

**63) DEMAND FOR THE NARROW MONEY STOCK
PART C**

These estimates are somewhat more stable than those given in Table 15, but interestingly are very similar. The maximum lag on income is two quarters and the maximum lag on prices is three quarters⁷. In addition the coefficient on the current price term is insignificant and the long-run elasticities are almost exactly the same as those previously estimated. The lag on the rate of interest is obviously considerably shorter, and the total elasticity substantially less, than before. Adding additional lagged values of the rate of interest does result in correctly signed coefficients but they do not significantly improve the fit of the equation.

The results from these last two equations should really be considered together. The equation estimated in first differences provides the most stable coefficient estimates, but the implied model is essentially short run, and does not yield reasonable long-run properties. On the other hand the levels equation has more reasonable long-run properties, but because of the multicollinearity is less able to identify the separate short-run properties of the equation. The first difference equation provides strong support for the suggestion that the lags on income and prices really are very short and that such a restriction should be imposed on the levels equation. This would seem the most obvious next step, but has not yet been done*. The close correspondence between the two sets of results for the longest period would suggest that there is sufficient data variation to identify fairly accurately the separate coefficient values even in the levels equation. However we might still expect the first difference equation to provide the most accurate short-term forecasts.

The most worrying aspect of these results is the high elasticity estimated on the income term, and the rather low elasticity on prices. There is generally thought to be some

⁷Lags longer than four on prices were tried but never resulted in any significant improvement.

*An alternative approach of estimating a first difference equation including levels, and the lagged ratio of the dependent variable to the constraint variable (as suggested, for example, by Hendry and Mizon, 1977) was also tried but failed to produce any statistically,

Table 18

First Differences

Estimation period	DLNX	DLX1	DLX2	DLP1	DLP2	DLP3	DINR	DIR1	DIR2	R ²	DM	SE
63(4) 70(4)	0.588 (2.28)	0.483 (2.14)	0.261 (1.35)	0.585 (1.23)	-0.765 (1.30)	0.344 (0.60)	-0.052 (1.87)	-0.017 (0.62)	-0.027 (0.98)	.253	2.017	.0132
63(4) 71(4)	0.441 (1.81)	0.464 (2.04)	0.196 (1.07)	0.891 (1.88)	-0.689 (1.28)	0.251 (0.45)	-0.051 (1.91)	-0.023 (0.84)	-0.038 (1.39)	.294	2.035	.0139
63(4) 72(4)	0.488 (2.25)	0.412 (1.79)	0.167 (0.90)	0.709 (1.55)	-0.734 (1.58)	0.684 (1.32)	-0.023 (0.97)	-0.019 (0.73)	-0.037 (1.42)	.297	1.659	.0144
63(4) 73(4)	0.360 (1.95)	0.476 (2.76)	0.250 (1.74)	0.865 (2.25)	-0.856 (2.22)	0.594 (1.30)	-0.050 (2.87)	0.001 (0.04)	-0.059 (2.94)	.513	1.949	.0142
63(4) 74(4)	0.335 (2.46)	0.442 (3.08)	0.217 (1.66)	0.825 (2.57)	-0.801 (2.57)	0.750 (2.16)	-0.051 (3.00)	-0.002 (0.08)	-0.070 (3.78)	.630	1.859	.0140
63(4) 75(4)	0.309 (2.47)	0.408 (3.36)	0.228 (2.00)	1.073 (4.06)	-0.891 (3.25)	0.589 (1.92)	-0.048 (2.91)	-0.012 (0.69)	-0.070 (4.04)	.652	1.956	.0137
63(4) 76(4)	0.284 (2.34)	0.419 (3.51)	0.224 (2.03)	0.999 (4.70)	-0.816 (3.30)	0.567 (2.52)	-0.045 (3.08)	-0.018 (1.11)	-0.064 (4.01)	.658	2.010	.0135
65(1) 76(4)	0.280 (2.19)	0.449 (3.51)	0.228 (1.82)	1.077 (4.71)	-0.938 (3.47)	0.609 (2.58)	-0.047 (3.02)	-0.021 (1.20)	-0.061 (3.59)	.667	1.925	.0139
66(1) 76(4)	0.306 (2.27)	0.490 (3.63)	0.213 (1.63)	1.082 (4.59)	-0.945 (3.41)	0.604 (2.48)	-0.045 (2.75)	-0.026 (1.35)	-0.070 (3.72)	.673	1.929	.0142

Short-run and long-run elasticities

	<u>Income</u>		<u>Interest</u>		<u>Price</u>	
	<u>SR</u>	<u>LR</u>	<u>SR</u>	<u>LR</u>	<u>SR</u>	<u>LR</u>
63(4) 70(4)	0.588	1.332	-0.052	-0.096	0	.164
63(4) 71(4)	0.441	1.101	-0.051	-0.112	0	.453
63(4) 72(4)	0.488	1.067	-0.023	-0.079	0	.659
63(4) 73(4)	0.360	1.086	-0.050	-0.108	0	.603
63(4) 74(4)	0.335	0.994	-0.051	-0.123	0	.774
63(4) 75(4)	0.309	0.945	-0.048	-0.130	0	.771
63(4) 76(4)	0.284	0.927	-0.045	-0.127	0	.750
65(1) 76(4)	0.280	0.957	-0.047	-0.129	0	.748
66(1) 76(4)	0.306	1.009	-0.045	-0.141	0	.741

economies of scale in holdings of transactions balances, and no money illusion. One possible, tentative, explanation for the high income elasticity transactions have been growing relative to TFE so that the coefficient estimate on TFE overestimates the "true" coefficient on transactions. It is, however, hard to think of any satisfactory economic reason why the price elasticity should be so low.

No attempt has been made to estimate a monthly equation of similar lag length in view of the number of variables required. Some experiments have been carried out employing the Almon technique, but the results have proved highly variable. Some tentative support is provided for the suggested lag profiles if third order Almons are calculated over the longest data period, see Table 19 below. The lag pattern is most satisfactory and the fit of the equation is very good. It is however easy to obtain very different results by only slightly changing the assumptions of the model, and for this reason these estimates should be treated with great caution.

Before leaving this discussion of alternative specifications some mention should be made of the most recent published demand for money equation estimated at the Bank of England. This equation was of the simple form with which we began, but estimated in first differences in order to provide stationary series, as suggested for example by Granger and Newbold (1974), and allowing for first order autocorrelation. This procedure has recently been attacked by Courakis (1977) and Hendry and Mizon (1977), in the context of the personal sector's demand for M3 balances. This first difference equation when estimated over different time periods performs very badly,

Table 19

$$m = K + \sum_0^{10} \alpha_i x_{-i} + \sum_0^{10} \beta_i p_{-i} + \sum_0^{15} \gamma_i r_{-i} : \text{Almon estimates (3rd order)}$$

1972 (9) - 1976 (12)

i	<u>x</u>	<u>p</u>	<u>r</u>	
0	0.020 (0.38)	-0.003 (0.04)	-0.018 (3.88)	
1	0.070 (1.81)	0.059 (1.29)	-0.017 (4.99)	K = 3.495
2	0.110 (3.72)	0.105 (3.62)	-0.016 (6.36)	(4.71)
3	0.140 (5.72)	0.139 (4.80)	-0.015 (7.21)	
4	0.160 (7.27)	0.157 (4.59)	-0.014 (6.75)	$\bar{R}^2 = 0.996$
5	0.171 (8.38)	0.161 (4.36)	-0.013 (5.75)	
6	0.171 (9.19)	0.151 (4.32)	-0.012 (4.95)	DW = 1.881
7	0.162 (9.08)	0.126 (4.28)	-0.011 (4.47)	
8	0.143 (6.84)	0.087 (3.13)	-0.011 (4.29)	SE = 0.0088
9	0.114 (3.83)	0.034 (0.82)	-0.010 (4.40)	
10	0.075 (1.72)	-0.034 (-0.49)	-0.010 (4.89)	
11			-0.009 (5.80)	
12			-0.009 (6.75)	
13			-0.009 (4.62)	
14			-0.008 (2.91)	
15			<u>-0.008</u> (1.93)	
$\Sigma =$	<u>1.336</u>	<u>0.983</u>	<u>-0.190</u>	

and there is no evidence of stability in the coefficient estimates. This form of the equation has therefore already been rejected within the Bank of England.

(c) Seasonality

Because of the problems it has been argued may occur as a result of the prior seasonal adjustment of the data series used in regression, we have also estimated M1 demand equations employing non-seasonally adjusted data. Re-estimating the simple equations we began with, including seasonal dummies, does not change the character of the results, but does improve the statistical fit; as measured by the standard error of the equation and the Durbin-Watson statistic. When the nominal equation (5) is re-estimated the overall pattern of the results is the same, but the long-run elasticities are generally slightly higher. In particular the long-run income elasticity is even closer to unity. There is not much to be said about these results at this point, but it is worth noting that the estimated coefficients on the dummy variables do indicate a reasonably stable seasonal pattern. This can be seen most clearly if the long-run income and price elasticities are constrained to unity; the estimates are reported in Table 20.

In trying to find the best fitting equation over 1964(1) to 1976(4) equations have been estimated with and without seasonal dummies. The best fitting equation without dummies was

$$m = b_0 + b_1 x - b_2 x_{-3} + b_3 p - b_4 p_{-2} - b_5 r - b_6 r_{-2} + b_7 r_{-3} + b_8 m_{-1} + b_9 m_{-3} + u \quad (34)$$

and the results from estimating it over different periods are given in Table 21. The statistical fit of the equation is very good over all periods, but the coefficient estimates are not particularly stable. In addition the long run elasticity on income is particularly high. However, if we take a more detailed look at the

Table 20

	<u>k</u>	<u>log R</u>	<u>log</u> <u>M-1/Y</u>	<u>Q1</u>	<u>Q2</u>	<u>Q3</u>	<u>R²</u>	<u>DW</u>	<u>SE</u>
64(1)-70(4)	0.101 (3.64)	-0.070 (3.75)	0.840 (20.91)	-0.048 (6.06)	-0.025 (3.64)	-0.018 (2.62)	0.977	2.21	0.013
64(1)-71(4)	0.092 (3.84)	-0.061 (4.52)	0.860 (31.18)	-0.048 (6.71)	-0.028 (4.78)	-0.020 (3.03)	0.979	2.24	0.013
64(1)-72(4)	0.093 (4.22)	-0.062 (5.38)	0.853 (34.66)	-0.049 (7.70)	-0.028 (4.71)	-0.021 (3.58)	0.979	2.18	0.012
64(1)-73(4)	0.085 (4.16)	-0.061 (5.45)	0.841 (29.02)	-0.049 (6.77)	-0.023 (3.41)	-0.023 (3.50)	0.973	2.46	0.015
64(1)-74(4)	0.072 (4.27)	-0.059 (5.56)	0.817 (30.23)	-0.050 (7.00)	0.023 (3.57)	-0.025 (3.87)	0.981	2.24	0.015
64(1)-75(4)	0.073 (4.43)	-0.058 (5.52)	0.825 (34.24)	-0.048 (7.07)	-0.022 (3.52)	-0.022 (3.59)	0.985	2.28	0.015
64(1)-76(4)	0.081 (4.87)	-0.062 (5.73)	0.833 (36.27)	-0.045 (6.88)	-0.021 (3.27)	-0.019 (3.03)	0.987	2.20	0.016

Long-run and short-run interest elasticities

	<u>SR</u>	<u>LR</u>	<u>average lag</u>
64-70	-.070	-.438	5.250
64-71	-.061	-.436	6.143
64-72	-.062	-.422	5.803
64-73	-.061	-.384	5.289
64-74	-.059	-.322	4.464
64-75	-.058	-.331	4.714
64-76	-.062	-.371	4.988

Table 21

Non-seasonally adjusted data without seasonal dummies

Estimation period	constant		lnX		lnX ₋₃		lnP		lnP ₋₂		lnR		lnR ₋₂		lnR ₋₃		M ₋₁		M ₋₃		R ²	DW
	constant	lnX	lnX	lnX ₋₃	lnP	lnP ₋₂	lnR	lnR ₋₂	lnR ₋₃	M ₋₁	M ₋₃											
1964(1)-1970(4)	-3.303 (1.47)	0.911 (6.64)	-0.185 (1.10)	0.641 (1.72)	-0.836 (2.00)	-0.043 (2.16)	0.003 (0.09)	0.033 (1.01)	0.571 (4.43)	0.020 (0.12)	0.974	2.272	0.6									
1964(1)-1971(4)	-1.715 (0.67)	0.681 (4.72)	-0.343 (1.92)	0.559 (1.28)	-0.551 (1.15)	-0.068 (3.70)	0.002 (0.05)	0.010 (0.28)	0.651 (4.38)	0.172 (0.94)	0.982	1.986	0.6									
1964(1)-1972(4)	-2.825 (1.16)	0.653 (4.72)	-0.261 (1.78)	0.269 (0.69)	-0.300 (0.70)	-0.064 (3.78)	-0.010 (0.27)	0.003 (0.10)	0.722 (5.43)	0.190 (1.18)	0.991	1.788	0.6									
1964(1)-1973(4)	-0.952 (0.38)	0.570 (4.04)	-0.349 (2.56)	0.386 (1.14)	-0.295 (0.80)	-0.065 (3.66)	-0.048 (1.66)	0.037 (1.37)	0.570 (4.49)	0.319 (2.44)	0.994	1.979	0.6									
1964(1)-1974(4)	0.928 (0.63)	0.518 (5.64)	-0.461 (5.23)	0.426 (1.87)	-0.205 (0.70)	-0.059 (3.70)	-0.059 (2.11)	0.047 (1.86)	0.516 (5.05)	0.339 (3.29)	0.995	1.879	0.6									
1964(1)-1975(4)	-0.166 (0.21)	0.530 (8.17)	-0.383 (5.14)	0.638 (3.29)	-0.510 (2.29)	-0.070 (4.64)	-0.058 (2.14)	0.053 (2.09)	0.567 (6.64)	0.314 (3.30)	0.997	1.903	0.6									
1965(1)-1976(4)	-0.448 (0.80)	0.521 (9.28)	-0.362 (5.32)	0.685 (4.47)	-0.584 (3.81)	-0.073 (5.29)	-0.067 (2.98)	0.064 (2.93)	0.564 (7.28)	0.334 (3.87)	0.998	1.929	0.6									
1966(1)-1976(4)	-0.117 (0.19)	0.519 (9.03)	-0.395 (5.38)	0.802 (4.60)	-0.697 (4.04)	-0.076 (5.36)	-0.072 (3.15)	0.059 (2.69)	0.555 (6.89)	0.347 (3.89)	0.993	2.116	0.6									
1966(1)-1976(4)	-0.543 (0.81)	0.536 (8.98)	-0.357 (4.42)	0.708 (3.79)	-0.600 (3.26)	-0.074 (4.92)	-0.078 (3.23)	0.069 (2.86)	0.563 (6.89)	0.326 (3.53)	0.997	2.270	0.6									

	Income		Price		Interest	
	SR	LR	SR	LR	SR	LR
1964-70	0.911	1.775	0.641	-0.477	-0.043	-0.017
1964-71	0.681	1.910	0.559	0.045	-0.068	-0.316
1964-72	0.653	4.455	0.269	-0.352	-0.064	-0.807
1964-73	0.570	1.991	0.386	0.820	-0.065	-0.685
1964-74	0.518	0.393	0.426	1.524	-0.059	-0.490
1964-75	0.530	1.235	0.638	1.076	-0.070	-0.630
1964-76	0.521	1.559	0.685	0.990	-0.073	-0.745
1965-76	0.519	1.265	0.802	1.071	-0.076	-0.908
1966-76	0.536	1.613	0.708	0.973	-0.074	-0.748

Short-run and long-run elasticities

lag profile we find that the elasticities for both income and the price level reach unity after a very short space of time, and the much higher value for income is distributed over a very long period; see table 22. The implied average lag of 8.56 on $\ln Y$ may therefore be quite misleading: the average lags on $\ln P$ and $\ln R$ are 3.79 and 14.50 respectively.

Table 22

Cumulative elasticities: 1964(1)-1976(4)

<u>i</u>	<u>$\ln X$</u>	<u>$\ln P$</u>	<u>$\ln R$</u>
0	0.521	0.685	-0.073
1	0.807	1.112	-0.115
2	0.977	0.737	-0.208
3	0.825	0.756	-0.221
4	0.863	0.902	-0.243
5	0.941	0.945	-0.286
6	0.940	0.908	-0.314
7	0.952	0.936	-0.337
8	0.983	0.951	-0.363
9	0.985	0.912	-0.385
∞	1.559	0.990	-0.745

The pattern of these results, with a long distributed lag on the rate of interest, is very similar to that obtained employing seasonally-adjusted data, except that the very long-run adjustment is rather unrealistic. One disadvantage of this equation is that it exhibits significant negative third-order autocorrelation. The estimated equation incorporating seasonal dummies has negative first order autocorrelated errors, as can be seen in table 23. The results are, however, very similar to those reported immediately above, and also for those estimated with seasonally-adjusted data. The lag profile, given in table 24, gives strong support to the suggestion that the lags on income and the price level are much shorter than those on the rate of interest.

Table 23

Estimation

Non-seasonally adjusted data including seasonal dummies

Estimation Period	Constant	LNX	LNX-3	LNP	LNP-2	LNR	Lm-1	Q1	Q2	Q3	R ²	DM
64(1) 70(4)	-2.944 (1.20)	0.691 (3.61)	0.146 (0.60)	0.789 (2.40)	-0.851 (2.24)	-0.067 (2.97)	0.452 (2.98)	-0.021 (1.54)	-0.027 (2.25)	-0.021 (1.38)	.979	1.964
64(1) 71(4)	-0.924 (0.35)	0.427 (2.36)	0.026 (0.10)	0.621 (1.82)	-0.518 (1.34)	-0.079 (3.30)	0.642 (4.78)	-0.031 (2.16)	-0.028 (2.19)	-0.019 (1.18)	.987	2.127
64(1) 72(4)	-1.216 (0.46)	0.392 (2.46)	-0.144 (0.67)	0.222 (0.76)	-0.174 (0.49)	-0.058 (3.08)	0.886 (14.30)	-0.031 (2.31)	-0.016 (1.48)	-0.007 (0.47)	.993	2.133
64(1) 73(4)	0.781 (0.27)	0.372 (2.17)	-0.301 (1.49)	0.152 (0.50)	0.034 (0.10)	-0.052 (3.10)	0.854 (13.64)	-0.029 (2.24)	-0.008 (0.86)	-0.002 (0.14)	.994	2.613
64(1) 74(4)	2.528 (1.86)	0.321 (2.42)	-0.407 (2.95)	0.262 (1.22)	0.035 (0.13)	-0.048 (3.61)	0.827 (15.62)	-0.029 (2.39)	-0.006 (0.67)	0.002 (0.16)	.996	2.626
64(1) 75(4)	0.319 (0.42)	0.414 (3.89)	-0.276 (2.16)	0.497 (2.71)	-0.342 (1.62)	-0.059 (4.82)	0.833 (15.22)	-0.027 (2.29)	-0.009 (0.92)	-0.001 (0.10)	.997	2.468
64(1) 76(4)	0.073 (0.13)	0.407 (3.77)	-0.238 (1.99)	0.573 (3.74)	-0.431 (2.73)	-0.066 (5.97)	0.829 (14.99)	-0.026 (2.29)	-0.009 (1.07)	-0.001 (0.06)	.998	2.497
65(1) 76(4)	0.442 (0.72)	0.456 (3.97)	-0.343 (2.44)	0.683 (3.93)	-0.550 (3.03)	-0.068 (5.99)	0.847 (14.50)	-0.021 (1.68)	-0.004 (0.44)	0.007 (0.53)	.997	2.625
66(1) 76(4)	0.160 (0.24)	0.473 (3.95)	-0.309 (2.06)	0.635 (3.41)	-0.487 (2.47)	-0.070 (5.89)	0.825 (13.00)	-0.021 (1.59)	-0.005 (0.44)	0.006 (0.43)	.997	2.657

Short-run and long-run elasticities

Income		Price		Interest	
SR	LR	SR	LR	SR	LR
0.691	1.527	0.769	-0.133	-0.067	-0.122
0.427	1.265	0.621	0.288	-0.079	-0.221
0.392	2.175	0.222	0.421	-0.058	-0.509
0.372	0.486	0.152	1.274	-0.052	-0.356
0.321	-0.497	0.262	1.717	-0.048	-0.277
0.414	0.826	0.497	0.928	-0.059	-0.353
0.407	0.988	0.573	0.830	-0.066	-0.386
0.456	C 39	0.683	0.869	-0.068	-0.444
0.473	C 937	0.635	0.846	-0.070	-0.400

Table 24

Cumulative elasticities: 1964(1)-1976(4)

i	<u>lnX</u>	<u>lnP</u>	<u>lnR</u>
0	0.407	0.573	-0.066
1	0.744	1.048	-0.121
2	1.024	1.016	-0.166
3	1.018	0.985	-0.204
4	1.013	0.959	-0.235
5	1.009	0.938	-0.261
6	1.005	0.921	-0.282
7	1.003	0.906	-0.300
8	1.001	0.893	-0.315
9	0.998	0.884	-0.327
∞	0.988	0.830	-0.386

There is not much to choose between the last two equations. Both fit the data well, but neither is very stable. The results of the last equation suggest, contrary to previous results, that there may have been a change in the seasonality of the data.

Since the work on this paper was started Hendry and Mizon (1977) have drawn attention to an estimation approach which can be reduced to a rational distributed lag formulation, as, for example, shown in equation (29) above. The actual equation they estimated was,

$$\Delta(m-p) = b_0 + b_1 \Delta x + b_2 \Delta r + b_3 \Delta(m-p)_{-1} + b_4 \Delta p + b_5 (m-y)_{-1} + b_6 r_{-4} + b_7 x_{-4} + u \quad (35)$$

and a similar type of equation was also suggested by Davidson and Hendry (1976) for estimating a consumption function.

The general equations we have estimated (in nominal terms) have provided no support for specifications of this type. We did, however, estimate two equations in the spirit of these equations, and these are given below in table 25. It can be seen that the results are not good, in particular equation (a) exhibits first, second and third order autocorrelation and (b) fourth order autocorrelation. In addition $\ln(M/Y)$ was included in the first difference equations but it never proved significant, we have therefore not persisted with these formulations*.

Estimating a general equation without any lagged dependent variables again results in a first order autocorrelation coefficient which is not significantly different from one. This is true whether seasonal dummies are included or not. The inclusion of the dummies makes very little difference to the coefficient estimates but does significantly improve the fit of the equation. This can be seen by comparing table 26 (a) with part (b).

The best fitting equation without lagged dependents is again estimated in first differences, including seasonal dummies. The equation is in fact very similar to that estimated with seasonally adjusted data, except that only one lag on the price level is included, and r_{-2} is left out. The coefficient estimates are given in table 27, and, if anything, seem more stable than their seasonally adjusted counterparts. Still this stability does not extend back over the earlier periods, and again the most likely explanation is the

*This is not intended to suggest that the equations estimated by Hendry and Hizon, and Davidson and Hendry, were in any way incorrectly specified, only that they were specific to the problem being considered. There is, however, one possible problem surrounding the inclusion of the inverse of velocity (M/Y) (or in the other case C/Y) in the estimation. This variable is presumably included on the grounds that there exists a long-run equilibrium relationship between the dependent variable and the 'constraint' variable. If that is the case it might be better to define this ratio as the dependent variable.

Table 25

1965(1)-1976(4)

dependent variable	Constant	Δx	Δp	$\frac{\Delta x}{-1}$	$\frac{\Delta m}{-1}$	$\frac{(m-y)}{-1}$	$\frac{x}{-4}$	$\frac{p}{-4}$	$\frac{r}{-4}$	$\frac{\bar{r}}{-2}$	se
(a) Δm	-1.714 (1.7)	0.436 (3.71)	-0.533 (1.59)	-0.087 (3.19)	0.221 (1.67)	-0.034 (0.28)	0.178 (1.69)	-0.029 (0.82)	0.003 (0.15)	0.594	0.020
(b) $\Delta 4m$	Constant -1.031 (1.20)	$\Delta 4x$ 0.212 (1.22)	$\Delta 4p$ 0.211 (1.11)	$\Delta 4r$ -0.055 (2.49)	$\Delta 4m$ -1 0.628 (4.79)	$\frac{(m-y)}{-1}$ -0.015 (0.12)	$\frac{x}{-1}$ 0.115 (1.23)	$\frac{p}{-1}$ -0.004 (0.08)	$\frac{r}{-1}$ -0.038 (0.99)	\bar{r}^2 0.876	se 0.020

Table 26

$$(a) m = k + \sum_{i=0}^4 (b_i x_{-i} + c_i p_{-i} + d_i r_{-i}) + u; \quad 1965(1)-1976(4), \text{ nsa}$$

variable/i	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
x_{-i}	0.460 (3.21)	0.433 (3.17)	0.229 (1.72)	0.014 (0.10)	0.176 (1.14)
p_{-i}	0.131 (0.40)	0.509 (1.52)	-0.181 (0.49)	0.134 (0.41)	0.135 (0.46)
r_{-i}	-0.068 (2.51)	-0.036 (1.41)	-0.060 (2.51)	0.006 (0.22)	-0.022 (0.80)
$k = -3.105$ $\rho = 0.897$ $\bar{R}^2 = 0.996$ $se = 0.0180$ $RSS = 0.010053$ (0.68) (8.75)					

$$(b) m = k + \sum_{i=0}^4 (b_i x_{-i} + c_i p_{-i} + d_i r_{-i}) + Q_1 + Q_2 + Q_3 + u; \quad 1965(1)-1976(4), \text{ nsa}$$

variable/i	<u>0</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>
x_{-i}	0.259 (1.71)	0.569 (3.65)	0.503 (3.10)	0.042 (0.19)	-0.182 (0.96)
p_{-i}	0.022 (0.07)	0.954 (3.06)	-0.163 (0.46)	-0.114 (0.39)	0.038 (0.15)
r_{-i}	-0.075 (3.02)	-0.005 (0.22)	-0.066 (2.97)	-0.016 (0.66)	-0.020 (0.80)
$Q_1 = -0.044$ $Q_2 = 0.027$ $Q_3 = -0.009$ $k = -1.939$ $\rho = 0.916$ $\bar{R}^2 = 0.994$ (3.45) (2.15) (0.71) (0.42) (9.49)					
$se = 0.0155$ $RSS = 0.006721$					

Table 27

First difference equation including seasonal dummies

Estimation period	ΔX	$\Delta X-1$	$\Delta X-2$	$\Delta P-1$	ΔR	$\Delta R-2$	$Q1$	$Q2$	$Q3$	R^2	DM	SE
63(4) -70(4)	0.561 (3.83)	0.603 (4.21)	0.401 (3.56)	0.619 (1.72)	-0.065 (2.90)	-0.020 (0.83)	-0.028 (2.80)	-0.002 (0.28)	-0.001 (0.08)	.832	1.931	0.011
63(4) -71(4)	0.445 (3.26)	0.669 (5.11)	0.340 (3.73)	0.965 (3.02)	-0.067 (3.23)	-0.029 (1.29)	-0.036 (3.61)	0.001 (0.14)	-0.007 (0.62)	.832	2.026	0.012
63(4) -72(4)	0.340 (2.57)	0.667 (4.49)	0.405 (3.35)	0.980 (2.82)	-0.043 (2.08)	-0.056 (2.39)	-0.037 (3.22)	0.008 (0.96)	-0.002 (0.16)	.766	1.670	0.014
63(4) -73(4)	0.328 (2.65)	0.611 (4.65)	0.485 (4.73)	0.623 (2.40)	-0.060 (3.33)	-0.057 (2.80)	-0.034 (3.56)	0.010 (1.16)	0.010 (1.13)	.775	1.663	0.014
63(4) -74(4)	0.321 (3.09)	0.569 (5.06)	0.479 (5.44)	0.729 (4.82)	-0.061 (3.54)	-0.059 (3.42)	-0.035 (4.16)	0.008 (1.02)	0.010 (1.19)	.822	1.727	0.013
63(4) -75(4)	0.259 (2.74)	0.498 (4.64)	0.468 (5.49)	0.778 (6.81)	-0.062 (3.56)	-0.061 (3.57)	-0.035 (4.14)	0.006 (0.77)	0.014 (1.73)	.800	1.851	0.014
63(4) -76(4)	0.223 (2.50)	0.478 (4.64)	0.480 (5.81)	0.770 (7.14)	-0.066 (4.28)	-0.066 (4.14)	-0.035 (4.33)	0.007 (0.91)	0.017 (2.18)	.795	1.940	0.014
65(1) -76(4)	0.224 (2.37)	0.493 (4.56)	0.446 (4.71)	0.762 (6.65)	-0.069 (4.15)	-0.068 (4.06)	-0.034 (3.91)	0.009 (1.16)	0.015 (1.83)	.789	1.946	0.014
66(1) -76(4)	0.221 (2.22)	0.507 (4.43)	0.452 (4.48)	0.767 (6.36)	-0.069 (3.86)	-0.072 (3.85)	-0.035 (3.79)	0.009 (1.06)	0.015 (1.74)	.777	1.967	0.015

Short-run and long-run elasticities

	Income	Price	Interest
	LR	LR	LR
63(4) -70(4)	1.565	0.619	-.065
63 -71	1.454	0.965	-.067
63 -72	1.412	0.980	-.043
63 -73	1.424	0.623	-.060
63 -74	1.369	0.729	-.061
63 -75	1.225	0.778	-.062
63 -76	1.181	0.770	-.066
65(4) -76(4)	1.163	0.762	-.069
66(4) -76(4)	1.180	0.767	-.069

limitations on independent variation in the data. It does, however, appear that the seasonal pattern has remained reasonably stable. As with the seasonally adjusted data the most consistent estimates are obtained on the first difference equation with very short lags on all variables, but again the results are consistent with the levels equations. Although, as noted above, the first difference equations do not possess desirable long run properties they do seem the most likely to provide reliable short-term forecasts.

The seasonal adjustment of the data series seems to have very little effect on the long-run coefficient values, but has a substantial influence on the lagged adjustment on prices. One possible explanation is that with seasonally adjusted data the price index is obtained as the ratio between two seasonally adjusted series, and that the resulting series does not represent the true seasonally adjusted behaviour of prices.

(3) Forecast performance

The main equations have been estimated up to end-1975, and end-1976, and used to dynamically forecast up to 1977(2). The calculated forecasts are given in table 28 (quarterly) and table 29 (monthly) together with their percentage forecast errors.

In the case of the quarterly results the first difference equations, using seasonally or non-seasonally adjusted data, forecast very well, and considerably better than the distributed lag versions. These latter equations also seem to have become worse during 1977, whereas the first difference equations continue to forecast accurately. The equation employing seasonally adjusted data has also forecast the third quarter money stock within £100 million, on the basis of prior income forecasts. Perhaps the most encouraging feature of the forecasting ability of this equation is that it is the only one that predicts the downturn in the money stock in 1976(4). In fact the change in the stock that quarter was forecast exactly.

Quarterly dynamic forecasts: 1976(1)-1977(2) and 1977(1)-1977(2)
 Percentage forecast errors are given in parentheses

	Seasonally adjusted M1				non-seasonally adjusted M1			
	(A)	(B)	(C)	(D)	(A)	(B)	(C)	(D)
s.a. (A)	$m = b_0 + b_1 Y + b_2 r + b_3 m_{-1} + u$							
s.a. (B)	$m = b_0 + b_1 Y + b_2 r + b_3 m_{-1} + b_4 m_{-2} + u$							
s.a. (C)	$\Delta m = b_1 \Delta x_{-1} + b_3 \Delta x_{-2} + b_4 \Delta p_{-1} + b_5 \Delta p_{-2} + b_6 \Delta p_{-3} + b_7 \Delta r + b_8 \Delta x_{-1} + b_9 \Delta r_{-2} + u$							
n.s.a. (D)	$\Delta m = b_1 \Delta x + b_2 \Delta x_{-1} + b_3 \Delta x_{-2} + b_4 \Delta p_{-1} + b_5 \Delta r + b_6 \Delta r_{-2} + Q1 + Q2 + Q3 + u$							
Estimated to 1974(4) adjusted M1	Seasonally				non-seasonally			
1976(1)	17,886	18,111	18,299	18,029	17,801	17,648	17,915	17,648
(2)	18,343	18,777	18,936	18,305	18,290	17,915	17,915	17,915
(3)	19,211	19,423	19,736	19,607	19,227	18,717	18,717	18,717
(4)	19,061	19,859	20,221	19,457	19,467	19,326	19,326	19,326
1977(1)	19,680	20,626	21,241	20,322	19,566	19,612	19,612	19,612
(2)	20,460	21,899	22,670	20,868	20,410	20,396	20,396	20,396
Estimated to 1976(4)	Seasonally				non-seasonally			
1977(1)	19,680	19,867	20,236	19,865	19,566	19,803	19,803	19,803
(2)	20,460	21,150	21,461	20,478	20,410	20,644	20,644	20,644

Table 29

Monthly dynamic forecasts: 1976(1)-1977(6) and 1977(1)-1977(6)

Percentage forecast errors are given in parentheses

$$(A) \quad m = b_0 + b_1x + b_2p + b_3r + b_4m_{-1} + u$$

$$(B) \quad m = b_0 + b_1x + b_2p + b_3r + b_4m_{-1} + b_5m_{-2} + u$$

$$(C) \quad m = b_0 + \sum_0^{10} b_{1i}x_{-i} + \sum_0^{10} b_{2i}p_{-i} + \sum_0^{15} b_{3i}r_{-i} + u$$

<u>Estimated to 1975(12)</u>	<u>Seasonally adjusted M1</u>	<u>(A)</u>	<u>(B)</u>	<u>(C)</u>
1976 (1)	16,477	16,744 (1.62)	16,699 (1.35)	16,586 (0.66)
(2)	16,898	17,048 (0.89)	17,029 (0.78)	16,808 (-0.53)
(3)	16,972	17,342 (2.18)	17,313 (2.01)	17,069 (0.57)
(4)	17,371	17,604 (1.34)	17,574 (1.17)	17,337 (-0.20)
(5)	17,248	17,883 (3.68)	17,860 (3.55)	17,573 (1.88)
(6)	17,260	18,075 (4.72)	18,045 (4.55)	17,849 (3.41)
(7)	17,879	18,277 (2.23)	18,270 (2.19)	18,070 (1.07)
(8)	18,030	18,490 (2.55)	18,496 (2.58)	18,208 (0.99)
(9)	18,476	18,689 (1.15)	18,702 (1.22)	18,246 (-1.24)
(10)	18,180	18,841 (3.64)	18,852 (3.70)	18,182 (0.01)
(11)	18,320	19,021 (3.84)	19,051 (3.99)	18,179 (-0.77)
(12)	18,660	19,203 (2.89)	19,239 (3.08)	18,219 (-2.38)
1977 (1)	18,404	19,444 (5.65)	19,497 (5.94)	18,299 (-0.57)
(2)	18,534	19,756 (6.59)	19,823 (6.95)	18,611 (0.42)
(3)	18,490	20,135 (8.90)	20,213 (9.32)	19,050 (3.03)
(4)	19,146	20,552 (7.34)	20,640 (7.80)	19,594 (2.34)
(5)	19,198	21,030 (9.54)	21,133 (10.08)	20,290 (5.69)
(6)	19,456	21,440 (10.20)	21,541 (10.72)	20,912 (7.48)
<u>Estimated to 1976(12)</u>				
1977 (1)	18,404	18,881 (2.59)	18,824 (2.28)	18,577 (0.94)
(2)	18,534	19,158 (3.37)	19,134 (3.24)	18,877 (1.85)
(3)	18,490	19,491 (5.41)	19,460 (5.25)	19,262 (4.18)
(4)	19,146	19,853 (3.69)	19,825 (3.55)	19,704 (2.91)
(5)	19,198	20,258 (5.52)	20,240 (5.45)	20,240 (5.43)
(6)	19,456	20,593 (5.84)	20,568 (5.72)	20,698 (6.38)

The monthly equations have also forecast reasonably well through 1976, particularly the Almon estimates, but they have all deteriorated considerably during 1977. This is somewhat surprising since estimation up to end-1976 results in what appears to be intuitive reasonable coefficients for both monthly and quarterly data. Furthermore there is a close correspondence between the two sets of estimates which might encourage the belief that the results are really quite good. Judged on the basis of forecasting ability this conclusion is however not supported. This lends support to the argument that a general approach is more likely to produce reasonable estimates of the underlying structure than starting from a very basic equation.

Conclusion

In concluding this study there are a number of interesting results that would benefit from further elaboration. This however would extend what has already become a rather lengthy paper. Instead the opportunity is taken to concentrate attention on the main, general, implications of these results.

The first point to emphasise is the very short lags in the adjustment of M1 balances that have been estimated. These contrast sharply with the findings of many previous studies. It is however important to note that we could have stopped at a number of places in this study and produced plausible arguments to support the proposition that a stable demand function had been found. In addition we could have taken account of statistical biases in these equations in order to further "improve" their fit. Instead of following that route we have turned to a wider examination of the data to see if it is capable of providing further insight into the structure of an equation explaining the demand for money. I believe that this is a more illuminating approach and, in this case, has resulted in a much better understanding of the short-run adjustment process. No amount of statistical manipu-

lation with the simple equations with which we began could have revealed the behaviour that resulted from taking a wider approach. If there is a strong relationship between certain variables this is likely to show up in many different forms as we have seen. It is only in comparison with some alternative that the results can be judged, and very often the range of alternatives considered has been too narrowly defined.

This last argument is similar to that put forward by Courakis (1977) and Hendry and Mizon (1977). They however concentrated attention on a redundant "Bank of England equation", and a definition of money that others (eg, Artis and Lewis, 1974 and 1976) have argued has to a large extent been supply determined. The argument is in fact much stronger and applies to all previous demand for money studies, as is indicated, for example, by Hendry and Mizon's preferred equation. Furthermore, the wide use of distributed lag models in economics means that these results have potentially important implications over a much broader area. It is unlikely that it is only in the area of the demand for money that what might be called "the minimal approach" to econometric testing is to be found. In fact a more general approach has probably been adopted in demand for money studies [see, for example, Price (1972)] than to the estimation of many other behavioural relationships. It may be argued, as in this paper, that there has been a lack of consistency in the various approaches adopted, but an added problem, which is not restricted to the demand for money, is that most quarterly data series have only been compiled since 1963. There have therefore been only limited data available for econometric testing. Furthermore the 1960s was a period of tight financial controls, continuing balance of payments difficulties and low levels of economic activity; the period may well therefore not be very representative or likely to yield strong econometric results. These considerations make it difficult to judge parameter stability over time.

There is no real evidence of a breakdown of the demand for M1 function, as had been suggested. On the question of whether there has been a shift in the relationship the evidence is less clear. However, the recent rapid growth in M1 has at least been consistent with an apparently stable demand for money that is interest elastic, and the outcome has so far closely followed prior forecasts.

Finally the first difference and levels equations taken together do seem to have identified an adjustment process that is different for each of the explanatory variables, and is both rapid and stable. Furthermore this behaviour could not be adequately captured by simple partial adjustment and adaptive expectations assumptions. It is a conclusion of this study that these simple models should not represent a starting point but only a possible outcome of a wider analysis of the data. Taking these results as a base it should be possible to develop the analysis and obtain further improvements.

References

- Artis, M.J. and Lewis, M.K., "The Demand for Money: Stable or Unstable"
The Banker, Vol.124 No.577, March 1974 pp 239-246
- Artis, M.J. and Lewis, M.K., "The Demand for Money in the United Kingdom: 1963-1973",
The Manchester School, Vol.43 No.2, June 1976, pp 145-181
- Baumol, W.J., "The Transactions Demand for Cash: An Inventory Theoretic Approach",
Quarterly Journal of Economics, Vol.66 No.3, November 1952 pp 545-556
- Chow, G.C., "Tests of Equality Between Sets of Coefficients in Two Linear Regressions",
Econometrica, Vol.28 No.3, July 1960, pp 591-605
- Courakis, A.S., "Serial Correlation and the Bank of England's Demand for Money Function: An Exercise in Measurement without Theory",
University of Oxford: mimeo, 1977
- Davidson, J.E.H. and Hendry, D.F., "Econometric Modelling of the Aggregate Time Series Relationship Between Consumers' Expenditure and Income in the United Kingdom",
LSE: mimeo, 1976
- Goldfeld, S.M., "The Demand for Money Revisited",
Brookings Papers on Economic Activity, No.3, 1973, pp 577-638
- Goodhart, C.A.E., "Money, Information and Uncertainty",
The Macmillan Press Ltd., London, 1975
- Goodhart, C.A.E. and Crockett, A.D., "The Importance of Money",
BEQB, Vol.10 No.2, June 1970, pp 159-198
- Granger, C.W.J. and Newbold, P., "Spurious Regressions in Econometrics",
Journal of Econometrics, Vol.2 No.2, 1974 pp 111-120
- Hacche, G., "The Demand for Money in the United Kingdom: Experience Since 1971",
BEQB, Vol.14 No.3, September 1974, pp 284-305
- Hamburger, M.J., "The Demand for Money in an Open Economy: Germany and the United Kingdom",
Journal of Monetary Economics, Vol.3 No.1, January 1977 pp 25-40
- Hamburger, M.J. and Wood, G.E., "Interest Rates and Monetary Policy in Open Economies",
mimeo 1977

- Hendry, D.F. and Mizon, G.E., "Serial Correlation as a Convenient Simplification, Not a Nuisance: A Comment on the Bank of England's Demand for Money Function",
LSE: mimeo 1977
- Jorganson, D.W., "Rational Distributed Lag Functions",
Econometrica Vol.32 No.1, January 1966, pp 135-149
- Laidler, D.W., "The Influence of Money on Economic Activity - A Survey of Some Current Problems", in
"Monetary Theory and Monetary Policy in the 1970s"
ed. by Clayton, Gilbert and Sedgwick OUP, London, 1971
- Laidler, D.W. and Parkin, M.J., "The Demand for Money in the UK, 1955-1967: Preliminary Estimates",
The Manchester School, Vol.38 No.3, September 1970, pp 187-208
- Markowitz, H., "Portfolio Selection",
Journal of Finance, Vol.7 No.1, 1952, pp 77-91
- Price, L.D.D., "The Demand for Money in the UK: Experience Since 1971",
BEQB, Vol.14 No.3, September 1974, pp 284-305
- Thomas, J.J. and Wallis, K.F., "Seasonal Variation in Regression Analysis",
Journal of the Royal Statistical Society, Ser.A., 134, Part 1(1971), pp 57-72
- Tobin, J., "The Interest Elasticity of Transactions Demand for Cash",
Review of Economics and Statistics, Vol.38 No.3, August 1956, pp 241-247
- Tobin, J., "Liquidity Preference as Behaviour Towards Risk",
Review of Economic Studies, Vol.25 No.1, February 1958, pp 65-68
- Wallis, K.F., "Seasonal Adjustment and Relations Between Variables",
Journal of the American Statistical Association, Vol.69 No.345, March 1974, pp 18-31

Demand for Money Studies in the UK

- A.J.Brown, "Interest, Prices and the Demand for Money", Oxford Economic Papers, 1939
- A.M.Khusro, "An Investigation of Liquidity Preference", Yorkshire Bulletin of Economic and Social Research, 1952
- H.F.Lydall, "Income, Assets and the Demand for Money", Review of Economics and Statistics, 1958
- *N.J.Kavanagh and A.A.Walters, "The Demand for Money in the UK, 1877-1961 Preliminary Finding", Bulletin of the Oxford University Institute of Economics and Statistics, 1966
- De Alessi, "The Demand for Money: A Cross Section Study of British Business Firms", Economica, 1966
- R.L.Crouch, "A Model of the UK's Monetary Sector", Econometrica, 1967
- D.Fisher, "The Demand for Money in Britain: Quarterly Results, 1951-67" Manchester School, 1968
- *C.A.E.Goodhart and A.D.Crockett, "The Demand for Money: Some Results for the UK", Bank of England Quarterly Bulletin, June 1970.
- *D.E.W.Laidler and J.M.Parkin, "The Demand for Money in the UK, 1955-67: Preliminary Estimates", Manchester School, September 1970
- D.E.W.Laidler, "The Influence of Money on Economic Activity: A Survey of Some Current Problems", in Monetary Theory and Monetary Policy in the 1970s ed. by G.Clayton, J.C.Gilbert and R.Sedgwick
- L.D.D.Price, "The Demand for Money in the United Kingdom: a further investigation", Bank of England Quarterly Bulletin, March 1972
- G.Hacche, "The Demand for Money in the United Kingdom: Experience Since 1971", Bank of England Quarterly Bulletin, September 1974
- M.J.Artis and M.K.Lewis, "The Demand for Money: Stable or Unstable?", The Banker, March 1974

M.J.Artis and M.K.Lewis, "The Demand for Money in the United Kingdom
1963-1973", The Manchester School, June 1976

M.J.Hamburger, "The Demand for Money in an Open Economy: Germany
and the United Kingdom", The Journal of Monetary
Economics, January 1977

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Demand for Money in the UK Summary of Results

Author	Data	Money	Interest rate	Interest ^C elasticity	Income variable	Income ^G elasticity	Price
Kavanagh & Walters	Annual: 1880-1961	Broad	long	-0.31 (-0.22) ^a	GNP	1.149	-
	1926-1961	Broad	long	-0.50 (-0.25) ^a	GNP	-	-
Crouch	Quarterly: 1954-1965	LCB Bank Deposits (total)	long	-0.50	GNP	1.08	-
Fisher	Quarterly: 1955(I)-1967(II)	Narrow	short	-0.11	PDI (nom)	0.686	-
		Broad	short	-	PDI (nom)	0.742	-
		Narrow	long	-0.30	PDI (nom)	0.650	-
		Broad	long	-	PDI (nom)	0.712	-
Goodhart & Crockett	Quarterly: 1955(III)-1969(III)/1963(II)-1969(III) ^b	Narrow	short	-1.05	GDP	1.25	-
		Narrow	long	-0.80	GDP	1.09	-
		Broad	short	-0.09/-0.21 ^b	GDP	0.77/1.50 ^b	-
		Broad	long	-0.35/-0.51 ^b	GDP	1.09/1.89 ^b	-
Laidler & Parkin	Quarterly 1955(III)-1967(IV)	Broad	short	-0.008	GDP (real) (perm)	0.68	1*
Laidler	Annual: 1900-1965	Broad	long	-0.570	GDP (real)	0.795	1*
	1900-1913	Broad	long	-0.268	"	1.241	1*
	1920-1938	Broad	long	-0.448	"	0.793	1*
	1946-1965	Broad	long	-0.739	"	0.684	1*
Price	Quarterly: 1964(I) 1970(IV): <u>Persons</u>	Broad	short	-			
	Quarterly: 1964(I) 1970(IV): <u>Companies</u>	Broad	long	-0.30	GDP (real)	2.29	0.90
		Broad	short	-0.36			
		Broad	long	-	GDP (real)	2.77	0.41
Hacch	Quarterly: 1963(IV)-1971(III)	Narrow	short	-0.081	TFE (real)	0.391	1*
			long	-0.184			
		Broad	short	-0.091	TFE (real)	0.450	1*
			long	-			
	<u>Persons</u>	Broad	short	-	PDI (real)	0.927	1*
			long	-0.069			
	<u>Companies</u>	Broad	short	-0.067	TFE (real)	0.511	1*
			long	-0.197			
	Quarterly: 1963(IV)-1972(IV)	Narrow	short	-0.062	TFE (real)	0.697	1*
			long	-0.206			
		Broad	short	-	TFE (real)	-	1*
			long	-			
	<u>Persons</u>	Broad	short	-	PDI (real)	1.081	1*
			long	-0.110			
	<u>Companies</u>	Broad	short	-0.044	TFE (real)	2.206	1*
			long	-0.696			
	Quarterly: 1963(IV)-1972(IV)	Broad	short	-0.248	TFE (real)	0.995	1*
			long	-			
			own rate	0.537			
	<u>Companies</u>	Broad	short	-	TFE (real)	1.003	1*
			long	-0.345			
			own rate	0.568			
Artis and Lewis	Quarterly: 1963(II)-1970(IV)	Narrow	long	-0.26	GDP (nom)	0.77	-
	1963(II)-1971(IV)	Narrow	long	-0.39	GDP (nom)	0.95	-
	1963(II)-1973(I)	Narrow	long	-0.66	GDP (nom)	1.24	-
	1963(II)-1970(IV)	Broad	long	-0.47	GDP (nom)	1.42	-
	1963(II)-1971(IV)	Broad	long	-0.52	GDP (nom)	1.48	-
	1963(II)-1973(I)	Broad	long	-3.00	GDP (nom)	4.27	-
Hamburger	Quarterly: 1963(II)-1971(I)	Narrow	short ^e	-1.20 ^f	GDP (nom)	0.672	-
			long ^e	-1.07 ^f			

GNP = Gross National Product
PDI = Personal Disposable Income
TFE = Total Final Expenditure

(a) From the same equation estimated in first differences.

(b) Results for money on a broad definition for both M2 and M3 respectively.

(c) These are the long run elasticities.

(d) Here only the results of the standard approach are summarised, and not the attempts to provide an improved specification.

(e) In this case the short rate is the three-month Eurodollar rate, and the long rate is the dividend-price ratio on ordinary shares.

(f) These are not the interest elasticity, but the elasticity times one plus the rate of interest divided by the rate of interest.