The Household Demand for Money: Estimates from Cross-sectional Data

Virtually all quantitative research on the transactions demand for money has used aggregate time-series data. More specifically, the key variables comprising the economic relationship — the dollar volume of M1, the size of GNP, and interest rates — are measured at the level of the national economy; and the data are averages over periods of time, usually a quarter of the year. The outcome of these research efforts has been rather unsatisfactory in recent years: regression analysis often shows marked instability in the demand for money, or sometimes, improbable estimates of elasticities or lagged effects.[1] Economists have reacted to the breakdown of the demand-for-money relationship by altering the specification of the relationship, questioning the econometric methods used, disputing the definition of money, or accepting the instability as reflecting structural changes in the economic and financial environment.

Our work reexamines the demand for money by taking a different approach: we estimate the household sector's demand for money using cross-sectional data. That is, the values of income, interest rates, and money pertain to individual families at a single point in time. This may be the first study to utilize this approach, since it was not feasible until the introduction of interest payments on some checking account deposits (e.g. negotiable order of withdrawal accounts). Only when the opportunity cost of these deposits varies across households at a point in time can regression analysis estimate the impact of such costs on checking account balances. Since some individuals hold a demand deposit account, which cannot earn interest, and others a NOW account, which typically earns 5 percent or more, the necessary variation in opportunity cost is observed.

The data we use in this study were collected through a sample survey conducted by the University of Michigan's Survey Research Center specifically for the Board of Governors of the Federal Reserve System. About 1,950 households nationwide were contacted in the spring of 1984. The general purpose of this survey was to provide basic information on the use of cash, bank accounts, and credit cards as the means of payment by American families. A more specific purpose was to enable the Board staff to estimate the amount of currency held by individuals for legitimate transactions.[2] Fortunately, we obtained enough information from the survey to do a credible job of estimating a cross-sectional demand-for-money equation and to test some hypotheses, although more information on the banking relationships and financial position of the sampled households would have been useful.

The empirical results obtained here are broadly consistent with the standard approach to analyzing the demand for M1. The estimated income and interest rate elasticities of money demand are well within the generally accepted range and are highly significant; and the

[1] For a survey through 1982, see John P Judd and John L Scadding, "The Search for a Stable Money Demand Function A Survey of the Post-1973 Literature," *Journal of Economic Literature* (September 1982), pages 993-1023 Also, see numerous articles on this subject in this *Quarterly Review* and in those of the other Federal Reserve Banks, as well as papers written by the Board of Governors staff economists

[2] "The Use of Cash and Transactions Accounts by American Families," Federal Reserve *Bulletin* (February 1986), pages 87-108 The survey was repeated to check the results, "Changes in the Use of Transactions Accounts and Cash from 1984 to 1986," Federal Reserve *Bulletin* (March 1987), pages 179-96

estimated coefficients of several other explanatory variables in the regression are significant and have the expected sign. These econometric results bolster the case for using the conventional approach to the demand for money at the household level. But two problems hinder the direct application of these results to money demand at the economy-wide level: the lack of a consensus model for the business sector and the difficulty of aggregating from the level of individual firms and households to the economy as a whole. Moreover, these results, while relevant to monetary issues, do not provide estimates of shifts in the demand for money during the past ten years.

Model specification

The demand-for-money equation is formulated along conventional lines. The underlying theory is that money (M1) is held as an inventory in order to conduct transactions.[3] Thus, observed checking account balances—either with or without currency holdings added—are explained by income, serving as a proxy for the dollar volume of transactions; by the (marginal) opportunity cost of holding checking account balances; and by several other factors affecting checking account usage among families.[4] We use dummy variables to incorporate many of these other factors in the regression. (See the box for a listing of the variables used.)

Notably absent from the regression equation is wealth; this survey made no inquiry as to the financial wealth of the individual households. We wanted to add wealth as an explanatory variable because of its possible role as a determinant of the demand for narrow money; and because another survey of households, conducted by a bank consulting firm, suggested that it does affect a family's money holdings.[5]

The equation is estimated in log-linear form; that is, the natural logarithms of the dependent variable, income, and the opportunity cost are used instead of their actual levels. Using the log of checking balances as the dependent variable is more consistent with the

[3]David E W Laidler, *The Demand for Money Theories and Evidence*, third edition (Harper and Row, New York, 1985), Chapter 6, William J Baumol, "The Transactions Demand for Cash An Inventory Theoretic Approach", *Quarterly Journal of Economics* (November 1952), pages 545-56, and James Tobin, "The Interest Elasticity of Transactions Demand for Cash," *Review of Economics and Statistics* (August 1956), pages 241-47

[4]The effects of fees and minimum balance requirements are very important for determining average opportunity cost, but can probably be ignored at the margin

[5]Synergistics Research Corporation, Atlanta, Georgia This survey contacted about 1850 families nationwide in the spring of 1986

Variables in the Regression Equation

Three alternative definitions of the dependent variable were used in the first set of regressions (reported in Table 1): (1) the household's balance in its main checking account, (2) its total balance across all its checking accounts (if it owns more than one), and (3) its total checking account balance plus the currency holdings of the household member responding to the survey (however they were obtained). All these variables are measured as of the day of the survey. The independent variables include:

- total household annual income,
- the household's marginal opportunity cost for holding checking account balances (the national average money-market deposit account rate shown in the Bank Rate Monitor, less the rate of interest earned on the household's checking account balance);
- the amount of currency held by that household member responding to the survey (provided that it was withdrawn out of a bank account);
- the total credit card balance of the household,
- a dummy variable taking the value of one for households holding a demand deposit account *and* normally paying a monthly service charge or other fees, and taking the value zero otherwise;
- a dummy variable exactly like the aforementioned, except in regard to NOW accounts;
- a dummy variable taking the value one for households reporting that they paid for less than one-quarter of their total expenditures from their main checking account, and the value zero otherwise;
- a dummy variable taking the value one for households reporting that their primary worker's pay period was shorter than a month, and zero otherwise;
- a dummy variable taking the value one for those responding that there was more than one full-time worker in the household, and zero otherwise;
- a dummy variable taking the value one for households who transferred funds during the past month into their main checking account from some other bank account, and zero otherwise;
- a dummy variable taking the value one for those households holding one or more secondary checking accounts, and zero otherwise;
- a dummy variable taking the value one for households also holding a money-market account (provided by either a bank or an investment firm) *with* checkwriting privileges, and zero otherwise; and
- a dummy variable taking the value one for those households who preferred to carry extra currency in the chance of an emergency, and zero otherwise.

basic assumptions of the classical regression model. If the actual level of the checking account balance (not its log) is specified as the dependent variable, the regression equation's disturbance term could not take on a full range of values—a household's checking account balance can never be negative.[6] Thus, the disturbance term could not take on large, negative values, a condition which violates a basic least squares assumption. Instead, the log-linear functional form is used. This specification leads to satisfactory least squares estimates because a very large negative value for the disturbance term implies that the household's checking account balance is close to, but not below zero.[7]

One additional restriction is imposed: we have included in the sample only those households whose income exceeded $10,000. We decided to drop low-income households because for such households income is probably a poor proxy for the volume of transactions. In many of these low-income households, adults are either suffering extended unemployment or have special circumstances and have voluntarily dropped out of the full-time labor force (for example, a student in graduate school). Many of these households are running down their assets or are receiving assistance from the government, their families, or elsewhere. In any case, their transactions volume and their checking account balance may not correspond to their income, and thus these respondents should be dropped from the sample, even though doing so may introduce a selection bias.[8]

Regression results

The regression results for household money demand are statistically meaningful and reliable, and some particular coefficient estimates agree neatly with the transaction motive for holding money. The estimates of the income elasticity (falling in a range of 0.60 to 0.86, depending on the exact specification of the regression) are consistent with widely-held expectations; and they have very high statistical significance (with t-statistics around 10). Money demand appears to have considerable elasticity with respect to opportunity cost, with estimates which are in the range of 0.37 to 0.49 and which are highly significant. The estimated effect of a household's primary worker having a shorter period between paydays is to reduce its checking account balance—the effect predicted by the inventory model of money demand.

Although there are many significant variables appearing in the equation, the explanatory power of the regression equation may seem low, with the adjusted R^2 on the order of 0.24 to 0.36. Cross-sectional data, however, usually produce regressions with lower explanatory power than do time-series data. Moreover, there is a particular reason for the low R^2 in the case of the cross-sectional equations we estimate—the dependent variable relates to the balance in the main checking account *on the day of the survey*. And naturally, there is substantial day-to-day variation in a household's account balance over the course of a month, even though its monthly average balance may be quite stable over an entire year. Had the survey collected data on the household's monthly average balance, the explanatory power of the regression equation would look much better. To convince ourselves of this, we constructed artificial daily- and monthly-average balance data conforming to the inventory model. On this basis, the R^2 of the regression equation would be expected to rise considerably if we had used monthly-average data instead.

There were 922 observations used in the regressions. While the survey contacted about 1,950 families, many had to be dropped from the sample for any of several reasons: the household did not own a checking account, the respondent could not or would not answer a question, or the recorded response was implausible.

Coefficient estimates of the core model

The demand equation was initially estimated three times, each time with a differently defined dependent variable: main checking account balance, total balance in all checking accounts, and total checking account balance plus currency holdings. The same set of ten independent variables—the "core" model—was used. These estimates are reported in Table 1.

- The estimated income elasticity is about 0.85, within the limits of 0.5 to 1.0 implied by transactions models of money demand. It should be noted, however, that this estimate is not significantly different from unitary elasticity at the 5 percent level.
- The estimated opportunity cost (interest rate) elasticity is on the high side: 0.40 to almost 0.50.

[6]Many households (almost one-third) do have overdraft privileges, but an overdraft usually triggers credits of $100 or some even amount, not an amount exactly equaling the overdraft

[7]So, when using cross-sectional data, there is an *a priori* economic rationale for the choice of functional form In research on money demand using time-series data, Zarembka developed an estimation procedure that discriminated between linear and log functional forms because of indecision between the two See Paul Zarembka, "Functional Form in the Demand for Money," *Journal of the American Statistical Association* (June 1968), pages 502-11

[8]Although the income variable is defined to include unearned income, in our judgment it is better to drop these households from the sample Another reason to do so is that they may not have sufficient assets to justify a savings account, in which case our concept of opportunity cost does not apply

These estimates indicate considerable sensitivity of the level of checking balances to changes at the margin in the amount of interest foregone in order to hold those balances.[9]

- D1: A household whose primary worker—or the person who answered the survey, in the case of two or more full-time workers—is paid more often than once a month (about 91 percent of the sample) tends to have lower money holdings, other factors constant. So, households paid weekly or bi-weekly have a lower average balance than households paid monthly. This is precisely what the inventory model of money demand would predict.
- D2: A household with two or more full-time workers (29 percent of the sample) also has lower money holdings on average. So, having two workers in a family is in effect similar to a shorter pay period. If one of the family's workers is paid at the beginning of the month and the other near the middle, a two-worker household is comparable in its deposit pattern to a household having one full-time worker paid bi-weekly.
- D3 and D4: Paying fees on a demand deposit account or NOW account correlates with lower money balances. (In the sample, 42 percent of the households paid a fee on a demand deposit account, and 9 percent paid a fee on a NOW account.) Our interpretation is that most households who have free checking do so because they meet a minimum balance requirement in the checking account itself, and meeting it in many cases causes them to maintain a higher average balance than they would otherwise.[10]
- D5: A household making relatively few payments from its main checking account (6 percent of the sample) holds a lower main account balance (or, for one with multiple accounts, lower total balance). A household in this group, however, does not tend to have lower total money holdings (checking account balance *plus* currency). Apparently, in most of these cases, cash is used for payments instead of check.
- D6: A household that during the past month transferred funds into its main checking account from one of its other bank accounts (15 percent of the sample) tends to hold less money. A household falling in this category was thought to be actively trying to maximize its interest income by keeping funds longer in its savings account and transferring them into the checking account only

[9]When the dependent variable is either total checking account balance or total balance plus cash, an inconsistency creeps in The opportunity cost variable refers to the main checking account If the main account is a NOW, then the opportunity cost of holding cash

Footnote 9 continued
will definitely be higher than the opportunity cost of holding balances in the main checking account, and the opportunity cost of holding balances in a secondary account may also be higher than in the main account

[10]Of course, some households have absolutely free checking (no fees and no minimum balance requirement), can avoid fees by maintaining a certain savings account balance, or do not find the minimum balance requirement to be a binding constraint, but they appear to be in the minority

Table 1

Regression Results for the Demand for Money by Households

Estimated Coefficients (with t-statistics in parentheses)

Independent Variables	Dependent Variable		
	Main Checking Account Balance	Total of Checking Account Balances	Currency Holdings plus Total of Checking Account Balances
Income	0 85 (10.5)	0 86 (10 8)	0 82 (11 2)
Opportunity Cost	−0.49 (−4 5)	−0 42 (−4.0)	−0 40 (−4.2)
D1 Pay Period Shorter Than a Month	−0 52 (−4.8)	−0.49 (−4 6)	−0 43 (−4 3)
D2 Two or More Full-Time Workers	−0 32 (−3.3)	−0 34 (−3 6)	−0 33 (−3 9)
D3 Usually Pays Fees for Demand Deposit Account	−0 40 (−4 1)	−0 41 (−4.2)	−0 39 (−4 5)
D4 Usually Pays Fees for NOW Account	−0 53 (−3 3)	−0 48 (−3.0)	−0 49 (−3 3)
D5 Pays for Few Expenditures out of Main Checking	−0 49 (−2 5)	−0 37 (−2 0)	−0 25 (−1 4)
D6 Made a Transfer to Checking during Past Month	−0 30 (−2 5)	−0 24 (−2 1)	−0 28 (−2.6)
D7 Owns a Money-Market Savings Account	0 21 (2.0)	0 32 (3 1)	0 30 (3 1)
D8 Owns a Secondary Checking Account	0 12 (1 2)	0 91 (9 5)	0.81 (9 2)
Intercept	−1 02 (−1 2)	−1 21 (−1 5)	−0 74 (−1 0)
Adj R^2	0 236	0 325	0 330

as needed; thus, the finding was expected.

- D7: A family holding a money-market savings account with checkwriting privileges (15 percent of the sample) tends to hold more M1-type money. On the one hand, this is surprising. Money-market accounts are so convenient and useful that—other things equal—a family with a money-market account would be expected to maintain a lower checking account balance, keeping more funds in the money-market account instead; but we observe the opposite. In light of the results from another household survey, however, the finding is much less surprising.[11] This survey showed that the ownership of a money-market savings account is highly correlated with a family's wealth, which is not measured in the survey used here. Ownership of a money-market savings account may be picking up the effect of wealth on money demand; so, a positive coefficient for this variable is reasonable.
- D8: Holding a secondary checking account (26 percent of the sample) has no impact on a household's main account balance, but has a positive effect on its total balance across all checking accounts. A typical household, it seems, does *not* split the same total balance among however many accounts it happens to hold. If it did, main account balance would be lower (and the variable's coefficient would be negative in the first regression), and total account balance would not be significantly higher (and the coefficient estimate would be insignificant in the second).

Variables relating to alternative payment methods

In addition to this core set of ten explanatory variables, a few others, relating to cash and credit cards, were tried. (In each of these regressions, total checking account balance is the dependent variable.) The regression results are presented in Table 2. First, the amount of cash on hand was added to the list of explanatory variables; its coefficient is positive and significant (first column of the table).[12] One might have thought that the sign would be negative, as cash and checking account balances are natural substitutes. Our estimate does not contradict this; instead, the positive coefficient would seem to be an artifact of the survey's design. The cash and checking balance information was collected, not as some average over the previous week or month, but as of the day of the survey. If that day happens to be soon after payday, cash holdings and checking account balance are both likely to be high. If that day is long after payday, they are both likely to be low.

Table 2

Regression Results for the Augmented Versions of the Demand for Money by Households

Estimated Coefficients (with t-statistics in parentheses)

Independent Variables	Dependent Variable: Total of Checking Account Balances		
Income	0 77 (9 7)	0 72 (8 7)	0 60 (6 2)
Opportunity Cost	−0 37 (−3 6)	−0 37 (−3 6)	−0 38 (−3 2)
D1 Pay Period Shorter Than a Month	−0 45 (−4 3)	−0 44 (−4.2)	−0 40 (−3 1)
D2 Two or More Full-Time Workers	−0 25 (−2 7)	−0 24 (−2 6)	−0 15 (−1 4)
D3 Usually Pays Fees for Demand Deposit Account	−0 39 (−4 2)	−0 39 (−4 2)	−0 30 (−2 7)
D4 Usually Pays Fees for NOW Account	−0 38 (−2 5)	−0 40 (−2.6)	−0 30 (−1 7)
D5 Pays for Few Expenditures out of Main Checking	−0 35 (−1 9)	−0.33 (−1 8)	−0 48 (−1 8)
D6 Made a Transfer to Checking during Past Month	−0 21 (−1.9)	−0 21 (−1 9)	−0 16 (−1 3)
D7 Owns a Money-Market Savings Account	0 27 (2 6)	0 26 (2 5)	0.31 (2 7)
D8 Owns a Secondary Checking Account	0 92 (9 8)	0 90 (9 6)	0 94 (9 0)
Cash	0.15 (6 5)	0 15 (6 5)	0 15 (5 2)
Credit Card Balance-1*	— —	0 00017 (2 1)	— —
Credit Card Balance-2†	— —	— —	0 90 (2 1)
Intercept	−0 86 (−1 1)	−0 41 (−0 5)	0 27 (0 3)
Adj R^2	0 354	0 357	0 339

*Credit Card Balance-1 the actual level of the balance
†Credit Card Balance-2 the natural logarithm of the balance if the balance is positive, otherwise, the respondent is dropped from the sample

[11]Synergistics Research Corporation

[12]More precisely, cash on hand is the amount held by the household member responding to the survey, providing it was obtained by a withdrawal from a bank account Earlier, in the regressions reported in Table 1, cash was added to checking balances and the sum was used as one form of the dependent variable But the cash variable was defined differently in that case, it was cash holdings—however obtained

The next step was to add to this augmented equation a variable representing attitude toward cash. This variable took the value one for those respondents who agreed with the statement, "I prefer to carry extra currency for emergencies because it is difficult to obtain currency on short notice." The variable took the value zero if the respondent disagreed. Its coefficient estimate (not shown in the table) falls far short of statistical significance; apparently attitude does not translate into identifiable extra checking account balances.[13]

The last step was to add total credit card balances to the equation. This is the sum of balances on all types of credit cards—store, gasoline company, travel and entertainment, and bank. This variable was added to the equation in three ways, with mixed and somewhat puzzling results.

- The *level* of the total balance (balance-1 in Table 2): This specification is asymmetric with respect to the income and opportunity cost variables (which enter the equation as their natural logs, not their levels), but it circumvents the problem of dealing with those households having no credit cards or a zero balance. High credit card balance corresponds with higher-than-average checking account balance (middle column of Table 2). Our interpretation is simply that credit card charges preserve checking account balances, or if the credit card balance is due, checking account balance must be built up in advance in order to pay the bill.
- The natural log of credit card balances (not shown in the table): To avoid the problem created by the fact that the log of zero is undefined, a balance of one dollar is arbitrarily attributed to those reporting a balance of zero. In this case, credit card balances are not correlated with money holdings.
- The natural log of credit card balances, but with those reporting a zero balance or not owning credit cards (297 households) dropped from the sample (balance-2 in Table 2): There are 625 households reporting a credit card balance in this reduced sample. For this equation, credit card balances have a significant effect, but by dropping one-third of the sample, the coefficient estimates for the other variables change somewhat and the significance of a few variables drops below the 5 percent level.

In sum, adding these variables somewhat improved the fit of the regression equation. We have provided our interpretation of the results, but admittedly, the connections between a household's cash on hand, credit card balances, and checking account balances are indirect, complex, and difficult to determine *a priori*.

[13]This dummy was also added to the equation explaining total M1 balances, its estimate is insignificant there as well

Summary and conclusions

This paper reports estimates of the household sector's demand for money obtained from regression analysis of cross-sectional survey data. In general, the estimates agree with the transactions motive for holding money and support the use of the conventional approach to the demand for M1. In the context of recent experience, these results suggest that the inability of econometric models to track the short-term movements of M1 satisfactorily is likely to have been the product of structural shifts in the demand for money, precipitated by various factors, including regulatory changes. The observed instability and unpredictability of money demand appear not to have been the fault of just the estimation methods or the definition of money. But the regression results reported here neither provide quantitative estimates of the suspected structural shifts nor identify the causes; they are only suggestive on these matters.

The empirical analysis, while important because it provides estimates of the household sector's money demand, cannot be directly applied to the setting of monetary targets. The estimates of the demand elasticities cannot be used to project the sensitivity of M1 to a change in money-market conditions. We do not know how to translate the elasticities derived from differences among individuals at a point in time into elasticities pertaining to changes over time. This is a problem parallel to converting estimates of the marginal propensity to consume derived from budgets of individual families into the marginal propensity to consume out of next year's GNP. Hence, the cross-sectional estimates cannot be used to make projections of the effect that a change in interest rates will have on the growth of M1 over a period of time, say one year.

These limitations aside, this study has the virtue of using a fresh approach to the research on money demand. In addition, the regression estimates indicate that the interest rate elasticity of the household sector's demand for money may currently be much greater than was estimated from pre-1974 aggregate time-series data. Indeed, the short- and medium-term sensitivity of M1 to interest rates may be substantially greater than economists and policymakers have thought it to be.

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