure of Macroeconomic Models: A Critical Review," Journal of Monetary Economics, vol. 4, no. 1 (January 1978): 1-44.

FOOTNOTES

¹The question of information available to decision makers in a rational expectations open economy setting is also considered by Barro (1978).

²For a discussion of the distinctions between beginning and end-of-period asset equilibrium in discrete time models, see Foley (1975) and Buiter and Woglom (1977).

³This disaggregation rather than into a traded and non-traded good, both produced by the home country, is chosen because it makes fluctuations in output easier to model. The drawback is that it rules out consideration of the effects of domestic and foreign shocks on the pattern of domestic production. For examples of this alternative disaggregation, see Boyer (1975, 1977) and Dornbusch (1973, 1975).

⁴The exclusion of a wealth term rules out the wealth effects which play a central role in the portfolio balance models of Boyer (1975, 1977), Dornbusch (1973, 1975) and in Jonson's (1977) model of the UK economy.

⁵Implicit in (1.2) is a disposable income term which takes into account taxation in terms of the domestic good. A fuller specification would include interest payments on holdings of bonds and the expected effect of inflation on money balances. For an example of this, see Kingston and Turnovsky (1978).

⁶The beginning-of-period wealth constraint which binds portfolio selection allows the bond market to be dropped from the analysis.

⁷No meaningful condition for stability has been derived for either case.

⁸It can be shown that if equations (4.3) and (4.4) are stable, given that the sequence of expected values of exogenous variables are bounded, the arbitrary constraints in the general solutions to these equations must be zero. The conditions for stability, however, have no simple interpretation.

⁹Dornbusch analyzes both a fixed and a variable output version of his model. Attention here is confined to the flexible output case. In the fixed output version an increase in the money supply unambiguously causes the exchange rate to overshoot its long-run equilibrium value.

¹⁰This applies only to cases where it is appropriate to consider the effect of an unexpected change in a single exogenous variable.

APPENDIX A

$$\alpha = \frac{b(f + g) + (1 - z + c)(1 - ga)}{D_1}$$

$$\beta = \frac{ga(1 - z + c)}{D_1}$$

$$\delta = \frac{ga(1 - z) - fac}{D_1}$$

$$\phi = \frac{g(az + b) - (z - bf)}{D_1}$$

$$\chi = \frac{az + b}{D_1}$$

$$\rho = \frac{g(az + b) + c(1 + af)}{D_1}$$

$$\gamma' = \begin{bmatrix} \frac{fac - ga(1 - z)}{n_1} \\ -\frac{(fac - ga(1 - z))}{D_1} \\ \frac{fac - ga(1 - z)}{D_1} \\ \frac{fac - ga(1 - z)}{D_1} \\ \frac{a(f + g)}{D_1} \\ \frac{a(1 - z + c)}{D_1} \end{bmatrix}$$

$$W' = \begin{bmatrix} \frac{(1 - z) + f(a + b)}{D_1} \\ \frac{-g(az + b) - c(1 + af)}{D_1} \\ \frac{g(az + b) + c(1 + af)}{D_1} \\ \frac{g(az + b) + c(1 + af)}{D_1} \\ \frac{1 + af}{D_1} \\ \frac{-az + b}{D_1} \end{bmatrix}$$

$$V_t = \begin{bmatrix} \pi_t \\ \pi_{t-1}^1 \\ \pi_{t-1}^2 \\ i_t \\ M_t \\ X_t \end{bmatrix}$$

$$D_1 = (1 - z + c) + f(a + b) + fac + g(b + az) > 0$$