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An Empirical Investigation into the Causes of the Failure of the Monetary Model of the Exchange Rate*

ABSTRACT

A well known characteristic of flexible exchange rates is their volatility, with result that their movement can be closely approximated by a random walk. One of the attractions of the monetary model of the exchange rate is its ability to offer an explanation of this volatility. A major drawback is that empirical tests of the exchange rate equation arising from the monetary model very often lead to rejection of the model. The blame for this is usually attributed to the breakdown of the purchasing power parity assumption.

The main purpose of this paper is to attempt to provide measures of the relative importance of the likely principal causes of the failure of the monetary model. A second objective is to test the random walk hypothesis for exchange rates. The methodology employed is new and has wide application elsewhere. It involves explicitly modelling the misspecification by time series techniques. The results, which are for the sterling-US Dollar and Deutschemark-US Dollar exchange rates, confirm the importance of the breakdown of the PPP assumption but they also show that misspecification of the money market is equally important. Whilst a random walk model is found to provide a very good fit, it is shown that lagged information can be used to improve the explanation of the spot exchange rate and hence the random walk hypothesis can be rejected.

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TABLE 5: Reduced form exchange rate equations.

a) Sterling - U.S.Dollar.

$$e_t = \underset{(14.53)}{1.012}\,\tilde{m}_t + \underset{(17.9)}{0.337}\,\tilde{y}_t + \underset{(181.9)}{0.958}\,\varepsilon_t + \underset{(12.5)}{0.644}\,\tilde{u}_t + \underset{(1.51)}{0.007}\,\xi_t$$

$$+ \sum_{i=0}^{5} \gamma_i^m \varepsilon_{t-i}^m + \sum_{i=0}^{5} \gamma_i^y \varepsilon_{t-i}^y + \sum_{i=0}^{5} \gamma_i^\varepsilon \varepsilon_{t-i}^\varepsilon + \sum_{i=0}^{5} \gamma_i^u \varepsilon_{t-i}^u + \text{seasonals} + u_t$$

$\bar{R}^2 = 1.0000$, $s = 0.000769$

	t	t-1	t-2	t-3	t-4	t-5
ε_1^m	0.137 (5.19)	-	-	-0.038 (2.76)	-0.044 (2.79)	-0.035 (2.07)
ε^y	0.018 (0.79)	0.018 (1.01)	0.017 (1.12)	-	-	-0.056 (4.59)
ε^ε	0.056 (6.25)	-	-	-	-	0.009 (1.62)
ε^u	-0.491 (8.20)	-0.298 (6.25)	-0.405 (7.97)	-0.191 (5.09)	-0.162 (7.14)	-0.036 (1.73)

b) Deutschemark - U.S.Dollar.

$$e_t = \underset{(4.24)}{0.836}\,\tilde{m}_t - \underset{(0.28)}{0.029}\,\tilde{y}_t + \underset{(18.00)}{0.924}\,\varepsilon_t - \underset{(9.81)}{0.908}\,\tilde{u}_t - \underset{(1.33)}{0.161}\,\xi_t$$

$$+ \sum_{i=0}^{5} \gamma_i^m \varepsilon_{t-i}^m + \sum_{i=0}^{5} \gamma_i^y \varepsilon_{t-i}^y + \sum_{i=0}^{5} \gamma_i^\varepsilon \varepsilon_{t-i}^\varepsilon + \sum_{i=0}^{5} \gamma_i^u \varepsilon_{t-i}^u + \text{seasonals} + u_t$$

$\bar{R}^2 = 0.9991$, $s = 0.00393$

	t	t-1	t-2	t-3	t-4	t-5
ε^m	0.442 (2.90)	-	-	-	-	-0.417 (1.23)
ε^y	-0.144 (0.48)	-	-	-	-	0.299 (2.17)
ε^ε	-	-	-	-	0.144 (2.10)	0.096 (0.97)
ε^u	-0.295 (1.46)	0.451 (1.09)	-	-	0.368 (0.93)	-

the change in the spot rate to be highly volatile. These features of the asset market theory appear to be broadly in accordance with the facts and are one of the main reasons for its attractiveness as an explanation of the behaviour of exchange rates.(4)

To provide a full explanation of the exchange rate it is necessary to embed the foreign exchange market within a complete structural model. The reduced form exchange rate equation of this structural model would then provide the full explanation required. This is the approach that has been adopted in most existing tests of asset market theories. Unfortunately, these reduced form equations of the exchange rate usually fail tests of misspecification(5) or they forecast poorly.(6) Thus whatever the theoretical merits of the asset market approach, when incorporated into a complete structural model they have been found not to provide a satisfactory empirical description. The explanation of why these reduced form equations have performed badly is complicated by the fact that they embody restrictions derived from structural equations which are required to complete the model but are not part of the asset market theory. Consequently it is difficult to isolate the causes of the poor performance of the reduced form exchange rate equation.

The main purpose of this paper is to attempt to provide measures of the relative importance of the likely principal causes of the failure of one of the most prominent asset market models, the rational expectations

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(4) Frenkel (1981),
Mussa (1979).

(5) Driskill (1981),
Frankel (1983),
Hacche and Townend (1981).

(6) Meese & Rogoff (1983a.and b.)

Table 3 (b) Estimates of Stochastic Generating Processes

Deutsche Mark/Dollar Exchange Rate

Lag	$\Delta\epsilon_t$	$\Delta\tilde{u}_t$	ω_t	$\Delta\tilde{m}_t$	$\Delta\tilde{y}_t$
1	-0.0551 (0.34)	0.661 (3.97)	-0.0418 (0.24)	0.171 (1.08)	0.1821 (1.10)
2	0.353 (2.16)	0.541 (2.68)		-0.311 (1.99)	0.442 (2.59)
3	-0.151 (0.88)	-0.256 (1.55)		-0.266 (1.68)	-0.019 (0.11)
4	-0.260 (1.57)			-0.087 (0.55)	0.301 (1.76)
5	-0.290 (1.72)			0.379 (2.43)	-
const.	-0.0004 (0.03)			0.00056 (0.14)	0.0009 (1.72)
s	0.066	0.027	0.042	0.027	0.024
Z(4)	4.46	10.31	3.16	2.27	5.30

attention to the most important of these causes of the failure of the model. In effect, therefore, this procedure provides a set of descriptive statistics that are aimed at improving the performance of a particular model but which are directed at particular endogenous variables, in this case the exchange rate.

The paper is set out as follows. In Section 2 the basic monetary model is stated and is then modified to incorporate additional terms designed to capture the possible causes of the failure of the monetary model. The reduced form exchange rate equation is then derived. Section 3 describes our method of estimation and resolves some econometric problems. Our results are reported in Section 4 and Section 5 presents our conclusions.

2. The Structural Model

The rational expectations monetary model consists of three structural equations: a goods market equilibrium condition reflecting purchasing power parity, a portfolio balance equation and an uncovered interest parity condition. Clearly a number of strong assumptions are required to collapse an open economy macro-economic model to these three equations. Although convenient especially for theoretical manipulation, these assumptions are unlikely to be even approximately true and hence are usually blamed for the poor performance of the model. The critical assumptions are the following:

(i) The PPP condition assumes that goods prices at home and abroad are perfectly flexible with the result that the goods market can be represented by a simple equilibrium condition. As explained above, this assumption more than any other distinguishes the

Table 2 Basic exchange rate equations

£/$

$$e_t = \underset{(2.34)}{0.451}\ \tilde{m}_t + \underset{(0.96)}{0.467}\ \tilde{y}_t + \text{constant} + \text{seasonals}$$

$$\bar{R}^2 = 0.076 \qquad s = 0.1199$$

DM/$

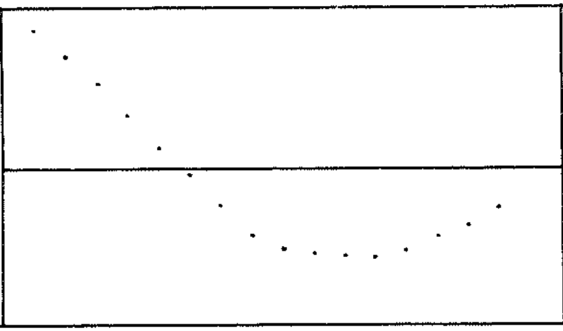
$$e_t = \underset{(3.59)}{-1.093}\ \tilde{m}_t + \underset{(1.36)}{0.796}\ \tilde{y}_t + \text{constant} + \text{seasonals}$$

$$\bar{R}^2 = 0.405 \qquad s = 0.1060$$

Figure 2 Correlograms

£/$

LM(5)=27.66

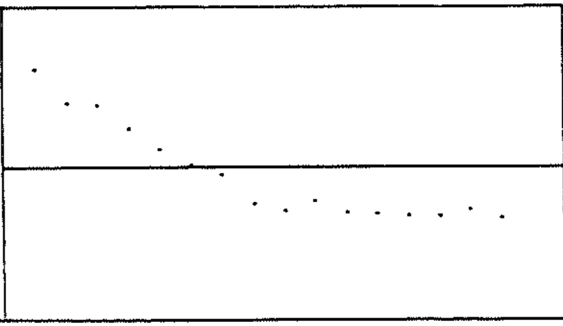


Correlation coefficients

1	.864
2	.713
3	.546
4	.341
5	.132
6	-.040
7	-.245
8	-.394
9	-.492
10	-.520
11	-.551
12	-.560
13	-.518
14	-.445

DM/$

LM(5)=17.51



1	.636
2	.431
3	.405
4	.247
5	.137
6	.025
7	-.049
8	-.259
9	-.305
10	-.222
11	-.301
12	-.322
13	-.325

(iv) Interest rates are assumed to be exogenous. This is less commonly assumed explicitly than (i)-(iii) but appears implicitly in a number of empirical studies.

A further possible cause of failure which will be examined is the use of incorrect stochastic generating processes for the exogenous variables usually due to imposing a specific structure a priori which is too restrictive. This affects the formation of expectations.

Alternative asset market models to the monetary model have been generated by modifying one or more of these assumptions. For example, in the well known variant due to Dornbusch (1976), the assumption of instantaneous price adjustment through short-run PPP is replaced by that of sticky price adjustment, with changes in the price level being determined by excess demand in the goods market.(8) Dornbusch also suggests two alternatives to the assumption of rationally expected exchange rate changes in UIP, namely, using perfect foresight or adaptive expectations. These models have been made operational empirically by Frankel (1979) and Driskill (1981). However, the limited success of their attempts and the subsequent poor performance of the model for the late 1970's which was noted by Frankel (1983) and Driskill and Sheffrin (1981) suggests that attributing the cause of the failure of the monetary model entirely to the absence of short-run PPP may be incorrect.(9) The portfolio models of Branson (1976) and Branson,

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(8) A similar assumption is made by Buiter and Miller (1981), (1982).

(9) Unless, of course, the choice of price adjustment mechanism was at fault. It should also be noted that these modifications presuppose PPP holding in the long run which may also be incorrect. Hooper and Morton (1982) have examined this issue.

Sterling/Dollar Exchange Rate

Table 1(a) Relative money demand equation

$$\tilde{m}_t - \tilde{p}_t = \underset{(0.34)}{-0.0554}\ \tilde{y}_t - \underset{(1.60)}{1.824}\ \tilde{r}_t + \text{constant} + \text{seasonals}$$

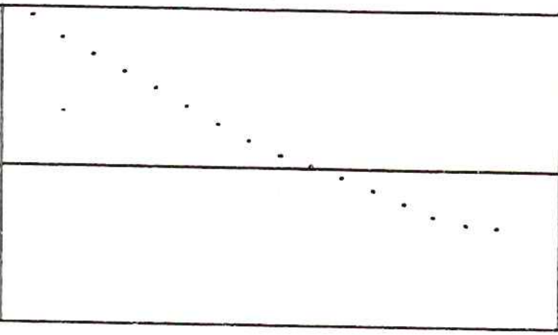
$\bar{R}^2 = 0.174$ $s = 0.0493$

Figure 1 (a) Correlograms — Correlation coefficients

PPP equation

ε_t

LM(5)=29.02

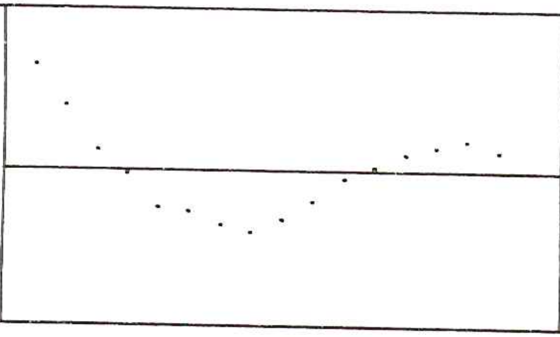


1	.923
2	.817
3	.718
4	.612
5	.480
6	.374
7	.279
8	.184
9	.087
10	.024
11	-.052
12	-.140
13	-.225

Relative money demand equation

$\tilde{u}_t$

LM(5)=18.14

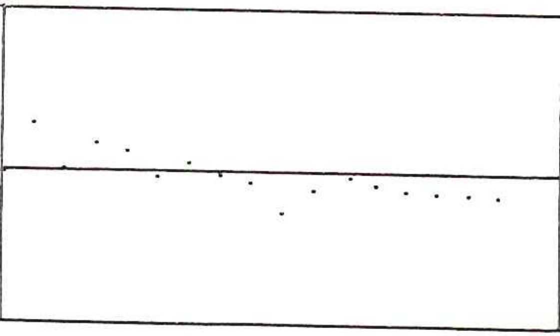


1	.646
2	.411
3	.125
4	-.014
5	-.233
6	-.252
7	-.359
8	-.382
9	-.329
10	-.215
11	-.060
12	.025
13	.122

UIP equation

ω_t

LM(5)=7.73



1	.310
2	.015
3	.179
4	.138
5	-.030
6	.069
7	-.003
8	-.064
9	-.284
10	-.161
11	-.030
12	-.090
13	-.148

the short run then the error term in equation (1) will exhibit cyclical behaviour and when included in the exchange rate equation will be significant. The proportion of the variance of the exchange rate due to this term will be a measure of its importance in explaining the failure of the basic monetary model. If PPP doesn't hold in the long run either then this error term will have a trend which will contribute to the long-run behaviour of the exchange rate.

These additional terms can also be given a slightly different interpretation since they can be decomposed into permanent and transitory components, see Beveridge and Nelson (1981). Moreover, the exchange rate equation can be similarly decomposed. Because the permanent component can be written as a random walk, by testing for any cyclical behaviour in a transitory component of the exchange rate, it is possible to examine the efficient market prediction that the exchange rate follows a random walk.

Although this approach to modelling the misspecification of the structural equation of the monetary model is a convenient device for measuring the different possible causes of failure, it should be stressed that it is not a substitute for a properly specified structural model. The method adopted here uses pure time-series techniques to represent the misspecification in the structural equations whereas a conventional

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money demand functions and exogenous money supplies and output, and includes $\tilde{u}_t$ principally in order to represent cross country differences and dynamic money demand functions. In equation (3), ξ_t will capture any systematic or random departures from UIP due, say, to the presence of a risk premium. Equation (4) is a particularly convenient, but quite general, uni-variate representation of a stationary or a non-stationary stochastic process first proposed by Wold (1938).(13) Beveridge and Nelson (1981) have shown that it can be interpreted to provide a decomposition of x_t into permanent and transitory components as follows:

$$x_t = \bar{x}_t - c_t \tag{5}$$

$$\bar{x}_t = \bar{x}_{t-1} + \mu + (\textstyle\sum_{i=0}^{\infty}\alpha_i)\epsilon_t \tag{6}$$

$$c_t = (\textstyle\sum_{i=1}^{\infty}\alpha_i)\epsilon_t + (\textstyle\sum_{i=2}^{\infty}\alpha_i)\epsilon_{t-1} + \cdots \tag{7}$$

where $\bar{x}_t$ is the permanent or trend component of x_t which is a random walk with drift parameter μ, and c_t is the transitory or cyclical component. For example, if the change in x_t is an MA(1) process with a rate of drift μ then

$$x_t = x_{t-1} + \mu + \epsilon_t + \alpha_1 \epsilon_{t-1} \tag{8}$$

implying

$$\bar{x}_t = \bar{x}_{t-1} + \mu + (1+\alpha_1)\epsilon_t \tag{9}$$

$$c_t = \alpha_1\epsilon_t. \tag{10}$$

(13) It would be possible to generalise this representation further by specifying a vector instead of univariate process. This would then allow for lagged cross-equation effects.

Data appendix

1. Exchange rates:

   Spot exchange rates (end of period) taken from International Financial Statistics. (line ah).

2. Prices:

   Consumer price indices, seasonally unadjusted data from International Financial Statistics. (line 64).

3. Real Output:

   Industrial production indices, seasonally unadjusted data from International Financial Statistics. (line 66).

4. Money Supplies:

   Narrow definition money supplies are approximately M1, seasonally unadjusted data from International Financial Statistics. (line 34).

5. Interest Rates:

   3-month Eurocurrency market rates (end of period). Data from International Monetary Fund.

Such differences are automatically captured by (4) which has the added advantage of not imposing a particular form on the generating process which may be incorrect.

The reduced form equation for the exchange rate can now be derived. Substituting (2) into (1) gives

$$e_t = \tilde{m}_t - k\tilde{y}_t + \lambda\tilde{r}_t + \varepsilon_t - \tilde{u}_t \qquad (15)$$

which is the appropriate reduced form if the interest rates are exogenous an assumption not made here.(14) Re-writing (15) as

$$e_t = \lambda\tilde{r}_t + w_t$$

where $w_t = \tilde{m}_t - k\tilde{y}_t + \varepsilon_t - \tilde{u}_t$ and substituting for $\tilde{r}_t$ from (3) gives

$$e_t = \frac{\lambda}{1+\lambda} E_t e_{t+1} + \frac{1}{1+\lambda}(w_t - \lambda\xi_t) \qquad (16)$$

$$= \frac{1}{1+\lambda} \sum_{s=o}^{\infty} \left(\frac{\lambda}{1+\lambda}\right)^s E_t z_{t+s} \qquad (17)$$

where $z_t = w_t - \lambda\xi_t$ and hence can be represented by the generating process equation (4). Next it is necessary to evaluate $E_t z_{t+s}$ from (4). It can be shown that for $s>o$

$$x_{t+s} = x_t + s\mu + \sum_{i=1}^{s}\left(\sum_{j=o}^{s-i} \alpha_j\right)\epsilon_{t+i} + \sum_{i=o}^{\infty}\left(\sum_{j=1}^{s}\alpha_{i+j}\right)e_{t-i} \qquad (18)$$

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(14) Frankel (1981) discusses this point and proposes joint endogeneity of the money supply and interest rates and instrumenting out interest rates in the reduced form exchange rate equation.

The greater importance of PPP innovations compared with money demand errors for the Deutschemark - US Dollar can also be gauged by measuring the increase in the standard error of the equation that occurs if in turn each set of innovations is omitted. There is a 292% increase in the case of the PPP innovations but only 0.2% for those of the money demand errors. This contrasts with the Sterling - US Dollar exchange rate where the corresponding increases are 623% and 100%. Finally and perhaps the most interesting aspect of these particular results, is that for both exchange rates lagged innovations are found to be significant, implying that past information can be used to provide better forecasts of these exchange rates than simply using the lagged exchange rate as implied by the random walk model.

5. Conclusions

These can be briefly stated. Our results confirm that the Sterling - US Dollar and the Deutschemark - US Dollar exchange rates can be approximated fairly closely by a random walk and that this can be justified by the basic rational expectations monetary model. They also show that simple misspecification tests of the residuals of the exchange rate equations are not very powerful. A far more powerful test is to construct an alternative exchange rate model in which the misspecification of the structural equations of the monetary model is explicitly represented. Many of these terms are found to be highly significant and lead us to reject both the monetary model and the hypotheses that these two exchange rates follow a random walk. When attributing blame for the breakdown of the monetary model PPP is usually singled out. Our results confirm that departures from PPP are an important source of misspecification, but they also show that misspecification of the relative noise error in the structural equations, then there would be no contribution from $\epsilon^{\varepsilon}_{t-i}$, ϵ^{u}_{t-i}, ϵ^{ξ}_{t-i} for $i>o$. Further, misspecification of the processes generating $\tilde{m}_t$ and $\tilde{y}_t$ would result in an incorrect specification of (21). For example, if Edwards's assumptions equation (13) and (14) are incorrect then β^m_i and β^y_i would be wrongly constrained. The restrictions implicitly imposed by Edwards are $\beta^m_o = -\frac{\lambda}{1+\lambda}$ and $\beta^m_i = 0 (i>o)$. Such incorrect a priori restrictions would clearly impair the properties of estimates of the reduced form exchange rate equation.(15)

Equations (20) and (21) can also be decomposed into permanent and transitory components. Substituting for z_t from (4), equation (20) can be re-written as

$$e_t = e_{t-1} + \mu + \sum_{i=o}^{\infty} \gamma_i \, \epsilon_{t-i} \tag{22}$$

where $\gamma_o = \sum_{s=o}^{\infty} \alpha_s (\frac{\lambda}{1+\lambda})^s$ and $\gamma_i = \frac{1}{1+\lambda} \sum_{s=o}^{\infty} \alpha_{i+s} (\frac{\lambda}{1+\lambda})^s$ for $i>o$.

From (5) - (7), equation (22) can be expressed as

$$e_t = \bar{e}_t - d_t \tag{23}$$

where

$$\bar{e}_t = \bar{e}_{t-1} + \mu + (\sum_{i=o}^{\infty} \gamma_i) \epsilon_t \tag{24}$$

$$d_t = (\sum_{i=1}^{\infty} \gamma_i) \epsilon_t + (\sum_{i=2}^{\infty} \gamma_i) \epsilon_{t-1} + \dots \quad . \tag{25}$$

---

(15) The biases that may be introduced by incorrectly imposing the same parameter values on both structural equations and exogenous variable generating processes are discussed by Haynes and Stone (1981).

estimated coefficients become somewhat meaningless, or at least difficult to interpret. This does not matter, however, since the main purpose of this exercise is to estimate the contribution of the structural errors and their innovations in explaining variations in the exchange rate. The t statistics reported are therefore better used as a measure of partial explanatory power.

Estimates of equation (31) are reported in Table 4 assuming $\tilde{m}_t$ and $\tilde{y}_t$ are generated by random walks (columns (1) and (3)) and linear trends (columns (2) and (4)). These results show that including the current disturbances of the structural equations as explanatory variable causes a dramatic change compared with the estimates of equation (32). The almost perfect fit is due primarily to ε_t,$\tilde{m}_t$ and $\tilde{u}_t$. The importance of ε_t, the PPP disturbance, largely reflects the much greater flexibility of the exchange rate compared with relative prices. The closeness of the coefficients of $\tilde{m}_t$ to unity and their large t statistics are consistent with the basic monetary model. The t statistics of $\tilde{u}_t$ show the importance of monetary disturbances in explaining the spot exchange rate. For the Sterling - US Dollar exchange rate, however, the signs of the coefficient of $\tilde{u}_t$ and $\tilde{y}_t$ are not as predicted by the monetary model. By comparison ξ_t, ε_t^m and ε_t^y are not very important for explaining e_t. Thus there is considerable support in these results for the basic monetary model, particularly for the Deutchemark-US Dollar exchange rate.

Estimates of the more general model, equation (33), are presented in Table 5. These results confirm most of the findings of Table 4. They also show that many of the lagged innovations are significant implying that using past information improves the basic monetary model. Despite the minuscule improvements in $\bar{R}^2$, the reductions in the standard errors of the equations for Sterling - US Dollar and Deutschemark - US Dollar

$$e_{t+1} = z_{t+1} + \lambda u + \sum_{i=0}^{\infty} \beta_i \epsilon_{t-i+1}$$

and so

$$e_{t+1} - E_t e_{t+1} = z_{t+1} - E_t z_{t+1} + \beta_0 \epsilon_{t+1}$$

$$= (\alpha_0 + \beta_0) e_{t+1} = \left(\sum_{s=0}^{\infty} \alpha_s \left(\frac{\lambda}{1+\lambda}\right)^s\right) \epsilon_{t+1} = \eta_{t+1} \quad . \qquad (25)$$

In other words η_{t+1} is a linear combination of $\epsilon^m_{t+1}, \epsilon^y_{t+1}, \epsilon^\varepsilon_{t+1}, \epsilon^u_{t+1}$ and ϵ^ξ_{t+1}. Hence instead of using equation (3) this solution uses in its place

$$e_{t+1} - e_t - \tilde{r}_t = \xi_t + \eta_{t+1}. \qquad (26)$$

This implies that we would in effect replace z_t in equation (20) with $z_t - \lambda\eta_{t+1}$. But since η_{t+1} is a white noise error, the reduced form exchange rate equation would then become

$$e_t = z_t + \lambda u + \sum_{i=0}^{\infty} \beta_i \epsilon_{t-i} - \lambda(\alpha_0 + \beta_0)\epsilon_{t+1} \qquad (27)$$

That is, we must include an additional term (or set of terms) in (21) to represent ϵ_{t+1}. However, because ϵ_{t+1} is uncorrelated with the other terms on the right hand side of (27) and we are not interested in ϵ_{t+1}, this additional error term would not affect the estimates of the other terms though it would affect the estimate of the residual variance.

Equations (21) and (30) and their modified versions (27) and (31) can be written in a form involving only observables which is immediately suitable for estimation:

$$e_t = \gamma_0 + \gamma_1\tilde{m}_t + \gamma_2\tilde{y}_t + \text{seasonals} + v_t$$

The error term v_t incorporporates all of the unobservable structural errors and innovations. Estimates of equation (32) are reported in Table 2 and correlograms of the resulting errors in Figure 2. The error v_t has mean zero but, as equation (31) shows, even for the basic model it will possess first order serial correlation. In both cases we observe serial correlation of an order higher than one. Moreover, the signs of some of the estimated coefficients are inconsistent with the monetary model, in particular the coefficient on relative money supplies is significantly different from unity and the coefficients on output are positive. These results confirm the more recent findings of others that the basic monetary model is badly misspecified both structurally and dynamically. Our purpose now is to explain the possible sources of this misspecification by estimating equation (21) and the special case, equation (30).

Incorporating our results about the apparent efficiency of the exchange market by constraining ξ_t, the error of equation (3), to be white noise, our general estimating equation is

$$e_t = \gamma_0 + \gamma_1\tilde{m}_t + \gamma_2\tilde{y}_t + \gamma_3\varepsilon_t + \gamma_4\tilde{u}_t + \gamma_5\xi_t + \sum_{i=0}\gamma_i^m \epsilon_{t-i}^m$$
$$+ \sum_{i=0}\gamma_i^y\epsilon_{t-i}^y + \sum_{i=0}\gamma_i^\varepsilon \epsilon_{t-i}^\varepsilon + \sum_{i=0}\gamma_i^u \epsilon_{t-i}^u + \text{seasonals} + v_t \qquad (33)$$

where now the unobservable structural errors and the innovations will be treated as observable variables by using estimates of them. The method of estimating ε_t, u_t and ξ_t has been described above and the approximately flat after lag 1, implying that ε_t can be closely represented by a white noise process and the efficiency of the exchange market cannot be rejected.

4. Empirical Results

The structural equations

The various forms of exchange rate model outlined above were estimated for two bilateral cases, namely, the Sterling - US Dollar and the Deutschemark - US Dollar rates. The data is quarterly for the period 1974.4 to 1982.3 and is chosen to avoid the period of instability in foreign exchanges immediately following generalised floating. We consider first the estimation of the structural equations (1) to (4) and then use these results to form the structural errors and innovations required for the estimation of the reduced exchange rate equation.

The correlograms of the structural errors of equations (1) to (3) are depicted in Figure 1. The errors $\tilde{u}_t$ are estimated by the OLS residuals of the relative real money demand equation (2). As discussed above, the errors from the UIP equation are in fact ω_t and not ε_t. The similarity of the results permit some general conclusions. The errors from equation (1) are highly autocorrelated suggesting that they are persistent through time. This result is consistent with the conventional view that goods prices are sticky and,relative to exchange rates, have adjusted slowly to both the anticipated and unanticipated real and nominal shocks that were experienced during the 1970's.

The correlograms of the residuals of equation (2) suggest that the errors $\tilde{u}_t$ are not white noise and hence that the relative money demand equations generally used in empirical tests of the monetary model are dynamically misspecified. It is, however, possible that similar results could also be obtained if there are omitted variables from the equation