Financial Innovations and the Interest Elasticity of Money Demand: Some Historical Evidence

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I. Introduction

A number of investigations into the difficulties of estimating the short-run money demand function recently have suggested that the trouble arose because of recent financial innovations [e.g., see 8,9,18,19 and 20. See 15 and 16 for another view]. Essentially two arguments have been put forward: 1) the "true" definition of a transactions money is different from the actual money measure used and 2) recent fluctuations of interst rates, and their general tendency to higher plateaus, have induced new forms of instruments (i.e., new cash management techniques) to circumvent the opportunity cost associated with holding non-interest bearing deposits, or deposits that yield returns far below market rates. In either case, it is argued that the recent emergence of financial innovations or money substitutes has led to a deterioration in the marginal relationships between real money balances (as conventionally measured) and real income and interest rates.[1/]

The specific argument that financial innovations affect the link between interest rates and money demand is not new. Indeed, this focus is the cornerstone of the much debated theories of Gurley and Shaw [13].

They, among others, argued that a proliferation of money substitutes increases the interest elasticity of money demand which, in turn, lessens the Fed's ability to affect economic conditions through open market operations. Although many fail to recognize the origins of the discussion, the recent debate concerning the stability of the money demand function as it relates to monetary policy is molded along much the same lines as that taken over two decades ago.[2/]

Estimates of the money demand function for recent periods should be quite dissimilar to those obtained using historical data if the foregoing argument is correct. This is because the most dramatic changes in the payments mechanism occurred during the past 20 years. [3/] The consequence of this unprecedented surge in financial innovations should be revealed in interest elasticities that are much larger today relative to earlier sample period estimates. Finding this to be true would support the Gurley-Shaw hypothesis and buttress recent claims that financial innovations have produced a much more interest elastic money demand function.

Unfortunately, little empirical work has been done to specifically examine the temporal nature of money demand's interest elasticity. One study of which we are aware was done by Cagan and Schwartz [4] wherein they compared estimated interest elasticities between two periods: I/1921-IV/1931 and I/1954-IV/1971. Based on their findings, they concluded that ". . . the short-run interest sensitivity of money demand has declined as least moderately since the 1920s."[4/]

The purpose of this paper is to provide further empirical evidence on this question. Unlike the Cagan and Schwartz study, we

compare the short- and long-run interest elasticities from a money demand equation estimated across the time period I/1915 to IV/1979.[5/] This data set permits us to examine the temporal sensitivity of real money balances to market interest rate changes. While the results presented are preliminary to a more exhaustive investigation, they suggest that while numerous financial changes that have transpired during the past 65 years have not seriously altered the relationship between real money balances and market interest rates. In the next section, we present the model and the empirical evidence to support this claim. Concluding remarks and policy implications close the paper.

II Empirical Results

To investigate the issue of whether or not financial innovations have increased the interest elasticity of money demand, we have elected to estimate a relatively simple specification. This is

$$(1)\quad \ln (M/P)_t = a_0 + b_1 \ln y_t + b_2 \ln RCP_t + b_3 \ln (M/P)_{t-1} + \varepsilon_t$$

where M represents nominal balances of M1 (currency plus total checkable deposits), P is the GNP price deflator (1975=100), y measures real GNP ($1975) and RCP stands for the prime commercial paper rate.[6/] The specification is common to the recent literature investigating the breakdown in money demand. Since the concern in the theories cited above is about the impact financial innovation on the interest sensitivity of money demand, we confine our analysis to examining the relationship between real money balances and a representative market rate of interest. The commercial paper rate series readily suites this purpose.

Moreover, it is consistently available for the historical period covered and is representative of other market rates.[7/]

To test the hypothesis that financial innovations have positively affected the interest elasticity of money demand, equation (1) was estimated for selected time periods between I/1915 and IV/1979. To study the temporal nature of the interest elasticity of money demand, the following procedure was adopted: Since much recent work has focused on the 1960-1979 period, we begin our estimation with the 20 year period I/1915-IV/1934 and increment this initial sample by adding 5 years to the start and end points. "Log-rolling" the sample in this manner yields 10 regression equations, the last of which covers the recent period of so much concern, I/1960-IV/1979. Even though this log-rolling approach introduces some averaging or smoothing process to the data, the diversity of economic environments across the set of regressions is sufficient to provide ample opportunity for any change in the relationship to occur. Moreover, unlike previous studies, we do <u>not</u> exclude any time period, such as the Great Depression or any of the war years, from our data set. This, we believe, further increases the variability in economic conditions in which changes in the relationship between real money balances and its determinants can be observed.

The regression results for the quarterly equation are presented in table 1.[8/] Preliminary tests using ordinary least squares (OLS) indicated a significant degree of first-order serial correlation in the residuals. The procedure used to correct this problem is a maximum likelihood grid search technique that minimizes the term $RSS(\rho)/[(1-\rho^2)1/T]$ where $RSS(\rho)$ is the residual sum of squares

conditional on rho (ρ). The grid search was done over both positive and negative values of rho with an accuracy of 0.01.[9/] Based on this technique, all the estimated coefficients have the theoretically correct sign and are statistically significant at the 5 percent level.[10/] The h-statistics [see 6] indicate that serial correlation is no longer a problem. Moreover, the equations indicate a generally high degree of explanatory power.

An interesting pattern emerges from the estimated income coefficients. For example, compare the point elasticity from the I/1915-IV/1934 sample, 0.088, to that from the I/1960-IV/1979 period, 0.064. The number of changes that have transpired across these years, financial and otherwise, makes the similarity of these estimates remarkable. The short-run income elasticity does have a tendency, however, to gradually rise throughout the early sample periods and then to decline. The largest coefficient, 0.204, is obtained from the I/1935-IV/1954 sample. From there the coefficient drops to 0.057 for the sample ending in IV/1974, increasing back to 0.064 for the most recent sample period ending in IV/1979. The increase in the short-run income elasticity clearly is attributable to the inclusion of World War II in the sample. Comparison of the coefficient estimates obtained from non-World War II samples eliminates the disparity: the estimated point elasticity for income averages about 0.08 with a range from 0.051 to 0.097.[11/]

Although the short-run income elasticities appear relatively small by some recent standards, the long-run estimates are quite consistent with the theoretical constraints imposed by the transactions

model.[12] The long-run income elasticities reported in table 2 indicate that whenever the sample period does not include World War II, the elasticity estimate varies between 0.55 and 0.61. Like the short-run elasticities, the size of the long-run estimate increases whenever the war years are included, averaging about 1.28.

There is some movement in the estimated lag term, but the large swings one would expect from an inherently unstable relationship do not appear. The lag estimates range from 0.814 for the 1920/I-1939/IV period to 0.912 for the 1950/I-1969/IV period. On average, the estimate is 0.87 with a standard error of 0.04: eight out of ten estimates fall within that range. Interestingly, the results generally indicate that the speed of adjustment $(1-\hat{b}_3)$ is much slower than recent findings suggest. For example, Goldfeld [10] reports the speed of adjustment to be about 35 percent per quarter based on a II/1952-IV/1973 sample period. The largest adjustment factor, obtained from the I/1945-IV/1964 sample, is only about 19 percent per quarter. This yields a mean adjustment lag of about 5 quarters compared with Goldfeld's estimate of almost 3 quarters. Although our estimates indicate a slower adjustment than Goldfeld reported, the regularity of our results suggest that the contrast among findings may result from unique sample characteristics, slightly different model specifications, or both.[13]

Finally, the parameter of importance: the estimated interest elasticity. The estimated commercial paper rate coefficient exhibits a slight upward movement throughout the early sample periods, but this again appears to be an outcome of including World War II. More important for our concern, the interest elasticity of money demand is no higher for

the I/1960-IV/1979 period--noted for its number and diversity of financial innovations and economic changes--than for any other sample in our study. In fact, the estimated short-run elasticity from the I/1960-IV/1979 sample (-0.017) is the lowest estimate obtained for any period. The empirical results presented in table 1 do not, therefore, support the thesis that increased number of financial innovations and money substitutes have increased the interest elasticity of transactions balances over time. Quite the contrary, our results confirm those of Cagan and Schwartz and indicate that the interest sensitivity of money demand has declined over time.

The long-run interest elasticities presented in table 2 tell a similar story. The estimate of -0.16 for the I/1960-IV/1979 sample is the smallest of all calculated. Compared with the I/1915-IV/1934 estimate of -0.20, this indicates that the recent financial innovations have not drastically altered the link between real money balances and market interest rates. Moreover, the estimates suggest that the transactions demand function is relatively interest inelastic. Thus, the empirical results presented indicate that the numerous changes in financial system have not increased either the short- or long-run sensitivity of real money balances to changes in market interest rates. This evidence contradicts the theories of Gurley and Shaw and their modern variants.

III Conclusion and Policy Implications

The evidence presented in this study indicates that the interest elasticity of money demand has not increased during the past 65 years.

If anything the empirical results point to a decline in the elasticity during the most recent period vis-a-vis other non-war periods tested. These findings, contrary to the theories of Gurley and Shaw, indicate that financial innovations and other economic developments have not increased the interest elasticity of money demand.

Recent discussions of monetary policy have focused on the behavior of money demand, especially the impact of new cash management techniques on the estimated relationship. More specifically, it is argued that recent financial developments have destabilized the relationship between money demand and market interest rates and real income, thus making monetary targeting a questionable policy goal.[14] Our results suggests otherwise: they point to an empirical association that is remarkably consistent across the varied and sometimes turbulent economic conditions covered by our data. Thus, claims of uncontrollable money due to shifts in the economic relationship embodied in the money demand function must be viewed skeptically.

FOOTNOTES

1/ One of the clearest statements to this effect is given by Axilrod and Lindsey: "... as more and more substitutes for money evolve, as different forms of money develop, and as financial technology becomes more and more computerized and transfers for payments out of almost any and all assets can be made rapidly by electronic means, it may become increasingly difficult to detect--indeed, to believe in--a stable demand function for money. [1, p. 252, emphasis added].

2/ A similar argument can be found in Simons [21].

3/ An excellent chronology of financial innovations since WWII is given in [17].

4/ [4], p. 154.

5/ This data set is used in Gordon [12]. See footnote 6.

6/ M1 is the current definition of money. The data for prices and real GNP are taken from Gordon [11]. Briefly, Gordon utilizes the interpolation techniques of Chow and Lin [4] to generate consistent time series for real GNP and the GNP deflator. The real GNP series is "guided" intrayear by the Index of Industrial Production and Retail Sales deflated by the Consumer Price Index, each of which is available monthly. The GNP deflator is generated using the Consumer and Wholesale Price indexes. See [12], pp. 1113-15 for a more detailed description.

7/ One aspect of the specification deserves comment: the omission of rates of return on demand deposits prior to 1933 and rates on savings deposits since then. The major obstacle precluding the use of rates paid on demand deposits is data availability: the only data available appear to be in annual form and for the period 1927-1932. With regard to a reliable series on savings deposit rates, availability remains a key consideration. Moreover, for the early years of the sample the data are annual figures. Finally, savings rates are artificially restricted by Regulation Q ceilings after 1933, thus causing some skepticism with regard to their usefulness in capturing the true opportunity cost of holding money. It should also be noted that the study by Cagan and Schwartz [4] found that incorporating the savings deposit rate into an equation similar to equation (1) produced no change in the estimated interest elasticity (using the commercial paper rate) for the period I/1921 to IV/1931. Thus, not unlike previous studies, we shall focus on the specification given above.

8/ Note that the regression equation for the I/1960-IV/1979 sample includes a intercept shift term. This is based on the analysis of [16] who demonstrate that the function underwent a statistically significant downward shift in early 1974.

9/ This procedure circumvents the problems associated with the Cochrane-Orcutt technique; namely, the possible iteration to a non-global minimum of the regression standard error. On this point, see [3].

10/ The estimated coefficient on real income for the sample I/1920-IV/1939 is significant at the 10 percent level, based on a two-tailed test. Since the sign can be hypothesized a priori, use of a one-tailed test may be appropriate. If so, then all the coefficients achieve significance at the 5 percent level.

11/ The change in income elasticity brought about by including the war years should not be surprising. During the 1940-45 period, the money stock increased rapidly and the rate of price increase was moderated by domestic controls. Real balances, consequently, increased rapidly: real money balances (M/P) increased from $1.31 billion in I/1940 to $2.69 billion in IV/1945, an increase of 105 percent. Real income, however, increased at a slower rate during this period, rising from $331.5 billion in I/1940 to $515.2 billion in IV/1945, or an increase of 55. Thus, due to the substantial rise in the real money balances relative to GNP, the regression estimate of the income elasticities increase during the periods including the 1940-45 period and return to "normal" levels once this period is omitted.

12/ The long-run elasticities are calculated as $\hat{b}_i/\lambda$ where $\lambda = 1-\hat{b}_3$; $i = 1,2$. See [2] for a discussion of the theoretical constraints implied by the transaction model.

13/ For example, Goldfeld includes a commercial bank passbook rate in his specification.

14/ One view of the relationship between money demand and monetary policy is expressed in the following quote:

> The sharp drop of money growth in the second quarter [1980] raises the question of the stability of money demand over a longer run and therefore the appropriateness of predetermined monetary objectives." [1, p. 251]

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Table 1
Short-Run Money Demand Regression Results
1915/I-1979/IV

	Estimated Coefficients[1]				Summary Statistics[2]			
stimation Period	Constant	y_t	RCP_t	$(M/P)_{t-1}$	$\bar{R}^2$	σ	h	$\hat{\rho}$
/1915-IV/1939	-0.493 (2.01)	0.088 (2.05)	-0.030 (2.75)	0.852 (14.27)	0.980	0.019	0.06	0.37 (2.88)
/1920-IV/1939	-0.536 (1.91)	0.097 (1.96)	-0.036 (3.29)	0.825 (12.00)	0.990	0.018	0.66	0.45 (3.40)
/1925-IV/1944	-0.653 (2.65)	0.118 (2.72)	-0.024 (3.17)	0.907 (20.84)	0.997	0.018	-0.01	0.37 (3.13)
/1930-IV/1949	-0.923 (4.38)	0.166 (4.46)	-0.026 (3.88)	0.866 (31.60)	0.997	0.021	-0.22	0.32 (2.88)
/1935-IV/1954	-1.146 (5.69)	0.204 (5.81)	-0.037 (4.37)	0.842 (32.13)	0.996	0.019	-0.59	0.34 (3.09)
/1940-IV/1959	-0.871 (5.16)	0.155 (5.46)	-0.039 (5.43)	0.881 (40.68)	0.988	0.017	-0.64	0.30 (2.73)
/1945-IV/1964	-0.415 (3.55)	0.091 (4.33)	-0.036 (3.75)	0.814 (14.28)	0.941	0.014	-0.55	0.22 (1.72)
/1950-IV/1969	-0.244 (3.70)	0.051 (3.94)	-0.018 (3.89)	0.912 (18.27)	0.979	0.006	0.05	0.46 (3.83)
/1955-IV/1974	-0.281 (5.28)	0.057 (4.82)	-0.020 (6.06)	0.905 (21.66)	0.994	0.004	0.35	0.46 (4.03)
/1960-IV/1979[3]		0.064 (4.69)	-0.017 (5.06)	0.895 (19.50)	0.990	0.005	0.57	0.20 (1.64)

All variables enter logarithmically. Absolute values of t-statistics are shown in parentheses.

[2] $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom, σ is the standard error of the regression, h is Durbin's h-statistic and ρ is the maximum likelihood estimate of rho.

A constant term is not reported for the I/1960-IV/1979 regression because of the use of the level shift parameter. Setting the dummy variable equal to 1 for the period II/1974-IV/1979 and 0 otherwise, the estimated constant term is -0.326 (5.12) and the dummy coefficient is -0.014 (4.13). Thus, the estimated constant term for the period prior to II/1974 is -0.326 and after II/1974 it is -0.339.

Table 2

Estimated Long-Run

Elasticities*

Estimation Period	Income	Interest Rate
I-1915/IV/1934	0.59	-0.20
I/1920-IV/1939	0.55	-0.21
I/1925-IV/1944	1.27	-0.26
I/1930-IV/1949	1.24	-0.19
I/1935-IV/1954	1.29	-0.23
I/1940-IV/1959	1.30	-0.33
I/1945-IV/1964	0.59	-0.19
I/1950-IV/1969	0.58	-0.20
I/1955-IV/1974	0.60	-0.21
I/1960-IV/1979	0.61	-0.16

*Based on estimates found in table 1.