Transactions Demand for Money: The Micro Evidence

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In monetary economics, the effect of an exogenous change in money supply on general economic activities is critically dependent upon the predictability of money demand. It is therefore not surprising that poor performances of aggregate money demand in recent decades have received great attentions in the literature. Using microeconomic data, the Baumol-Tobin model, and the life-cycle theory this study shows that when the long-run money demand model is directly estimated without its short-run counterpart, money demand is essentially a predictable function of income, interest rates, and a set of demographic variables. This implies that the long-run impacts of monetary policies on interest rates, incomes, employment, and prices are not as uncertain as those found in past standard aggregate money demand studies.

Introduction

In the literature, money demand plays a crucial role in the relationship between money supply and general economic activities When money demand is unpredictable, an increase in the quantity of money supply by the monetary authority does not necessarily lead to a fall in the rate of interest or a rise in the levels of investment, income, and employment. According to the standard model of aggregate money demand in the post-1973 literature, money demand usually is divided into a short-run component and a long-run component. The long-run component is based on the Baumol-Tobin inventory-theoretic model, while the short-run component is derived from the long-run component under a real, nominal, or price-adjustment mechanism (e.g., Chow, 1966; Goldfeld, 1973; Gordon, 1984; Goldfeld and Sichel, 1987). Empirically, parametric estimates of the long-run model, however, are not directly estimated as such but are indirectly inferred from their short-run counterparts via the speed of adjustment. The fate of long-run money demand therefore becomes critically linked to that of the short-run model.

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In this study, we attempt to examine the demand for monetary assets by individuals within the theoretical framework of the Baumol-Tobin model and the life-cycle theory of consumption and saving. Direct estimates of the long-run money demand model have several advantages: they are free from the identification problem (Cooley and LeRoy, 1981), the assumption of a representative consumer (Gorman, 1953; Barnett, 1997), the use of income proxies, or the employment of various adjustment mechanisms commonly associated with the standard model of aggregate money demand. These estimates not only provide valuable insights into the microfoundations of aggregate money demand, but also shed important lights on the life-cycle behavior of individuals.

This study uses micro data from the *1993 Panel of the Survey of Income and Program Participation* (SIPP) conducted by the U.S. Bureau of the Census. SIPP contains a comprehensive set of demand data on NOW or Super-NOW accounts, non-interest-earning checking deposits, regular and passbook savings, money market deposits, certificates of deposit, and other financial assets. It also gathers valuable information on the amount of income received by each respondent, the amount of return, the amount of each asset deposited in financial institutions, and sociodemographic characteristics of individuals. Regression results indicate that parametric estimates of the demand for money balances are reasonable and do not exhibit the wide fluctuations found in the standard model of aggregate money demand. Findings also show that the life-cycle motive, as captured by the demographics, is an important determinant of money demand.

The next section reviews the theoretical underpinnings and major empirical findings of aggregate money demand studies and cross-sectional studies on money demand and the life-cycle behavior of individuals. The econometric money demand model employed in this study is discussed. Regression results are presented, data sources are explained, and dependent and independent variables are defined. A brief conclusion is given in the final section.

Review of the Literature

In the literature, most empirical studies on money demand are based on the asset approach of Friedman (1956) or the inventory-theoretic transactions approach of Baumol (1952) and Tobin (1956). Theoretically, both approaches predict that the long-run equilibrium demand for money is a negative function of the opportunity cost and a positive function of the scale variable. Empirically, parametric estimates are often obtained with the following log-linear model:

$$(1)\quad \ln m_t^* = \alpha_1 + \alpha_2 \ln y_t + \alpha_3 \ln i_t$$

where:

m^*_t = Desired money demand;
y_t = Scale variable; and
i_t = Opportunity cost.

The restrictions $\alpha_2 > 0$ and $\alpha_3 < 0$ are assumed to hold. In the asset approach the appropriate scale variable is real wealth, and the opportunity cost or price of holding money is the user cost (e.g., Barnett 1980; Barnett, Fisher, and Serletis, 1992; Barnett 1997). In the transactions approach, however, the opportunity cost of holding money is the rate of interest, while the scale variable is real income (e.g, Goldfeld 1976; Goldfeld and Sichel, 1987). In addition, aggregate money demand studies based on the Baumol-Tobin model usually adopt the narrowly defined monetary aggregate, M1, as money demand. Studies based on the asset approach prefer higher levels of monetary aggregates such as M2 and M3 as the dependent variable.

Prior to the early 1970s, most empirical studies on aggregate money demand are long-run in nature and are primarily concerned with the relative importance of current income, wealth, permanent income, and interest rate in determining money demand. These results are contained in studies by Friedman (1959, 1966), Meltzer (1963), Brunner and Meltzer (1963), Teigen (1964), Laidler (1966a, 1966b), Hamburger (1966), Lee (1967), Kostas and Kjhouja (1969), Starleaf and Reimer (1969), Laidler and Parkin (1970), Clark (1973), and many others. An excellent discussion of these earlier studies can be found in Laidler (1977) and Hoffman and Rasche (1996). As with their aggregate counterparts prior to the 1970s, cross-section studies by Lydall (1958), Watts and Tobin (1960), Guthrie (1960), Kreinin (1961), Pesek (1963), Lee (1964), and Nieuwenburg (1969) also concern the determinants of long-run money demand and the relative performances of current income, permanent income, wealth, and net worth. Unlike aggregate money demand studies, these cross-section studies do not provide estimates of the interest rate elasticity because of the lack of microeconomic data. On the other hand, demographic variables that play no role in aggregate money demand have been consistently found to be determinants of microeconomic money demand. No explicit attempt has been made in these earlier studies to integrate microeconomic money demand the into life-cycle saving behavior of individuals.

In the post-1973 period, the number of cross-sectional studies is extremely small in comparison with that of aggregate money demand. The cross-section studies on money demand in the United States and other countries by Peterson (1974), Graves (1978, 1980), Kenny (1991), Asgary, Gregory, and Mokhtari (1997) and a few others essentially identify additional determinants of money demand. At the macroeconomic level, however, the landscape has changed drastically The primary focus of most empirical studies has shifted from analysis of the long-run aggregate money demand to the short-run partial dynamic adjustment model of Chow (1966) and Goldfeld (1973), especially Goldfeld who finds aggregate demand for M1 to be a stable function of real GNP, the rates of interest on time deposits, and short-term commercial papers. In Goldfeld's standard model of aggregate money demand, parametric estimates of long-run money demand are critically linked to their short-run counterparts via the speed of adjustment. An extremely slow speed of adjustment

would render the long-run parametric estimates large in absolute terms, while a negative speed of adjustment would cause the long-run parametric estimates to be inconsistent with theories. This is what has happened since the structural break of the early 1970s. As shown in Table 1, the coefficient of lagged money in Goldfeld's (1973) study suggests that the quarterly speed of adjustment is approximately 0.28. In absolute terms, this means that the long-run elasticities of income and interest rates are about 3.6 times greater than their short-run counterparts. Subsequent studies indicate that the speed of adjustment has become extremely slow (e.g., Garcia and Pak, 1979; Milbourne, 1983) or negative (e.g., Hafer and Hein, 1980; Weninger and Sivesind, 1979; Barnett, Offenbacher, and Spindt, 1984). Consequently, the long-run elasticity of income has become large or inconsistent with theories, and its magnitudes range from a negative value of -29.0 in the study by Barnett, Offenbacher, and Spindt (1984) to 1.50 in Milbourne's 1983 study. Similarly, the elasticity of interest rate on time deposits ranges from a positive value of 0.04 in the study by Hafer and Hein (1980) to 5.50 in the study by Barnett, Offenbacher, and Spindt (1984).

Table 1 also shows that past findings with different measurements of monetary aggregates, scale variables, or interest rates in the model exhibit similar problems. The speed of adjustment is slow when wealth (Friedman, 1978) or permanent income (Hafer and Hein, 1979) is employed as the scale variable. Likewise, empirical results using the buffer stock model of money demand (Carr and Darby, 1981) or Divisia monetary aggregates (Barnett, Offenbacher, and Spindt, 1984) also show a quarterly speed of adjustment that is slow or beyond the theoretical bound of 0 and 1. In the buffer stock model of Carr and Darby, for example, the long-run elasticity of income and interest rate on time deposits are -5.75 and 106.5, respectively, while the corresponding elasticities of income and the user cost in the Divisia model are 2.07 and -0.54. An excellent survey of many of these earlier studies can be found in Judd and Scadding (1982).

In addition to the emergence of Divisia and buffer stock money demand model, the cointegration analysis or the vector error-correction model of Hoffman and Rasche (1996) has emerged as a prominent school of thought on long-run aggregate money demand. In recent years, the impacts of these schools of thought on monetary economics are tremendous, and their contributions to the literature are growing (e.g. Cuthbertson, 1992; Mizen, 1994; Barnett, Fisher, and Serletis, 1992; Hoffman and Rasche, 1991; Crowder, Hoffman, and Rasche, 1999). At the microeconomic level, however, the state of cross-sectional studies on money demand remains unsatisfactory, and much more work must be done to gain the necessary insights into the microfoundations of aggregate money demand (Barnett 1997; Mizen, 1997; Laidler, 1997; Cuthbertson, 1997).

Table 1—Selected Findings on Post-1973 Short-Run Aggregate Money Demand

Money Demand	Real GNP	Permanent Income	Transitory Income	Wealth	Time Deposits	T-Bill or Commercial Papers	User Cost	Money Supply Shock	Lagged Money
Panel A Standard Approach									
Goldfeld (1973)	.193				-.045	-.019			717*
	(5.3)				(4.0)	(6.0)			(11.5)
Garcia-Pak (1979)	.029				.006	- 022			.977*
	(1 3)				(.8)	(5.8)			(2.7)
Wenninger-Sives (1979)	046				- 017	-.012			1.025*
	(3 8)				(1.3)	(3.6)			(38.2)
Hafer and Hein (1980)	.034				-.002	-.014			1.046**
	(3.49)				(29)	(4 98)			(38.93)
Milbourne (1983)	027					-.016			.982*
	(4.84)					(6.06)			(48.40)
Barnett-Offenbacher-Spindt (1984)	.058				-.011				1.002**
	(4 03)				(4.11)				(67.69)
B Friedman (1978)				.040	-.010	-.010			981*
				(2 8)	(1.2)	(4.2)			(3.5)
Hafer and Hein (1979)		060				-.020			.920*
		(4.9)				(4.5)			(21.29)
Panel B. Buffer Stock Approach									
Carr-Darby (1981)		.023	.101					633	1.004*
		(3.55)	(4.58)					(4.06)	(36.67)
Panel C. Divisia Approach									
Barnett-Offenbacher-Spindt (1984)	064						-.013		969**
	(5.93)						(3.00)		(35.37)

* Real partial adjustment mechanism

** Nominal partial adjustment mechanism

As mentioned earlier, one of the difficulties with past cross-section money demand studies is that little or no explicit attempt has been made to link the microeconomic behavior of asset demand to the life-cycle theory of consumption and saving (Modigliani and Brumberg, 1954). In recent decades, most empirical studies on the life-cycle behavior of consumption and saving generally have reached the consensus that a close relationship exists between demographic variables and the life-cycle behavior of consumption and saving. Cross-sectional studies by Hall and Mishkin (1982), Bernanke (1984), Altonji and Siow (1987), Altug and Miller (1990), Lawrence (1991), Eberly (1994), Attanasio and Weber (1995), Browning and Lusardi (1996), and others provide the evidence that the life-cycle motive as captured by demographic variables plays a crucial role in determining consumption and saving behaviors of individuals. Keynes also postulated the relationship between demographics and individual saving behavior more than six decades ago. In the general theory, Keynes explicitly stated that the propensities to save from income vary enormously among individuals with divergent socio-economic characteristics because of the differences in their subjective motives of precaution, foresight, calculation, improvement, independence, enterprise, pride, and avarice (The General Theory, pp. 107-109).

The Econometric Model

The aforementioned analysis suggests that the demand for a financial asset by heterogeneous individuals is not only a function of the scale variable and the opportunity cost of holding money but also a function of the life-cycle motive represented by a set of demographic variables. Equation (1) can be written as

$$(2)\quad \ln m_t = \alpha_1 + \alpha_2 \ln y_t + \alpha_3 \ln i_{ot} + \sum_{j=4}^{N} \alpha_j \ln i_{jt} + \theta' D_t + \varepsilon_t$$

where:

- m_t = Actual money demand held in financial institutions at time t and is assumed to be a good approximation of the unobservable equilibrium money demand;
- y_t = Gross income received by each individual during period t and is an approximation of total transactions postulated in the Baumol-Tobin model;
- i_{ot} = Own interest rate or rate of return;
- i_{jt} = The cross rate of return on the j^{th} financial asset other than m_t;
- D_t = A set of demographic variables.

The restrictions $\alpha_2 > 0$, $\alpha_3 > 0$, and $\alpha_j < 0$ hold, while the signs and magnitudes of the set of parameters, θ', are related to the life-cycle behavior and can be examined empirically. The error term, ϵ_t, is assumed to be normally distributed with zero mean and constant variance.

Empirically, equation (2) is estimable only if microdata on the dependent and independent variables are available. Most longitudinal or cross-sectional surveys,

however, are not designed for testing specific economic theories and therefore may not contain the exact information needed for the analysis. As mentioned earlier, one of the difficulties encountered by past cross-section studies is the lack of data on the rate of interest. A similar problem exists in SIPP. SIPP contains data on gross return and total amount of each asset deposited by respondents at financial institutions. Based on this information, the rate of return can be measured by dividing gross return by the total amount of the asset reported. The problem with this measurement is that it gives rise to an econometric problem that must be addressed. To see the problem, equation (2) can be expressed as

$$(3)\ \ln m_t = \alpha_1 + \alpha_2 \ln y_t + \alpha_3 \ln\left(\frac{r_t}{m_t}\right) + \sum_{j=4}^{N} \alpha_j \ln\left(\frac{r_{jt}}{m_{jt}}\right) + \theta' D_t + \varepsilon_t$$

where:

r_t = Gross return on m_t; and

r_{jt} = Gross returns on the j^{th} asset.

A casual glance at equation (3) suggests that regressing money demand on the explanatory variables would lead to biased parametric estimates, because the own rate of return is not only correlated with the error term but also correlated with other explanatory variables. Using the property of logarithm we get:

$$(4)\ \ln m_t = \alpha_1 + \alpha_2 \ln y_t + \alpha_3 \ln r_t - \alpha_3 \ln m_t + \sum_{j=4}^{N} \alpha_j \ln\left(\frac{r_{jt}}{m_{jt}}\right) + \theta' D_t + \varepsilon_t$$

Rearranging terms in equation (4), the following money demand function can be obtained easily:

$$(5)\ \ln m_t = \frac{1}{1+\alpha_3}\left[\alpha_1 + \alpha_2 \ln y_t + \alpha_3 \ln r_t + \sum_{j=4}^{N} \alpha_j \ln\left(\frac{r_{jt}}{m_{jt}}\right) + \theta' D_t + \varepsilon_t\right]$$

which can be expressed in reduced form as

$$(6)\ \ln m_t = \beta_1 + \beta_2 \ln y_t + \beta_3 \ln r_t + \sum_{j=4}^{N} \beta_j \ln\left(\frac{r_{jt}}{m_{jt}}\right) + \gamma' D_t + \mu_t$$

where:

$$\beta_1 = \frac{\alpha_1}{1+\alpha_3}$$

$$\beta_2 = \frac{\alpha_2}{1+\alpha_3}$$

$$\beta_3 = \frac{\alpha_3}{1+\alpha_3}$$

(7) $$\beta_1 = \frac{\alpha_1}{1+\alpha_3}$$

$$\gamma' = \frac{\theta'}{1+\alpha_3}$$

$$\mu_t = \frac{\varepsilon_t}{1+\alpha_3}$$

Equations (5) and (6) reveal that, in order to resolve the measurement error associated with the own rate of return, money demand can be expressed alternatively as a function of income, gross return, cross prices, and demographic variables. The main difference is that the reduced form parameters are smaller than their long-run structural counterparts in absolute terms due to the presence of the discount factor $1/(1+\alpha_3)$. In addition, the structural parameters can be expressed in terms of the reduced form parameters as

$$\alpha_1 = \beta_1 \left(1 + \frac{\beta_3}{1-\beta_3}\right)$$

$$\alpha_2 = \beta_2 \left(1 + \frac{\beta_3}{1-\beta_3}\right)$$

(8) $$\alpha_3 = \frac{\beta_3}{1-\beta_3}$$

$$\alpha_1 = \beta_1 \left(1 + \frac{\beta_3}{1-\beta_3}\right)$$

$$\theta' = \gamma' \left(1 + \frac{\beta_3}{1-\beta_3}\right)$$

From the estimates of β_1 and β_3 , α_1 is identified. Given β_2 and β_3, α_2 is identified. Similarly, α_3 can be identified by β_3. From β_j, γ' , and β_3, α_j, and θ' are identified.

Data Source and Definitions

All data used in this study are obtained from wave seven of the 1993 panel of the *Survey of Income and Program Participation* conducted by the U.S. Bureau of the Census. SIPP is a longitudinal survey that collects approximately two and a half

years of monthly data on income and program participation of individuals and households in the United States. The 1993 SIPP panel contains nine waves of longitudinal and cross-sectional data gathered by interviewers between February 1993 and January 1996. The primary focus of SIPP is individuals age 15 years and over, and SIPP covers the civilian noninstitutional population of the United States and members of the Armed Forces living off post or with their families on post.

Data in wave seven of SIPP were collected by interviewers from February 1995 to May 1995 from individuals who own financial assets in their own names or jointly with spouses. Financial assets covered in the survey include: (1) regular or passbook savings accounts in banks, savings and loan, or credit unions, (2) money market deposit accounts, (3) certificates of deposit or other savings certificates, (4) NOW or Super-NOW accounts or other interest-earning checking accounts, (5) money market funds, (6) U.S. government securities, (7) municipal or corporate bonds, (8) other interest-earning assets, (9) stocks and mutual fund shares, and (10) non-interest-earning checking accounts. Because the focus of this study is transactions money balances and their substitutes, major attention will be paid to non-interest-earning demand deposits, NOW or Super-NOW accounts, regular and passbook savings deposits, and money market deposits. For those who own an asset jointly with their spouses, the total amount is divided by two, and the average is added to the amount held in their own names.

Among the explanatory variables, income is defined as total income received by each individual during the reference period and consists of both labor and nonlabor incomes. Labor income includes wages and salary, nonfarm self-employment income, and farm self-employment income. Nonlabor income consists of income from financial and nonfinancial assets as well as income from other sources. A detailed list of these incomes is given in Appendix A. SIPP does not collect implicit returns on non-interesting-earning checking accounts, and the rate of return on these assets will not be used in regressions. For NOW accounts, money market deposits, and regular or passbook savings, SIPP only contains data on gross return on each asset and total amount of the asset held by individuals in financial institutions. As mentioned earlier, the rate of return on each asset is obtained by dividing the total amount of return by the total amount of asset deposited.

In order to capture the life-cycle motive and Keynes' postulate about the differences in the propensities of heterogeneous individuals to save and hold financial assets, age, education, number of children (with children = 1, 0 otherwise), marital status (married = 1, 0 otherwise), race (African Americans = 1, 0 otherwise), and gender (female = 1, 0 otherwise) are included in the analysis. In addition, as the environment in which an individual lives also may affect money demand (Pesek, 1963), metropolitan status (metro area = 1, 0 otherwise) and region (Northeast = 1, 0 otherwise) are included in each regression.

Regression Results

Econometrically, the method used to estimate money demand is closely related to the question whether money demand, income, and the rate of return are endogenous. For the economy as a whole, aggregate money demand, income, and interest rate are endogenous; applying ordinary least square (OLS) would yield biased parametric estimates. Maximum likelihood, two-stage least square, or instrumental variable method usually are used in past studies to obtain parametric estimates of aggregate money demand. At the individual level, however, income and prices are predetermined as each individual enters the market. As illustrated in the utility-maximizing process of most microeconomic textbooks, income and prices are treated as parameters. Other things being equal, a change in individual income or the price of a commodity would lead to a change in equilibrium commodity demand, but not vice versa. In the money demand literature, the asset approach of Friedman (1956) essentially reflects this microeconomic behavior of consumers, and the equilibrium quantity of money demand is already in reduced form. OLS therefore can be used to obtain unbiased parametric estimates, provided that the error term in one demand equation is not contemporaneously correlated with the error terms in other demand equations (Zellner, 1962). For the market as a whole, nevertheless, the equilibrium price and quantity are endogenous and determined by the intersection between money demand and money supply. OLS no longer can be used to obtain unbiased parametric estimates.

To facilitate the analysis, regression results presented in this study will be obtained with both OLS and limited information maximum likelihood methods (LIML). In each LIML regression, the instrumental variables employed may include such demographic variables as age, education, number of children, gender, and race that are likely to be correlated with the endogenous variables but not correlated with the error term. In order to minimize sample losses and multicollinearity problems, only one cross price will be used in each regression to examine the substitubility between two monetary assets. Regression results for non-interest-earning demand deposits, NOW or Super-NOW accounts, regular or passbook savings, and money market deposits are given in Tables 2, 3, and 4, respectively.

Non-Interest-Earning Checking Accounts

Table 2 contains OLS and LIML regression results for non-interest-earning checking deposits. In order to examine whether the parametric estimates differ among individuals with different monetary assets in their portfolios, four regressions are conducted for those who possess at least: (1) non-interest-earning checking deposits, (2) non-interest-earning checking deposits and money market deposits, (3) non-interest-earning checking deposits and NOW or Super-NOW accounts, and (4) non-interest-earning checking deposits and regular or passbook savings deposits. As mentioned before, SIPP does not contain the implicit rate of return on non-interest—

Table 2—Regression Results for Non-Interest-Earning Checking Accounts

Money Demand	Constant	Income	Rate of Return MMDA	Rate of Return NOW	Rate of Return Savings	Age	Education	Children	Married	Black	Female	Metro Area	Northeast	R^2	Sample Size
Panel A OLS Results															
1	3 8842	.1087				0412	.0387	-.0915	-.6363	- 7419	- 0481	.1821	-.0091	.1867	21174
	(44 71)	(12.22)				(52.16)	(17.47)	(2.77)	(22 69)	(14.62)	(1 71)	(5 71)	(27)		
2	2.2896	.2857	-.4836			.0347	.0064	.0159	-.6916	-.6396	.2707	0387	-.0858	2260	2424
	(5.88)	(9 50)	(9 94)			(13 72)	(98)	(15)	(8.18)	(2 69)	(3.32)	(40)	(.94)		
3	2 0084	1524		-.5429		.0389	.0215	-.2265	- 1981	-.8080	- 0162	.0985	- 0558	2442	9354
	(12.60)	(1 95)		(26.50)		(36.97)	(7.10)	(4.74)	(5.08)	(1 39)	(.42)	(2 21)	(1 24)		
4	1 9496	.0892			- 5977	.0401	.0283	-.0216	- 3444	-.7622	-.0933	.1815	-.0569	2503	14071
	(17 20)	(9 69)			(34 61)	(44 81)	(11.35)	(.58)	(1 71)	(13 54)	(2 99)	(5.07)	(1 56)		
Panel B· LIML Results															
1	3.9506	.1032				.0415	0390	-.0898	-.6452	-.7395	-.1227	.1814	-.0086	.1822	21174
	(16 47)	(2 75)				(4 24)	(11.77)	(2.61)	(21.41)	(14.48)	(4.49)	(5 55)	(26)		
2	2 5025	2643	- 4911			.0354	.0074	0218	- 7299	-.6410	.0928	0364	-.0623	1800	2424
	(2.75)	(3.08)	(3.37)			(13.49)	(.91)	(.20)	(6.55)	(2 69)	(1.19)	(.37)	(.71)		
3	2.0864	.1455		- 5445		.0393	.0217	-.2229	-.2075	-.8079	-.0854	.1000	-.0788	.1939	9354
	(4.83)	(3.16)		(7.74)		(33.87)	(5.45)	(4 66)	(4.20)	(1.37)	(2.31)	(2.21)	(1.76)		
4	1.9735	.0875			-.5982	.0402	.0284	-.0212	-.3482	-.7614-	1222	.1833	0384	1969	14071
	(5.12)	(2.16)			(7.71)	(32 45)	(7.07)	(.54)	(7 09)	(13.44)	(4.02)	(4.96)	(1.05)		

t-statistics are in parentheses

earning demand deposits, and it is omitted in each regression. In order to maximize the sample size and reduce the problem of multicollinearity, only one cross rate of return is included in each regression so that the degree of substitubility between non-interest-earning demand deposits and another asset can be better examined.

As shown in the first regression containing OLS and LIML results for all those who own non-interest-earning checking accounts, the income elasticity is positive and significant at the 5 percent level with similar magnitudes. This suggests that the long-run elasticity of income is neither very large nor negative as found in past aggregate studies on money demand, but this elasticity value falls short of the 0.5 predicted by the Baumol-Tobin model. This suggests that income is a significant scale variable affecting money demand but not a satisfactory proxy for total transactions, as postulated in the Baumol-Tobin model.

The coefficients of most demographic variables reveal that the life-cycle motive is significantly related to money demand. The coefficient of age shows that money demand increases with age. A positive age coefficient, however, does not necessarily mean that money demand increases with age for every individual and simply suggests that the average or net effect is positive. As dictated by the life-cycle theory, the reason is that income, consumption, and saving initially increase with age, reach a maximum, and then decline after retirement. These results are generally consistent with past cross-sectional findings (e.g., Peterson, 1974; Avery and Kennickell 1991). Similarly, the coefficient of education is significantly positive, suggesting that, on average, individuals with higher levels of education tend to hold more than those who are less educated. In contrast, the coefficient of children is significantly negative. This finding is plausible because at each given level of income, individuals with more children consume more and therefore hold fewer financial assets (Meghir and Weber 1996; Hall and Mishkin 1982). The next column shows that the coefficient of marital status is also significant and negative. At first glance, it is surprising that married people hold less than do those of other marital statuses. But at each given level of income, married people with children tend to consume more and hold less than those who are married and have no children. The negative coefficient simply reflects the average or net effect of these opposing forces on money demand (Bosworth, Burtless, and Sabelhaus, 1991; Avery and Kennickell, 1991). The coefficient of race is negative and significant. African Americans hold less than whites. As postulated by Keynes, this is probably due to the differences in the subjective factors affecting their propensities to save and hold financial assets. The coefficient for gender is significant at the 10 percent level but insignificant at the 5 percent level. Metropolitan residents hold more than their nonmetropolitan counterparts, and differences in the living environment also affect the demand for transactions money balances as suggested by Pesek (1963). Regional differences, however, have no effect on money demand. As with most past cross-sectional studies on money demand, the value of R square is low.

OLS and LIML results for the second model reveal that money market deposits are close substitutes of non-interest-earning demand deposits. For those who own at least non-interest-earning checking accounts and money market deposits, the elasticity of the cross rate of return is negative and significant with similar magnitudes in both OLS and LIML regressions. The income elasticity is significant and positive in each regression and is greater than that of the first model. The coefficients of most demographic variables are also statistically significant at the 5 percent level. The life-cycle motive is clearly an important factor in determining asset demand.

Likewise, OLS and LIML regressions for the third model reveal that NOW or Super-NOW accounts are substitutes of non-interest-earning checkable deposits. The magnitude of the cross rate of return shows that a rise in the rate of return on NOW or Super-NOW accounts of 100 percent would reduce the demand for non-interest-earning demand deposits about 54 percent. The income elasticity is also positive and significant at the 5 percent level. A rise in income by 100 percent would increase money demand about 15 percent.

Results for the fourth model show that regular and passbook savings are also close substitutes of non-interesting-earning checking deposits. Among those who possess non-interest-earning checking accounts and regular or passbook savings accounts, a rise in the rate of return on savings deposits of 100 percent would reduce the demand for non-interest-earning checking deposits about 60 percent in both OLS and LIML regressions. A rise in income of 100 percent would only increase the demand for these assets about 9 percent. Again, the strength of the life-cycle motive on money demand has been reflected in the signs and magnitudes of the coefficients of most demographic variables.

Generally, these findings reveal that:

- The cross-sectional demand for non-interest-earning demand deposits is not as unpredictable or volatile as found in past standard aggregate money demand studies;
- The income elasticity varies substantially among individuals possessing different types of monetary assets. The magnitude of each income elasticity is much smaller than the value of 0.5 predicted by the Baumol-Tobin model;
- The interest rate elasticity ranges from -0.48 to -0.60 and appears to be reasonable in comparison with those of the long-run aggregate money demand (Hoffman, Rasche, and Tieslau, 1995; Hoffman and Rasche, 1996);
- Money market deposits, savings deposits, and NOW or Super-NOW accounts have a high degree of substitutability with non-interest-earning demand deposits; and
- The life-cycle motive is a major factor affecting money demand.

NOW or Super-NOW Accounts

Table 3 contains the OLS and LIML regressions for NOW or Super-NOW accounts. The first regression indicates that, among those who hold these assets, the reduced-form elasticities of income and gross return are positive and significant at the 5 percent level in both the OLS and LIML regressions. From these reduced-form estimates, the corresponding long-run elasticities of income and the own rate of return in the OLS and LIML regressions can be shown to be similar. These results indicate that the demand for NOW or Super-NOW accounts are much more sensitive to changes in the own rate of return than to changes in income. The coefficients of the demographic variables are mostly significant and reveal that the life-cycle motive is a major factor determining money demand.

Parametric estimates for the second model exhibit a similar pattern. When the rate of return on money market deposit is included as an explanatory variable, the reduced-form elasticities of income, own return, and cross rate of return are similar in OLS and LIML regressions. Judging from the magnitude of the cross rate of return, money market deposits and NOW or super-NOW accounts are close substitutes. In the third model, NOW and Super-NOW accounts are also close substitutes of regular or passbook savings deposits. The reduced-form elasticities of income, gross return, and cross rate of return are also significant and have the expected signs. The coefficients of most demographic variables again reveal the importance of the life-cycle motive in determining money demand.

Regular or Passbook Savings Deposits

As shown in the first model of Table 4, the OLS and LIML regression results for those who possess at least saving deposits indicate that the reduced-form income and gross return elasticities are positive and significant at the 5 percent level. The long-run or structural elasticity of income is lower than that predicted by the Baumol-Tobin model, while the elasticity of the own rate of return is much higher. The coefficients of age, education, and marital status show the existence of a life-cycle motive. The second OLS and LIML regressions show that the reduced-form elasticity of the cross rate of return on NOW and Super-NOW accounts is negative and significant. The elasticity of income, however, becomes negative due to the problem of multicollinearity between income and the cross rate of return. Finally, the third model shows that money market deposits and regular or passbook savings are close substitutes for those who own these two assets. The elasticity of income is positive and significant. The elasticity of gross return is not included in the model, because no meaningful results can be obtained when it is included. Demographic variables again are important determinants of money demand as predicted by the life-cycle theory of consumption and saving.

Table 3—Regression Results for NOW or Super-NOW Accounts

Money Demand	Constant	Income	Own Return	Cross Rate of Return: MMDA	Cross Rate of Return: Savings	Age	Education	Children	Married	Black	Female	Metro Area	Northeast	R^2	Sample Size
Panel A: Money Results															
1	4.3409	0565	.2654			.0038	.0086	-.0686	-.7809	-.0107	1480	.0633	-.0721	.7875	9368
	(59.18)	(7.64)	(162.12)			(6.37)	(5.37)	(2.71)	(38.51)	(.26)	(7.28)	(2.69)	(3.05)		
Long-Run Elasticities		.0769	.3605												
2	.2742	.0201	.3019	-.3889	.0017	.0013	-.0367	-.4351	.0718	.1013	-.0225	.0042	.9876	1576	
	(4.54)	(4.31)	(309.70)	(146.71)		(4.29)	(1.31)	(2.37)	(34.28)	(1.99)	(8.45)	(1.54)	(.31)		
Long-Run Elasticities		0288	4325	- 5571											
3	3845	.0163	3040		-.3466	.0010	-.0009	-.0454	-.4316	.0741	.0749	.0006	.0099	9869	6096
	(14.41)	(7.45)	(581.61)		(306.66)	(5.36)	(2.05)	(6.14)	(67.98)	(5.91)	(12.24)	(.09)	(1.42)		
Long-Run Elasticities		.0136	.4364		-.4979										
Panel B: LIML Results															
1	4.1804	.0663	.2568			.0032	.0067	-.1829	- 3711	-.6915	.2058	.1337	-.1082	.5462	9368
	(28.29)	(3.49)	(61.97)		(3.89)	(3.43)	(6.99)	(17.84)	(16.21)	(8.19)	(5.49)	(4.42)			
Long-Run Elasticities		.0892	.3455												
2	3909	0177	.3018	-.3854		.0014	.0016	-.0255	-.4921	-.2797	.0901	-.0135	-.0147	.9766	1574
	(5.12)	(2.59)	(21.78)	(10.71)		(3.21)	(1.53)	(1.59)	(38.69)	(7.13)	(6.87)	(.89)	(1.07)		
Long-Run Elasticities		0161	.4895	-.5734											
3	.3427	.0209	.3013		-.3472	.0011	-.0063	-.0491	-.3924	-.3646	.0843	.0284	-.0459	.9731	6096
	(9.21)	(6.08)	(367.04)		(197.33)	(4.96)	(1.12)	(6.01)	(57.38)	(25.46)	(11.85)	(3.60)	(5.95)		
Long-Run Elasticities		.0299	.4312		-.4969										

t-statistics are in parentheses

Table 4—Regression Results for Regular or Passbook Savings Deposits

Money Demand	Constant	Income	Own Return	Cross Rate of Return: NOW	Cross Rate of Return: MMDA	Age	Education	Children	Married	Black	Female	Metro Area	Northeast	R^2	Sample Size
Panel A. OLS Results															
1	3.8218	.0211	.3109			.0021	.0086	- 0135	- 4389	-.0352	.0647	.0642	-.0274	.8261	14237
	(85.99)	(4.76)	(225.99)			(4.46)	(7.20)	(77)	(29.19)	(1.29)	(3.72)	(3.72)	(1.57)		
Long-Run Elasticities		.0306	.4512												
2	-.0736	- 0106	.3338	-.2556		-.0001	.0018	.0408	.3650	-.0857	-.0645	.0051	-.0148	.9884	6096
	(2.89)	(5.12)	(623.23)	(305.38)		(.58)	(3.87)	(5 85)	(57 17)	(7.28)	(11.19)	(.76)	(2 25)		
Long-Run Elasticities		-.0159	.5011	-.3837											
3	1 8262	.3063	---		-.5382	.0395	.0038	- 0640	-.1601	- 5316	-.0456	-.0223	-.1574	.2194	1580
	(3.81)	(8.16)			(9.01)	(13.00)	(.49)	(.52)	(1.54)	(2.04)	(.47)	(.19)	(1.51)		
Long-Run Elasticities															
Panel B: LIML Results															
1	3 8259	0209	.3107			.0020	.0087	- 0151	-.4379	-.0348	0611	.0641	-.0276	8261	14237
	(83.01)	(4.19)	(226.13)			(4.39)	(7.10)	(.85)	(29 14)	(1.25)	(4.10)	(3.71)	(1.56)		
sLong-Run Elasticities		0306	.4512												
2	.4870	-.0139	.3299	-.2313		-.0004	.0037	1444	-.0483	-.4370	-.0993	.1105	-.0596	.9638	6096
	(11.30)	(3.48)	(317.39)	(235.33)		(1.68)	(5.80)	(15.16)	(5.91)	(27.36)	(11.95)	(12.09)	(6.67)		
Long-Run Elasticities		-.0207	4923	-.3452											
3	2.4094	2932	---		-.4659	.0386	.0055	0066	- 5171	- 5650	- 1118	.0480	-.0962	.1620	1580
	(2.35)	(2.82)			(2.95)	(12.29)	(.56)	(.05)	(5.27)	(2.16)	(.89)	(41)	(92)		

t-statistics are in parentheses '---' denotes that when the variable is included the regression fails to converge

Conclusion

Findings in this study indicate that the long-run demand for non-interest-earning checking deposits, NOW or Super-NOW accounts, and regular or passbook savings accounts by heterogeneous individuals is a predictable function of income, own and cross rates of return, and demographic variables Income elasticities differ substantially among individuals possessing different monetary assets. The elasticities of the rate of return are reasonable, as compared with the elasticities of interest rate found in long-run aggregate money demand studies. The life-cycle behaviors of consumption and saving are significantly related to money demand as reflected in the signs and magnitudes of the demographic variables.

These results have some interesting implications. First, the impacts of monetary policies on income, interest rate, and money demand are not as unpredictable as those suggested in past standard aggregate studies. Second, the difficulties associated with the standard model of aggregate money demand may be attributable to the identification problem, the assumption of the representative consumer, or the adjustment mechanisms. When the data are free from these complications, the long-run elasticities of income and interest rates are not as volatile as those suggested in the standard model of aggregate money demand. Finally, social policies formulated to influence age, educational, marital, and racial compositions of the population are likely to affect the life-cycle behavior of consumption and saving, which in turn may have significant effects on money demand in the long run.

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Appendix A: Sources of Income

In the SIPP, income-generating assets consist of 13 categories: savings accounts, money market deposit accounts, certificates of deposit, NOW or Super-NOW accounts, money market funds, U.S. government securities, municipal or corporate bonds, other interest-earning assets, stocks or mutual fund shares, rental property, mortgages, royalties, and other financial investments. Other sources of income consist of 35 categories: (1) Social Security, (2) U.S. government railroad retirement, (3) federal supplemental security, (4) state-administered supplemental security income, (5) state unemployment compensation, (6) supplemental unemployment benefits, (7) black lung payments, (8) workers' compensation, (9) state temporary sickness or disability benefits, (10) employer or union temporary sickness policy, (11) payments from a sickness, accident, or disability insurance policy purchases by individuals, (12) Aid to Families with Dependent Children (AFDC), general assistance or general relief, (13) Indian, Cuban, or refugee assistance, (14) foster child care payments, (15) other welfare, (16) child support payments, (17) alimony payments, (18) pensions from a company or union, (19) federal civil service or other federal civilian employee pension, (20) U.S. military retirement, (21) National Guard or Reserve Forces retirement, (22) state government pensions, (23) local government pensions, (24) income from paid-up life insurance policies or annuities, (25) estates and trusts, (26) other payments for retirement, disability or survivors, and G.I. Bill/VEAP education benefits, (27) income assistance from a charitable group, (28) other unemployment compensation (e.g., Trade Adjustment Act benefits, strike pay, other), (29) veterans' compensation or pensions, (30) money from relatives or friends, (31) lump sum payments, (32) income from roomers or boarders, (33) National Guard or Reserve pay, (34) incidental casual earnings, and (35) other cash income not included elsewhere.