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THE ROLE OF MONEY SUPPLY SHOCKS IN THE SHORT-RUN DEMAND FOR MONEY

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This paper integrates a shock-absorber response to money supply shocks into a standard model of the short-run demand for money. In doing so, we argue that open market operations which unexpectedly increase money holdings do not lead to an immediate adjustment of money spending and receipt plans. The effect of the monetary shock variable on short-run money demand appears to be significant in both the statistical and economic sense. Its omission has biased previous estimates of long-run income and interest rate elasticities of money demand.

In Section I of the paper we present our model of the short-run demand for money and derive the implied price level equation. Empirical estimates comparing our model with the standard model are reported in Section II.

I. The Model

Since the pioneering work of Chow (1966) stock adjustment models have been used in formulating the short-run demand for money. The stock adjustment models do not require an equality between actual and desired cash balances. For the demand for money they postulate the following adjustment mechanism:[1]

$$m_t - m_{t-1} = \lambda(m_t^d - m_{t-1}) \qquad (1)$$

where m is actual real cash balances, m^d is desired cash balances and λ is the speed of adjustment. In general (1) can be expressed in nominal or real terms. We will consider (1) to be in real terms with all variables in their logarithmic form. Equation (1) coupled with a theory of desired real cash balances can be used to formulate either an individual or aggregate demand for money function. Since most empirical work is with the aggregate demand for money we will consider (1) as applying economy-wide.

Walters (1967) has pointed out that the adjustment equation (1) takes on a different interpretation when the variables are aggregate variables and expressed in real terms. For an individual the amount of nominal cash balances held is a control variable. Cash balances can be increased or decreased by the individual either by changing the form in which wealth is held (i.e. converting bonds to money or vice-versa) or by changing expenditure patterns. On the other hand, the amount of nominal cash balances available to the community as a whole is given.[2] It is a control variable of the central bank. If the nominal money supply is essentially an exogenous variable, then equation (1) really is a price adjustment equation. This will be the interpretation of (1) taken in this paper.

It is the purpose of this paper to see if equation (1) can be considered as a fair representation of the adjustment process that takes place in the economy in response to money supply changes. Let us consider two types of money supply change. First let us suppose that at some time between t-1 and t the money supply changes and that this change is perfectly expected. If the nominal money supply changes and this change is perfectly expected by all economic agents then prices should adjust simultaneously leaving real cash balances unaffected.[3] Perfectly expected money supply changes will not affect either side of equation (1). Such changes will not create a discrepancy between actual and desired real cash balances. Thus equation (1) implicitly allows prices to adjust instantaneously to perfectly expected money supply changes.

Now consider the case of a monetary shock or innovation, a money supply change which is completely unexpected, occurring between t-1 and t. With a monetary shock there would be little or no change in the absolute price level in period t. If the monetary shock was an unexpected increase in the nominal money supply, then with little or no change in the price level, real cash balances at the end of period t will be higher than real cash balances at the end of period t-1, by approximately the full amount of the monetary shock plus any lagged adjustment in real money demand.[4] The monetary shock causes an increase in the left-hand side of equation (1). What change that does take place in the R.H.S. variables of equation (1) will be primarily through the monetary shock affecting income and interest variables that influence desired real cash balances at period t. Hence equation (1) does not correctly specify the adjustment process for monetary shocks. A correctly specified version of the adjustment process would be

$$m_t - m_{t-1} = \lambda(m_t^d - m_{t-1}) + v(M_t - M_{t-1}^e) \qquad (2)$$

where M_t is the logarithm of the nominal money supply and M_{t-1}^e is the logarithm of the expected money supply where expectations are formed at t-1 for time t. If monetary shocks do not affect in the current period the price level or any of the variables influencing desired real cash balances, then one would expect w to equal one. To the extent that the above does not hold, w should be positive and less than one.

Equation (2) can be interpreted as underlying the shock-absorber approach to short-run money demand espoused in Darby (1976) as an explanation of (a) lagged effects of money shocks on income and (b) the initial movement of velocity in the opposite direction from the monetary shock.[5] The idea is that an unexpected increase in the money supply -- most likely via an open market operation -- frustrates plans of some potential purchasers of securities. During the period in which they are reformulating their plans, their money holdings are temporarily increased. When they make purchases, other plans are frustrated so that the process of adjustment is spread over time with the aggregate short-run money demand increased.

Since the aggregate real money demand equations, given the nominal money supply, are effectively price level equations[6], it is appropriate to see whether they are sensible as such. Manipulation of equation (1) yields

$$P_t = M_t - [\lambda m_t^d + (1-\lambda) m_{t-1}] \qquad (3)$$

That is, the logarithm of the price level equals the logarithm of the nominal money supply less a weighted average of the logarithms of real long-run money demand and lagged real money. The weighted average real money variable seems sensible, but not so when combined with long lags for effects of nominal money supply shocks on prices. An unexpected increase in M_t would leave P_t unaffected and require (given $\lambda < 1$) disproportionate short-run changes in real income and interest rates. Given the small effect of money shocks on real income in the initial quarter and the low interest elasticity of money in most estimates, the implied interest rate fluctuations are nothing less than incredible.

The shock-absorber equation (2) yields the price level equation

$$P_t = [wM^e_{t-1}+(1-w)M_t] - [\lambda m^d_t+(1-\lambda)m_{t-1}] \qquad (4)$$

In this case the logarithm of the price level is determined as the difference of two weighted averages. The terms in the second set of brackets are the same as in equation (3). The terms in the first set of brackets are a weighted average of the logarithms of the actual and expected nominal supply. The greater is the weight w, the less is the required initial period adjustment of real income and especially interest rates. Thus our approach seems to give a more reasonable view of the adjustment process than the standard formulation of equation (1).

Estimation of equation (1) when the correct adjustment mechanism is equation (2) implies biased parameter estimates. The bias in the parameter estimates can be derived for a given desired cash balances equation:

$$m^d_t = \alpha + \beta y^p_t + \gamma(y_t-y^p_t) + \delta i_t + \varepsilon_t \qquad (5)$$

where y^p = logarithm of permanent income

y = logarithm of actual income

i = nominal interest rate

Combining equation (5) with the stock adjustment mechanism (1) yields the standard short-run demand for money:[7]

$$m_t = \lambda\alpha + \lambda\beta y^p_t + \lambda\gamma(y_t-y^p_t) + \lambda\delta i_t + (1-\lambda)m_{t-1} + \lambda\varepsilon_t \qquad (6)$$

Combining (5) with the correctly specified stock adjustment mechanism (2) yields[8]

$$m_t = \lambda\alpha + \lambda\beta y^p_t + \lambda\gamma(y_t-y^p_t) + \lambda\delta i_t + (1-\lambda)m_{t-1} + w[M_t-M^e_{t-1}] + \lambda\varepsilon_t \qquad (7)$$

Equation (7) is the correctly specified demand for money whereas equation (6) is the one commonly estimated. Here we have a classical case of a left-out variable.

The bias in the parameter estimates will depend on the coefficient of the left-out variable (which is positive in this case) and the coefficients in the auxiliary regression of the left-out variable $M_t - M^e_{t-1}$ on all the included variables y^p_t, $y_t - y^p_t$, i_t, m_{t-1}.[9] Although the signs of the coefficients in this regression depend upon the signs of partial correlation coefficients, one may get a good idea of the nature of these signs by considering the signs of the simple correlation coefficients. Economic theory tells us that the monetary shock variable is positively correlated with our transitory income variable, is slightly positively correlated with permanent income, is negatively correlated with the interest rate variable and is not related at all to real cash balances at the end of period t-1. Since the direction of parameter bias depends on the sign of the partial correlation coefficients, one would expect that the estimation of equation (6), instead of equation (7) would result in all parameters, except λ, being biased away from zero. In the case of λ there should be no bias. Permanent and transitory income elasticities will be overestimated and interest rate elasticities will be overestimated (in an absolute value sense). These results can easily be rationalized. An unexpected monetary increase will initially cause real cash balances to rise, since the price level has not had time to adjust. In addition the monetary shock will cause income, both transitory and permanent to rise and interest rates to fall. If the monetary shock variable is not in the demand for money, the rise in real cash balances will be attributed by the regression solely to the rise in income and fall in interest rate. This will result in an over-estimate of all the relevant elasticities.

II. Empirical Estimates

Let us now see if the empirical evidence supports our theoretical arguments. Quarterly U.S. data were collected for the period 1947 I to 1971 II. The sample period was terminated at the second quarter of 1971 to exclude the questionable data from the price control period. The variables — all in natural logarithms except the interest rate — are:

M_1	Currency and demand deposits adjusted, seasonally adjusted quarterly averages (SAQA)
M_2	M_1 plus time deposits at commercial banks, excluding large negotiable CD's, SAQA
N	Total U.S. population, midquarter estimate
P	Implicit price deflator for gross national product, 1958 = 1.00
Y	Real gross national product, seasonally adjusted annual rates
Y_P	Permanent income[10]
i	Market yield on 90-day U.S. Treasury bills

In order to estimate equation (7) a monetary shock variable had to be created. For this purpose the following equation was estimated for both M_1 and M_2:

$$M_t = a + bM_{t-1} + \sum_{i=1}^{15} w_i(M_{t-i} - M_{t-i-1}) + u_t \qquad (8)$$

The residual from this equation, u_t, was used as our estimate of monetary surprise or monetary shock. This variable represents the unpredictable part of the money supply series.[11] This series is presented in the appended Table A.

Table 1 presents ordinary least squares (OLS) estimates of equation (6) and (7) using both the M_1 and M_2 definitions of money for the period 1951 I to 1971 II.[12] For equation (6) and (7) all variables except the interest rate variable are in logarithmic form and the money and income variables, with the exception of the monetary shock variable, are in real per capita terms. Real money balances are

Table 1

Parameter estimates of Demand for Money, 1951 I - 1971 II

Equation No.	Money Variable	Method of Estimation	$\lambda\alpha$	$\lambda\beta$	$\lambda\gamma$	$\lambda\delta$	$1-\lambda$	w	β	δ	S.E.E.	R^2	D.W.
6	M_1	OLS	-.0704 (-6.99)	.0770 (5.71)	.1067 (4.25)	-.0059 (-5.89)	.9680 (44.72)		2.41	-.1844	.00593	.9851	1.09
7	M_1	OLS	-.0594 (-5.80)	.0630 (4.63)	.0889 (3.62)	-.0047 (-4.50)	.9690 (47.07)	.5442 (3.03)	2.03	-.1516	.00563	.9867	1.14
6	M_2	OLS	-.1563 (-7.58)	.1987 (7.65)	.1632 (4.38)	-.0097 (-10.28)	.9237 (34.70)		2.60	-.1271	.00568	.9978	1.17
7	M_2	OLS	-.1403 (-6.74)	.1781 (6.77)	.1389 (3.74)	-.0084 (-8.10)	.9308 (36.03)	.4381 (2.59)	2.57	-.1214	.00548	.9979	1.25
6	M_1	GLS	-.0506 (-3.86)	.0498 (2.77)	.1498 (4.40)	-.0055 (-5.02)	.9390 (32.40)		.8150	-.0905	.00461	.9952	1.64
7	M_1	GLS	-.0399 (-3.42)	.0377 (2.38)	.1261 (4.25)	-.0042 (-4.14)	.9484 (38.96)	.5026 (4.28)	.7310	-.0817	.00416	.9961	1.55
6	M_2	GLS	-.1322 (-6.08)	.1733 (6.07)	.1812 (3.81)	-.0092 (-8.26)	.9221 (27.15)		2.225	-.1181	.00483	.9977	1.71
7	M_2	GLS	-.1121 (-5.45)	.1465 (5.42)	.1478 (3.33)	-.0077 (-6.89)	.9372 (30.32)	.4271 (3.43)	2.332	-.1232	.00452	.9980	1.63

t - statistics appear in parenthesis below parameter estimates.

obtained by dividing the nominal money stock by the implicit GNP price deflator. Equations (6) and (7) were estimated using both GNP and private income as the income variables.[13] As the results using the two definitions had no substantive differences, only the GNP results are reported in Table 1. Since the Durbin-Watson statistics for the ordinary least squares regressions indicated positive serial correlation and since serial correlation is especially troublesome in the presence of a lagged defendent variable, Table 1 also presents generalized least squares (GLS) estimators of the parameters of equations (6) and (7). Generalized least squares estimators were obtained by the Cochrane-Orcutt (1949) method.[14]

The first point to notice is that the monetary shock variable enters all regressions with the correct sign and is statistically significant at the 1% level of significance. The coefficient of the monetary shock variable is between .5 and .55 for M_1 and .4 and .45 for M_2.[15] Next it should be noted that the inclusion of the monetary shock variable affects all parameter estimates precisely as predicted by a priori theorizing. Adding the monetary shock variable reduces all short-run income elasticities and reduces in absolute value the interest rate elasticity. This result holds for all long-run elasticities with the exception of the long-run elasticities obtained for M_2 using generalized least-squares. Here the inclusion of the monetary shock variable reduces the estimate of λ enough to cause the ordering of the long-run elasticities to be different from the ordering of the short-run elasticities.[16] With the monetary shock variable in the regression, the generalized least-squares results yield a long-run permanent income elasticity of .73 for M_1 and 2.33 for M_2. These nonlinear estimates of the long-run elasticities should be treated with care since small changes in the parameter estimates of $1-\lambda$ will lead to large changes in the long-run elasticities.[17]

The generalized least squares results yield values of λ between .05 and .08. This means that between 5% and 8% of the difference between desired and actual real cash balances is eliminated in the aggregate each quarter.

Some consideration must be given to possible simultaneous equation bias since we have not embedded equation (7) in a full-scale macroeconomic model -- an obvious topic for future research beyond the scope of the present paper. The possibility of such bias in the standard coefficients is a well-covered drilling ground and that story will not be repeated here. The main new issue is whether the money supply reacts passively to disturbances in the money demand function. In that case our money-supply shock variable might serve as no more than a proxy for shocks in the money demand function. From here too the path of the debate is well-trodden. No conclusive answer can be hoped for until money-supply shock variables have been tried in money demand equations in a variety of simultaneous models.

Theoretical considerations led us to believe that the ordinary stock adjustment models as applied to the demand for money are misspecified. A correct specification of the adjustment feature needs a monetary shock variable as part of this procedure. All our empirical results verify this theoretical proposition.

REFERENCES

Barro, R. J. "Unanticipated Money Growth and Unemployment in the United States," American Economic Review 67 (March 1977): 101-15.

Box, G. E. P., and Jenkins, G. M. Time Series Analysis: Forecasting and Control. San Francisco: Holden-Day, Inc., 1970.

Chow, G. C. "On the Long-Run and Short-Run Demand for Money," Journal of Political Economy 74 (April 1966): 111-31.

Cochrane, D. and Orcutt, G. H. "Application of Least Squares Regression to Relationships Containing Autocorrelated Error Terms," Journal of the American Statistical Association 44 (March 1949): 32-61.

Cooper, J. P. "Asymptotic Covariance Matrix of Procedures for Linear Regression in the Presence of First Order Serially Correlated Disturbances," Econometrica 40 (March 1972): 305-310.

Darby, M. R. "The Allocation of Transitory Income Among Consumers' Assets," American Economic Review 62 (December 1972): 928-41.

__________. "The Permanent Income Theory of Consumption -- A Restatement," Quarterly Journal of Economics 88 (May 1974): 228-50.

__________. Macroeconomics: The Theory of Income, Employment, and the Price Level. New York: McGraw-Hill Book Co., 1976.

__________. "The Consumer Expenditure Function," Explorations in Economic Research, forthcoming 1977.

__________. "The Monetary Approach to the Balance of Payments: A Review Article," Journal of Finance, forthcoming 1978.

Goldberg, M. S., and Thurston, T. B. "Monetarism, Overshooting, and the Procyclical Movement of Velocity," Economic Inquiry 15 (January 1977): 26-32.

Lucas, R. E., Jr. "Some International Evidence on Output-Inflation Tradeoffs," American Economic Review 63 (June 1973): 326-34.

Sargent, T. J. "A Classical Macroeconometric Model of the United States," Journal of Political Economy 84 (April 1976): 207-37.

____________, and Wallace, N. "'Rational' Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule," Journal of Political Economy 83 (April 1975): 241-254.

Theil, H. Principles of Econometrics. New York: John Wiley & Sons, Inc., 1971.

Walters, A. A. "The Demand for Money -- The Dynamic Properties of the Multiplier," Journal of Political Economy 75 (June 1967): 293-98.

Table A

Money Supply Shock Variable

Year & Quarter	$M_t - M^e_{t-1}$	
	M_1 definition	M_2 definition
1951 I	.00431	.00135
1951 II	.00164	.00050
1951 III	.00345	.00270
1951 IV	.00712	.00379
1952 I	.00184	.00154
1952 II	.00066	.00049
1952 III	.00312	.00262
1952 IV	.00253	.00290
1953 I	-.00566	-.00265
1953 II	.00331	.00336
1953 III	-.00269	-.00050
1953 IV	.00093	.00283
1954 I	-.00253	-.00114
1954 II	-.00315	.00053
1954 III	.00539	.00477
1954 IV	.00076	-.00243
1955 I	.00128	.00097
1955 II	-.00298	-.00307
1955 III	-.00208	-.00174
1955 IV	-.00339	-.00324
1956 I	.00101	-.00171
1956 II	-.00320	-.00134
1956 III	-.00268	-.00222
1956 IV	.00243	-.00176
1957 I	-.00350	-.00024
1957 II	-.00514	-.00502
1957 III	-.00171	-.00208
1957 IV	-.00809	-.00651
1958 I	.00294	.00515
1958 II	.00833	.01024
1958 III	-.00308	-.00741
1958 IV	.00255	-.00219
1959 I	.00231	.00444
1959 II	-.00147	-.00414
1959 III	-.00280	-.00422
1959 IV	-.01232	-.01060
1960 I	.00057	-.00128
1960 II	.00173	.00252
1960 III	.00488	.00528
1960 IV	-.00927	-.00765
1961 I	.00173	.00043
1961 II	.00175	-.00122
1961 III	-.00158	-.00119
1961 IV	.00066	-.00335

Table A (Continued)

Year & Quarter	$M_t - M^e_{t-1}$	
	M_1 definition	M_2 definition
1962 I	-.00275	.00347
1962 II	-.00065	.00017
1962 III	-.00421	-.00424
1962 IV	.00308	.00618
1963 I	.00058	.00140
1963 II	-.00112	-.00053
1963 III	-.00068	-.00208
1963 IV	.00420	.00478
1964 I	-.00382	-.00389
1964 II	.00310	.00447
1964 III	.00343	.00132
1964 IV	.00055	.00362
1965 I	-.00501	.00086
1965 II	.00339	-.00118
1965 III	.00199	.00553
1965 IV	.00438	.00665
1966 I	-.00302	-.00514
1966 II	.00039	.00224
1966 III	-.00981	-.00457
1966 IV	.00132	.00020
1967 I	.00284	.00702
1967 II	.00146	.00351
1967 III	.00584	.00455
1967 IV	-.00304	-.00445
1968 I	.00247	.00064
1968 II	.00498	.00224
1968 III	-.00115	.00133
1968 IV	.00131	.00377
1969 I	.00282	-.00291
1969 II	-.00215	-.00452
1969 III	-.00326	-.01012
1969 IV	-.00545	-.00306
1970 I	-.00172	-.00856
1970 II	.00162	.00725
1970 III	.00002	.00030
1970 IV	-.00020	-.00063
1971 I	.00365	.00595
1971 II	.00498	.00116

FOOTNOTES

1. Other variants of (1) are possible. The main point of this paper applies equally well to these other variants.

2. We do not consider the possibility of individuals affecting the nominal money supply through political lobbying. Our analysis applies directly only to a reserve-currency country such as the U.S.; otherwise induced balance-of-payments flows might not be sterilized completely by the monetary authorities (see Darby (1978)).

3. This is the central implication of the rational expectations approach associated with Lucas (1973), Sargent and Wallace (1975), Sargent (1976), and Barro (1977).

4. Equation (1) does not explicitly allow for full adjustment of real money balances for normal growth in real money balances. This will be reflected in the constant term however, and need not concern us here.

5. See Goldberg and Thurston (1977) for evidence that this short-run response appears to dominate the cyclical movements of velocity in the postwar U.S.

6. The empirical results in Table 1 below are identical to those of the corresponding price level equations except that the signs on the coefficients are reversed.

7. This form of the equation is meant to represent the sort of money demand equation which is usually estimated. Following Chow (1966) a stock adjustment mechanism of the form $m_t - m_{t-1} = \lambda(m_t^d - m_{t-1}) + u(a_t - a_{t-1})$ where a is real wealth, combined with a demand for money $m_t^d = b + ca_t + di_t$ and combined with the assumption that consumption is proportional to permanent income and permanent income is proportional to wealth will yield equation (6). Alternatively following Darby (1972) a stock adjustment model of the form $m_t - m_{t-1} = \phi(y_t - y_t^p) + \lambda(m_{t-1} - m_{t-1}^d) + (m_t^d - m_{t-1}^d)$ combined with equation (5)

without the transitory income term will yield a similar equation

$$m_t = \lambda\alpha + \beta y_t^P - \beta(1-\lambda)y_{t-1}^P + \phi(y_t - y_t^P)$$

$$+ \delta i_t - \delta(1-\lambda)i_{t-1} + (1-\lambda)m_{t-1} + \lambda\varepsilon_t \qquad (6')$$

8. The corresponding equation on the Darby (1972) approach is

$$m_t = \lambda\alpha + \beta y_t^P - \beta(1-\lambda)y_{t-1}^P + \phi(y_t - y_t^P) + \delta i_t$$

$$- \delta(1-\lambda)i_{t-1} + (1-\lambda)m_{t-1} + v[M_t - M_{t-1}^e] + \lambda\varepsilon_t \qquad (7')$$

9. See Theil (1971, pp. 549-550).

10. Computed from Y by use of the unbiased Darby weights of 0.025 per quarter (0.105 per annum); see Darby (1974, 1977) for details.

11. Using M_1, the R^2 for equation (8) was .9995, the standard error of estimate was .00427 and the Durbin-Watson statistic was 2.00. Using M_2, the R^2 for (8) was .9998, the standard error of estimate was .00460 and the Durbin-Watson statistic was 1.99. An argument is frequently made that the approach of Box and Jenkins (1970) is to be preferred because it is more parsimonious with respect to parameters and data lost in lagging. Given the experimentation involved in fitting we are not convinced of the parsimony of the procedure and would wish to exclude the pre-accord data in any case.

12. The first four years of data were lost due to the lags in equation (8).

13. The private income series and corresponding permanent income were taken from the data appendix to Darby (1977). The personal consumption deflator was used as the price index for these regressions to correspond to the income data.

14. With a lagged dependent variable the Cochrane-Orcutt method yields asymptotically biased estimators of the standard errors of the coefficients. The standard errors of the coefficients were calculated according to Cooper (1972).

15. Constrained least-squares estimates of equations (6') and (7') yielded the following parameter estimates:

Equ. type	α	β	ϕ	δ	λ	w	S.E.E.
6', M_1	-0.16	-0.10	0.081	-0.004	0.056		0.0068
	(-0.94)	(-0.72)	(2.56)	(-0.24)	(2.42)		
7', M_1	-0.28	0.01	0.041	0.003	0.036	1.00	0.0058
	(-0.98)	(-0.04)	(1.37)	(1.73)	(1.81)	(5.55)	
6', M_2	-0.74	0.92	0.087	-0.005	0.087		0.0086
	(-5.79)	(8.22)	(1.51)	(-2.02)	(2.40)		
7', M_2	-1.27	1.28	-0.050	0.005	0.024	1.39	0.0072
	(-1.30)	(1.95)	(-0.84)	(2.02)	(0.86)	(6.04)	

The estimated coefficients for the long-run parameters do not follow any neat pattern. The log-linear approximation to Darby's (1972) linear model may have been inappropriate. Clearly the estimated equations put more emphasis on the money shock-variables and less emphasis on intraperiod adjustments in real income and interest rates than the estimates in Table 1.

16. It should be noted that $\lambda\delta$ and δ are not the short-run and long-run interest rate elasticities. To obtain the interest-rate elasticities, these parameters have to be multiplied by the level of the interest rate. For the period 1951 I - 1971 II the average value for the short-term interest rate was 2.90.

17. For example a change in $1-\lambda$ from .95 to .975, ceteris paribus, will result in a doubling of the long-run elasticities. It is improper to treat γ as the long-run transitory income elasticity since transitory income cannot persist in the long-run.