The Interest Elasticity of Money
Demand: Further Evidence

Ahmet Baytas and Alvin L. Martyn

INTRODUCTION

In recent years, autonomous and induced market developments, financial deregulation, and the spread of cash-management techniques, have made available a richer array of financial assets. Some assets have both investment and transaction capabilities and blur the distinction between "money" held for transactions and assets held for portfolio purposes. It has been suggested that these developments may have altered the traditional relationship between the money stock, interest rates, and GNP (Judd and Scadding 1982, Roley 1985).

Thus, the growth of money substitutes is often held to increase the interest elasticity of the money demand function, a proposition initially advanced by Garley and Shaw (1960). In an empirical study covering the period 1953.1-1975.4, Hafer and Hein (1984) found no increase in the interest elasticity of demand for M1 and rejected the Garley and Shaw thesis. However, we would expect that in the 1980s, a period characterized by deregulation as well as financial innovation, several factors, such as increased flows of funds within and between monetary aggregates and redeployment of these aggregates, proliferation of money substitutes, and contamination of M1 by more interest sensitive portfolio balances, would lead to an increased interest elasticity. In fact, we show that when the sample period is extended to 1987.11, this elasticity does increase. Moreover, when explicit interest paid on M1 balances is incorporated into the demand function (a variable which Hafer and Hein did not deal with), we find that the elasticity of M1 with respect to the net opportunity cost of holding such balances has also increased.

An important related question concerns the impact of deregulation on the LM schedule as well as on the interest elasticity of money demand. Although empirical evidence on the slope of the LM schedule is inconclusive, we show in section 3 that any effect of deregulation on the slope depends on the specification of the money demand function, and on the manner in which interest is paid on M1.

ESTIMATION RESULTS

We use the same money demand function specification employed by Hafer and Hein,

\[ \ln (M/P) = \alpha + \beta \ln y + \gamma \ln RCP + \delta \ln (M/P)_s + \epsilon \]

where \(M\) is nominal balances (currency plus all checkables), \(P\) is the GNP deflator (1972 = 100), \(y\) is the real GNP (1972), and \(RCP\) is the interest rate on 4-6 month commercial paper.

We estimate equation (1) over the period 1950.1-1987.11. As in Hafer and Hein, a "log-rolling" procedure is adopted: we start with the sample 1950.1-1965.4 and increment this sample by adding five years at the start and end points. This enables us to estimate five equations, the last of which covers 1970.1-1983.4. Then we estimate two additional equations covering 1974.1-1987.11 and 1978.1-1987.11. It is in these periods of financial innovation and deregulation that a change in the interest elasticity may occur.

The regression results are presented in Table 1. A dummy variable, with a value of zero until 1974, and a value of one otherwise, is used, when appropriate, to account for the shift in the demand function.

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TABLE 1
Money Demand Regression Results

<table>
<thead>
<tr>
<th>Sample</th>
<th>Coefficient Estimates</th>
<th>Summary Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>RCP</td>
</tr>
<tr>
<td>1960-1963 IV</td>
<td>0.046</td>
<td>-0.023</td>
</tr>
<tr>
<td>(2.10)</td>
<td>(2.58)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>1955-1968 IV</td>
<td>0.068</td>
<td>-0.009</td>
</tr>
<tr>
<td>(4.33)</td>
<td>(2.63)</td>
<td>(16.22)</td>
</tr>
<tr>
<td>1960-1973 IV</td>
<td>0.147</td>
<td>-0.016</td>
</tr>
<tr>
<td>(2.97)</td>
<td>(2.90)</td>
<td>(2.65)</td>
</tr>
<tr>
<td>1965-1978 IV</td>
<td>0.046</td>
<td>-0.020</td>
</tr>
<tr>
<td>(2.77)</td>
<td>(4.73)</td>
<td>(17.04)</td>
</tr>
<tr>
<td>1970-1983 IV</td>
<td>0.084</td>
<td>-0.022</td>
</tr>
<tr>
<td>(4.08)</td>
<td>(4.73)</td>
<td>(17.59)</td>
</tr>
<tr>
<td>1974-1987 II</td>
<td>0.130</td>
<td>-0.029</td>
</tr>
<tr>
<td>(3.88)</td>
<td>(3.77)</td>
<td>(28.78)</td>
</tr>
<tr>
<td>1978-1987 II</td>
<td>0.107</td>
<td>-0.035</td>
</tr>
<tr>
<td>(3.55)</td>
<td>(4.45)</td>
<td>(15.49)</td>
</tr>
</tbody>
</table>

All regressions equations are estimated using OLS. In each Cressie-Oxner procedure is used to correct for serial correlation. Like Hafer and Hein, we find that use of the maximum likelihood grid search technique yielded identical results. Constant term is not reported. Numbers in parentheses are t-statistics. SEE is the standard error of the estimate. DW denotes Durbin-Watson statistic. \( R^2 \) is adjusted for degree of freedom. RHO is the estimate of the first-order serial correlation coefficient. The quarterly data for all variables is obtained from Citibase Data Bank (formerly FERBER Data Bank).

Since sample periods are different, it is not possible to compare our findings directly with those obtained by Hafer and Hein. However, as table 2 indicates, we obtained the same estimates for all coefficients from the 1960-1979 IV period.

All coefficient estimates are significant at the 5 percent level with theoretically correct signs. Both the short-run and long-run income elasticities have increased over time. In particular, the 1974-1987 II sample yields a short-run income elasticity of 0.394 compared to 0.646 obtained from the 1950-1963 IV sample. The long-run income elasticity estimates for the latter sample is only 0.13, whereas the samples 1974-1987 II and 1978-1987 II yield estimates that exceeds one. The speed of adjustment of real balances varies from about 7 to about 27 percent per quarter with no discernible trend over time.

The estimated short-run interest elasticity from the 1960-1973 IV sample, before the new financial environment took shape, is the lowest, -0.016, while the estimate of -0.047 from the 1978-1987 II sample is the largest. The 1974-1987 II sample also yields an estimate, -0.029, which is significantly larger than -0.016 at the 5 percent level. The long-run interest elasticity estimate from the sample 1974-1987 II, -0.414, is the largest. Although the 1978-1987 II sample yields a lower estimate of -0.289, it is larger than the estimates of -0.069 and -0.043 obtained from the 1950-1963 IV and

TABLE 2
Comparison of Regression Results, 1960-1979 IV

<table>
<thead>
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</tr>
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<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>RCP</td>
</tr>
<tr>
<td>Hafer and Hein</td>
<td>0.064</td>
<td>-0.017</td>
</tr>
<tr>
<td>(4.00)</td>
<td>(3.56)</td>
<td>(19.50)</td>
</tr>
<tr>
<td>Buxton and Mitty| 0.064</td>
<td>-0.018</td>
<td>0.895</td>
</tr>
<tr>
<td>(2.25)</td>
<td>(5.60)</td>
<td>(22.99)</td>
</tr>
</tbody>
</table>

Whereas the 1960-1973 IV sample, respectively. These findings indicate that the interest elasticity of demand for money with respect to the open market rate has increased, particularly during the 1978-1987 II period. The money demand function specification used above does not take into account the explicit interest paid on M1 components (NOW and ATS balances). Such components increased in size and importance after the Depository Institutions Deregulation and Monetary Control Act of 1980. Therefore, we replaced RCP by the net opportunity cost of holding M1, R, defined as RCP minus the proportion of other checkable in M1 times the interest rate earned by other checkables.

The regression results are summarized in table 3. The short-run elasticity estimates obtained from the samples 1974-1987 II and 1978-1987 II are -0.030 and -0.045, respectively. As the comparison of table 1 and table 3 indicates, these elasticities are virtually identical to those obtained from regressions using RCP as the opportunity cost variable. Hence, we conclude that the interest elasticity of demand for M1 balances with respect to the net opportunity cost of holding such balances has also increased.

RECENT DEVELOPMENTS AND THE SLOPE OF LM

We now turn to a theoretical analysis of the effect of deregulation on the slope of the LM schedule. Some economists, notably Tobin (1983), have claimed that deregulation has steepened the LM schedule. If initially the parameters of the LM schedule captured the variance of real output, a steepening of the LM schedule would need to be offset by an increase in the interest sensitivity of money supply to maintain the original slope. This is a policy implication which Tobin derives. Within the framework of the Podo (1980) model, it can be shown that any effect of deregulation on the slope of LM depends on both the specification of the money demand function and on how interest paid on M1.

The payment of interest on money balances increases the demand for such balances, and, in a price fixed world, requires a once-and-for-all increase in the nominal money supply to offset the decline in velocity and restore the rate of interest to its full-employment level. This is the case both in a deterministic model (in which the IS and LM schedule are not subject to shocks) and in a stochastic model (in which such shocks occur). In the analysis that follows, we assume that such an increase in the money supply does not take place and test whether deregulation twists the LM schedule at the given full-employment rate of interest, \( r \), as assumed throughout the variance of shocks to IS and LM are independent of the deregulation. Also, the existence of currency is ignored.

The analysis points two demand function for deposits, a log-linear one and the semi-log Cagan function. In each of these cases, two assumptions are made about the payment of interest on deposits: firstly, that these payments are flexible (continuously indexed against open market rate), and secondly, that these payments are fixed for long time periods. Consider first the case of the log-linear money demand function and the payment of flexible interest:

\[
\text{m} = A \text{e}^{\gamma r(t)} \quad \beta < 0 < \gamma < 1
\]

where \( m \) is real balances, \( A \) is a constant, \( y \) is real income, \( t \) is the open market rate (such as the commercial paper rate). In a competitive banking system subject to a sterile reserve requirement, \( r \) is the

TABLE 3
Money Demand Regression Results

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<tbody>
<tr>
<td></td>
<td>( y )</td>
<td>RCP</td>
</tr>
<tr>
<td>1974-1987 II</td>
<td>0.109</td>
<td>-0.030</td>
</tr>
<tr>
<td>(6.47)</td>
<td>(6.23)</td>
<td>(11.31)</td>
</tr>
<tr>
<td>1978-1987 II</td>
<td>0.142</td>
<td>-0.045</td>
</tr>
<tr>
<td>(3.36)</td>
<td>(3.93)</td>
<td>(18.90)</td>
</tr>
</tbody>
</table>
net opportunity cost of holding \( m \). When \( r = 1 \), no explicit interest is paid on deposits. Note that

\[
dm/dr|_{r_{-}} = -m/r
\]

which is independent of \( r \).

The LM schedule is

\[
m = L(y, r)
\]

and

\[
dr/dy = L_1(y, r)/L_2, \quad \text{where } L_1 = dm/dy, \quad \text{and } L_2 = dm/dr.
\]

Now, \( dm/dy = \alpha(y) y \) and, since as shown,

\[
dm/dr = m/r,
\]

\[
dr/dy|_{r_{+}} = -\alpha(y)/y (m/r) = -(\alpha/y)\beta
\]

which is also independent of \( r \). Thus, the slope of the LM schedule is unchanged. This result is intuitively plausible. Payment of flexible interest \( r(1-r) \) on deposits does not alter the percent swing in \( r \) as \( r \) changes. A rise in \( r \) from 3 to 4 percent (2 percentage points) has, unambiguously, the same impact on causing an \( \% \) reduction in money demand as a rise in \( r \) from 8 to 16 percent (8 percentage points). However, the increase in \( \beta \) would be a factor tending to flatten the LM schedule. Such an increase in \( \beta \), the interest elasticity of money demand, did occur in the late 1970s and early 1980s.

Consider next the semi-log specification,

\[
m = A\exp^\beta r \quad \beta < 0, \quad 0 < \beta < 1.
\]

Since \( L_1 = dm/dy = \alpha(y)y \), and \( L_2 = dm/dr = m/r \), the slope of the LM

\[
(dr/dy)|_{r_{+}} = -(\alpha(y)y)/m/r = -(\alpha/y)\beta
\]

Clearly, lowering \( r \) reduces the spread between \( r \) and \( r(1-r) \) and allows higher interest to be paid on deposits. As a result, \( dr/dy \) increases in absolute value and LM steepens. Intuitively, the reason for this steepening is that payment of flexible interest on deposits lowers the percentage point swing in \( r \) as \( r \) changes. In the extreme case when \( f = 0 \), LM becomes vertical. On the other hand, any increase in \( \beta \) flattens LM.

Now consider the case where interest paid on deposits is regulated by the authorities for long periods. The log-linear demand function becomes

\[
m = A(r - r^0)^\beta
\]

where \( r^0 \) is the regulated interest. The slope of the LM schedule equals

\[
(dr/dy)|_{r_{+}} = -(\alpha/y)\beta (dm(r - r^0))/dr = -(\alpha/y)\beta
\]

so that payment of \( r^0 \) on deposits flattens LM. This result is not surprising, since a given percent change in \( r \) would be associated with a greater swing in \( r - r^0 \). For example, assuming that \( 1 \) percent, a rise in \( r \) from 10 to 12 percent (a 20 percent increase) would increase \( r - r^0 \) from 5 to 7 percent (a 40 percent increase). Again, this effect would be reinforced by the increase in \( \beta \) which characterized the recent years.

Finally, consider the Cagan function,

\[
m = A\exp^\beta(1-r)
\]

Since "dm/dy = \alpha(y)y", and "dm/dr = \beta m", the slope of the LM schedule is

\[
(dr/dy)|_{r_{+}} = -(\alpha/y)m/r = -(\alpha/y)\beta
\]

In this case, the slope of the LM schedule does not change with payment of \( i \). Again, the reason is intuitively obvious: payment of fixed interest \( i \) does not alter the percentage point swing in \( r - r^0 \) as \( r \) changes, and so leaves LM invariant to \( i \). However, once again, any increase in \( \beta \) flattens LM.

CONCLUSIONS

Our empirical results show that the interest elasticity of demand for M1 balances with respect to both the open market rate and the net opportunity cost of holding such balances has increased, particularly in the late 1970s and early 1980s. This is true whether the money demand function is specified in log-linear form or as a semi-log Cagan function. During periods of declining interest rates, this increase in the interest elasticity of the money demand function may well require a temporary increase in high-powered money to offset an unusual decline in velocity. But such a decline in velocity provides no roommate for a permanent increase in high-powered money. Moreover, we show that during the late 1970s and early 1980s, a period of relatively fixed interest payments on M1, there is no theoretical presumption that the LM curve has steepened. Indeed, this is a period characterized by an increase in the interest elasticity of money demand which would tend to flatten LM. However, as deregulation is phased-in and interest is paid more flexibly on M1, it may well be the case that such steepening will occur.\(^5\)

NOTES

1. For a critique of this view, see Marty (1961).
2. Some recent studies have shown increased elasticity \( \kappa \) (e.g., see Kretz and Zimmermann 1986).
3. Our regression yields a Durbin-Watson statistic of 1.94 and a value of \( \rho \) of 0.095.
4. This variable is suggested by Cagan (1985). We are aware that part of our new explanatory variable, \( \kappa \), is derived from the dependent variable, suggesting a host of econometric problems.
5. For simplicity, we assume that all components of M1 are held.
6. For the purpose of study, we drew a line between the log-linear function in this paper.
7. The results obtained using the full log-linear specification are available upon request.
8. It is evident that the exclusion of interest-bearing deposits in M1 has altered the interest elasticity of money demand for M1 balances. Because some M1 assets now pay interest, M1 balances may grow more rapidly and velocity more slowly if market interest rates fall relative to rates paid on M1 deposits.\(^6\)
10. We show in section 3 above that this would be true with the more realistic case of the semi-log form of the money demand function, but not with the log-linear form.

REFERENCES