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ARE MONEY BALANCES AN INFERIOR ASSET?: Rational Expectations and the Household Demand for Money

by

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ABSTRACT

The rational expectations hypothesis presents the challenge that estimates of permanent income should be calculated from the statistical expectation of such income. This study reports on basic research undertaken on this proposition as it applies to the demand for money, a relation generally considered to be a function of permanent income. Data on 735 households from a national sample of the U.S. reveals that consumers reduce their demand deposits in response to an increase in lifetime wealth. The data also reveals that households do not exhibit money management behavior consistent with full information.

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1. INTRODUCTION

The form of the demand for money function most commonly used in macroeconomic analysis is one where current money balances are functions of current and lagged values of income and lagged values of money balances themselves. Such a form is always justified as the result of some non-instantaneous adjustment by some of the variables to changes in economic conditions.

The use of the Koyck transformation in conjunction with the assumption of adaptive adjustment to desired and/or "permanent" quantities particularly for income and money balances is the standard procedure by which the appearance of lagged values in the demand for money function is justified. Economic agents are assumed to be unable to achieve their desired money balances except gradually or they gear the money balances they hold to their "permanent income", an estimate that is formed adaptively from current and past values of income. (For particular examples see Feige [1967], Hamburger [1966], and pages 142-148 in Laidler [1977].)

The issue of rational expectations arises from the need to estimate these unobserved "desired" or "permanent" quantities.

The rational expectations hypothesis, first studied by Muth [1960], presents the challenge that if permanent income is indeed the expected value of income that will be received over the household's lifetime then such a statistical expectation should be carried out over the actual

income process of the household. Muth showed that the use of adaptive expectations to estimate permanent income is at best an approximate except[1] when the true income process is of a very special form.

This study estimates a demand for money function for households as function of permanent income where the permanent income estimate does not require such a restricted income process.

Such a procedure is carried out by first determining the actual form of the income process and then jointly estimating the parameters of the two equation system consisting of the demand for money equation and the income process by maximum likelihood. Annual panel data from 735 households gathered by the Michigan Survey Research Center from 1967-1970 was used in this study. 'Money' for this study was the demand deposit holdings of these households and 'income' was their disposable income.

The methodology is an application of the techniques and a slight generalization of the model developed by Hall and Mishkin in [1980] in their study of permanent income and household consumption.

The significance of this study originates from its application of rational expectations to the estimate of permanent income (an admittedly entrenched concept in the demand for money) and from its use of household data to test these two hypotheses (which, while typically applied to aggregate data, are hypotheses about individual behavior).

The response by consumers to increases in permanent income turns out to be negative - a relatively unknown result. Less wealthy consumers have a large negative response. Wealthier consumers have a response not significantly different from zero. Consumers seem to be hoarding more than transactions balances in their demand deposits. As an asset balance however consumers seem to consider demand deposits as an inferior good. That this negative response is unknown brings into question the identification properties of aggregate demand for money equations.

An implication of the rational expectations hypothesis is that if indeed the consumer aggressively adjusts his money balances to his current economic situation at all points in time then all changes in money balances are a function solely of current period innovations to his information set. This means that innovations to income of the previous year should exhibit a zero coefficient. This implication is not supported in the data violating the full implications of rational expectations.

All these results are significant at the 1% level and can only be deemed "poor" in the sense that it is a demand for money study that does not fully confirm results of previous studies. The novelty of the results, however, poses a challenge to the microeconomic foundations of demand for money functions.

The next section develops the estimating model and explains the nature of the data used. Section 3 reports the results. Section 4 explores the insights into household behavior that has been revealed

by this study.

2. THE ESTIMATING MODEL AND THE DATA

The methodology used in this paper implements the suggestions made by Muth in Sections 3 and 4 in his 1960 paper. (Details of an optimization based money demand as a function of permanent income are found in Montes [1981] and beyond the scope of this empirical report.)

As Muth suggested, let us specify the income process to be composed of a permanent component and a transitory component. The permanent component, y_t^L for "lifetime income", is not the same quantity as "permanent income" which is lifetime income plus the annuity value of transitory income - but the response of money holdings to lifetime income will be equal to its response to permanent income.

To be fully consistent with the spirit of the approach, the identification (in the Box-Jenkins sense) of the actual income process should be an empirical matter, guided by theoretical considerations.

For estimation purposes, Hall and Mishkin [1980] suggest the following a priori guidelines. Think of the household's observed real income at time t as the sum of three components. The first component, $\bar{y}_t$ is deterministic. For most households this component would rise systematically with age until just before retirement then fall rapidly. The deterministic component represents an empirical extension of Muth's suggested model where only purely stochastic influences were considered.

The second component, y_t^L, fluctates with changes in the household's lifetime prospects. Permanent changes in family characteristics are captured by this component. A natural specification is a random walk:

$$y_t^L = y_{t-1}^L + \epsilon_t \tag{2.1}$$

where ϵ_t is independently distributed with mean zero and variance σ_ϵ^2. In order to apply maximum likelihood estimation, we assume that ϵ_t is normally distributed. Elements that can be foreseen are captured by the deterministic component. Only truly unforeseen permanent changes are stochastic.

The third component, y_t^s, fluctuates with transitory influences. Preliminary studies revealed the appropriateness of a white noise specification for this process:

$$y_t^s = \eta_t \tag{2.2}$$

where η_t is an independent, normal random variable with mean zero and variance σ_η^2. Efforts to fit a more elaborate income process, such as an AR(1), were hampered by the fact that only three first differences in the income data were available so that only three convariances could be used for identification: the contemporaneous variance, and the covariances of lag one and two.

The transitory component is distinguished from the permanent component only in that transitory changes take time to make presence

felt while permanent changes are immediately reflected in the data (the coefficient of lagged lifetime is one). Under this view, the implicit permanent income processes fitted under adaptive expectations would actually be classed as transitory influences.

Total observed real income, $\tilde{y}_t$, is therefore:

$$\tilde{y}_t = \bar{y}_t + y^L_t + y^S_t. \tag{2.3}$$

Let y_t denote the purely stochastic elements of income. Then

$$\begin{aligned} y_t &= \tilde{y}_t - \bar{y}_t \\ &= y^L_t + y^S_t \\ &= y^L_{t-1} + \epsilon_t + \eta_t. \end{aligned} \tag{2.4}$$

Let $\tilde{s}_t$ denote the amount of assets other than money a household owns at period t. Before any theoretical restrictions, the actual stock of money maintained by the household, $\tilde{m}_t$ will be a function of income and its other assets:

$$\tilde{m}_t = ft\,(\bar{y}_t, y^L_t, y^S_t, \tilde{s}_t). \tag{2.5}$$

Household characteristics induce a deterministic path on money balances which we will denote as $\bar{m}_t$. It is convenient to use a linear form for (2.5):

$$\tilde{m}_t = \bar{m}_t + \alpha'_t\, y^L_t + \beta'_t\, y^S_t + \zeta_t(\tilde{s}_t - \bar{s}_t) \tag{2.6}$$

where $\bar{s}_t$ is the deterministic path of other savings, α'_t, β'_t, and ζ_t are the propensities to hold money balances from lifetime income, transitory income, and stochastic savings.

Let m_t and s_t be the purely stochastic paths of money and other savings respectively so that:

$$m_t = \tilde{m}_t - \bar{m}_t \qquad s_t = \tilde{s}_t - \bar{s}_t. \tag{2.7}$$

We use these definitions to rewrite Equation (2.6) as:

$$m_t = \alpha'_t y^L_t + \beta'_t y^s_t + \zeta_t s_t. \tag{2.8}$$

We assume the consumer faces a known and fixed interest rate r and that demand deposit holdings yield zero net interest. The equation of motion for savings net of money is:

$$s_t = (1+r)\,[s_{t-1} + y^L_{t-1} + y^s_{t-1} - c_{t-1} - (m_{t-1} - m_{t-2})] \tag{2.9}$$

where c_{t-1} was consumption last period. Substitution of (2.1), (2.2), and (2.9) into (2.8) and taking first differences on money balances produces this expression:

$$\begin{aligned} \Delta m_t = {} & \alpha'_t \varepsilon_t + \beta'_t \eta_t \\ & + [\alpha'_t - \alpha'_{t-1} + (1+r)\zeta_t]\, y^L_{t-1} \\ & + [(1+r)\zeta_t - \beta'_{t-1}]\, y^s_{t-1} \\ & - (1+r)\zeta_t c_t \\ & + [(1+r)\zeta_t - \zeta_{t-1}]\, s_{t-1} \\ & - (1+r)\zeta_t (m_{t-1} - m_{t-2}). \end{aligned} \tag{2.10}$$

If we used this last equation to test the permanent income hypothesis, our test would violate two assumptions in neoclassical consumer theory. Equation (2.10) indicates that information available in period t-1 such as y^L_{t-1} helps to determine money balances in year t. Taken literally, it states that the change in money balances from year t-1 to t is dependent on data from year t-1. Since by year t, m_{t-1} is presumably known, only the value of m_t needs to be chosen at this time. That lagged information apart from m_{t-1} has predictive power on this choice can only mean either or both of two things:

1. m_{t-1} was not fully adjusted to all information known at t;

or

2. not all information supposedly known in t-1 was actually there.

The first possibility violates the notion of full equilibrium. It is likely that money balances are not fully adjusted to equilibrium at any particular point in time. But continued disequilibrium either represents some equilibrium of a sort or indicates naivete on the part of the consumer. There is also the empirical issue of errors in measurement. This error is adjusted for in the estimation procedure. We hypothesize that observed changes in money balances are the sum of the changes induced by the model plus a measurement error term, ν_t, which is independent and normally distributed with mean zero and variance σ^2_ν.

The second possibility subverts our own notation and should be quickly expunged except that it is fitting at this point to explain the role of "rational expectations" in the model. A fully informed consumer is one who uses all the information available in year t-1 to form an estimate of his permanent income. Any other definition would be non-operational. This information includes the parameters of the model contained in Equations (2.1), (2.2), (2.8) and (2.9).

Since systematic factors are presumably captured in the deterministic path of money balances, the only issues in doubt have to do with the stochastic elements of income. In year t-1, the best estimates of permanent income would make full use of the knowledge of the model after which the consumer adjusts the money balances he wants to maintain accordingly. When year t comes along, new information comes along and consistent with the model a new estimate of permanent income must be made. Since all previous information would have been captured in the level of m_{t-1}, only the new information should be relevant to the choice of m_t apart from m_{t-1} itself. All other information would be redundant.

The rational expectations hypothesis at this micro level only clarifies the meaning of full information in a dynamic, sequential decision context.

These considerations constrain the coefficients of the lagged terms in (2.10) to zero. Because the coefficient of c_{t-1} in (2.10) must be zero, ζ_t must be zero as long as the rate of interest is not

equal to -1. Since the consumer re-optimizes every period, last period period's consumption does not provide information for this period's money balances. In the same way, last period's savings are orthogonal to this period's money balances.

A zero coefficient for s_{t-1} along with ζ_t also implies that β'_{t-1} must be zero. A zero coefficient for y^L_{t-1} implies that α'_{t-1} equals α'_t, i.e., the response to permanent income is independent of time.

That β'_{t-1} is zero means that only the current innovations in transitory income should influence money balances. In particular, estimating permanent income by a weighted average of past incomes contradicts the principle of full information. If money balances do not serve as a buffer for transitory fluctuations in income, then the data should reveal that β'_t is zero.

These calculations save us the trouble of having to estimate household savings other than money balances because the estimating equation new becomes:

$$\Delta m_t = \alpha' \varepsilon_t + \beta' \eta_t + \nu_t - \nu_{t-1} \qquad (2.11)$$

where now the terms in ν represent the measurement errors on money balances in periods t and t-1. This equation together with Equation (2.4) for income represents the basic model used in this test of permanent income.

2.1 TEST OF THE RATIONAL EXPECTATIONS HYPOTHESIS

We would like to test the rational expectations assumption directly (while still avoiding the need to estimate total household savings). The simplest alternative assumption is that households manage their money balance solely on the basis of their current income so that when money is measured without error:

$$m_t = \kappa y_t \tag{2.12}$$

which implies:

$$\begin{aligned} \Delta m_t &= \kappa \Delta y_t \\ &= \kappa\varepsilon_t + \kappa(\eta_t - \eta_{t-1}) \end{aligned} \tag{2.13}$$

where κ is the response of money balances to current income. The current change in money balances is now dependent on last year's innovation in transitory income, η_{t-1}. The change in total income from year t-1 to year t includes the change in transitory income from t-1 to t. If a household habitually pegs its money balances on the level of its current income then these balances are sensitive to the transitory income of the previous period. Excess sensitivity to current income by a permanent income consumer violates rational expectations.

We assume that each household exhibits some behavior of the type in Equation (2.11) and some of the type of Equation (2.13).

$$\Delta m_t = [\alpha' \varepsilon_t + \beta' \eta_t] + [\kappa \varepsilon_t + \kappa(\eta_t - \eta_{t-1})] \qquad (2.14)$$
$$= (\alpha' + \kappa)\varepsilon_t + (\beta' + \kappa)\eta_t - \kappa\eta_{t-1}.$$

If we let

$$\begin{aligned} \alpha &= \alpha' + \kappa \\ \beta &= \beta' + \kappa \\ \alpha &= -\kappa \end{aligned} \qquad (2.15)$$

the estimating equation simplifies to:

$$\Delta m_t = \alpha \varepsilon_t + \beta \eta_t + \gamma \eta_{t-1} \qquad (2.16)$$

where α is the household's total response to innovations in permanent income, β the response to contemporary transitory income and γ the response to lagged transitory income.

2.2 DATA USED

Some effort was put into integrating interest rates into the estimation. Cross section interest rates were calculated using the state-by-state method of Feige [1964]. These interest rates had negligible effect on the first differenced money demand equation like (2.16) and were not statistically significant. These same interest rates are used in the level regression reported in Tables 3 and 4. (See Montes [1981].)

The consumer durables study of the Michigan Survey Research Center asked consumers during the first quarter of the years 1967, 1968 1969, and 1970 what their incomes were in the previous year and the size of their current demand deposit balances at the time of the interview. There are therefore four data points which provide three first differences for both income and demand deposits for each consumer.

2.3 TIMING OF INFORMATION

Because of the timing of the data, it is not clear whether current money balances are adjusted on the basis of previous year's income which is fully known or the current year's income which is gradually being revealed. To account for this ambiguity, the variable ϕ was defined as the fraction of money balances that was managed on the basis of last year's income so that $(1-\phi)$ is the fraction that was based on this year's income. In order to apply maximum likelihood, it is actually assumed that all households know ϕ. The covariances of the model under either interpretation are equivalent.[2]

2.4 DATA EDITING

There were a total of 1434 respondents to the panel study. Because of missing values for either income or demand deposits 165 had to be dropped. If a household reported zero demand deposits in all years, this household was dropped. Households that reported zero demand deposits in any of the four years contribute an implied infinite

percent change in their balances between the years when balances are zero and those when they are positive which increases the sampling variance considerably. The number of cases dropped because they had zero demand deposits in any year was 453.

A check was also run on the reasonableness of the liquid asset balances reported. Fifty-five cases were dropped because they reported missing values for any of the three liquid assets: demand deposits, time deposits or bonds. An additional 26 cases were dropped because the reported increase in their liquid asset balances between any two years was greater than the sum of disposable income net of housing payments (mortagage or rent) and inheritance and the decrease in the value of common stock owned and the decrease in the value of the residence (if there was a decrease). This criterion was a minimum guarantee that none of the included respondents reported implicity negative liquid asset balances in any year. The total remaining cases that was used in this estimation was 735.

2.5 ESTIMATION OF DETERMINISTIC COMPONENTS

In order to provide the estimating model with only the stochastic changes in money and income, we need to estimate the deterministic parts of the income and the money balance processes and subtract these from actual observed values. In the study of time series processes, the deterministic components are frequently thought of as the mean of the process. In our case, it is natural to suppose that the deterministic

paths are influenced by demographic variables such as age, number of children, and so on. There is also the issue of the downward sloping schedule of money demand on interest rates.

Regression estimates of the trend (see Appendix A) show little deterministic influence. There was little difference in the results between those which used these estimates for the deterministic path and those which used the mean of the observation as the deterministic path. Only those results which used the latter method are reported here.

2.6 ESTIMATION BY MAXIMUM LIKELIHOOD

The full model consists of two equations:

$$\begin{aligned} \Delta m_t &= (1-\phi)\alpha\varepsilon_t + \phi\alpha\varepsilon_{t+1} \\ &\quad + (1-\phi)\gamma\eta_{t-1} \\ &\quad + [(1-\phi)\beta + \phi\gamma]\eta_t \\ &\quad + \phi\beta\eta_{t+1} \\ &\quad + \nu_t - \nu_{t-1} \end{aligned} \tag{2.17}$$

$$\Delta m_t = \varepsilon_t + \eta_t - \eta_{t-1}$$

where there is the data for the left-hand observed variables for t=1, 3..

Note that the basis of the estimating model is the individual unit through time so that the results actually reflect the time-series

behavior of households. Only the rare availability of the panel data for this study permits the estimation of this model.

The left-hand variables of (2.17) provide the data variance-covariance matrix. Estimates of the coefficients and variances are obtained by maximizing the likelihood that the model in the right-hand side of (2.17) provides the observed matrix under the assumption of normality. The full numerical maximization of the likelihood function is carried out by the moments program written by Bronwyn Hall.

3. RESULTS

Estimation of the model provided some startling results which are exhibited in Table 1. The estimates imply the following:

1. The response of money balances to permanent income is negative. A $100 increase in permanent income is accompanied by a permanent $3 decrease in demand deposit balances.

2. Households exhibit a significant response to current transitory income. Eighteen dollars ($18) out of every $100 in transitory income is temporarily maintained in checking accounts. The implied value of β' was estimated at 0.090 with a standard error of 0.029.

3. The rational expectations hypothesis is unsupported by the data. Lagged transitory income has a significant coefficient in the γ estimate of -0.09. Since the fraction of total income kept in money

TABLE 1

Results of Main Estimation

Parameter	Estimate (Standard Error)	Interpretation
α	-0.031 (0.013)	Response to permanent income
β	0.183 (0.029)	Response to current transitory income
γ	-0.094 (0.037)	Response to lagged transitory income
ϕ	0.551 (0.062)	Fraction of information about income in year t+1 available in t
σ_ϵ^2	5163.081 (459.281)	Variance of innovation in lifetime income (dollars squared)
σ_ν^2	279.244 (12.505)	Variance of measurement error on money balances
σ_η^2	2889.564 (279.254)	Variance of innovation in transitory income

balances - κ - is negative y by Equation (2.15), it seems that households that manage their money balances solely according to current income keep $9 out of every $100 of such income in demand deposits.

4. All of the estimates of coefficients and variances are significant at the 1% level.

5. The very negativeness of the permanent income coefficient confirms that asset motives instead of transactions motives dominate the demand for money.[3] Transactions balances would be expected to increase (though possibly fractionally) with wealth. Tests of the importance of liquidity constraints are explained below.

3.1 SENSITIVITY TO SUB-POPULATIONS

Is it only the wealthier members of the population that can afford a reduction in their demand deposits when permanent income goes up? Let the level of education be an instrumental variable for wealth. Model 3 was estimated separately for households where the head of the household finished high school plus other vocational training only and for those households where the head had at least some college credits, with sub-populations of 331 and 404 respectively. (The cutoff was chosen to have about the same number of observations for each subpopulation.)

The estimates are given in Table 2, where Column 1 is the previous estimate for the whole sample, Column 2 are the estimates for the less educated and Column 3 for the more educated. All the signs of the coefficients from the whole sample are maintained in the subpopulations. Except for ϕ, the amount of advance information, there are however significant differences between the subpopulations on the sizes of the coefficients.

TABLE 2

Estimates on Subpopulations

	(1)	(2)	(3)
α	-0.031	-0.158	-0.003
	(0.013)	(0.033)	(0.015)
β	0.183	0.275	0.110
	(0.029)	(0.042)	(0.045)
ϕ	0.552	0.525	0.529
	(0.063)	(0.054)	(0.110)
γ	-0.094	-0.195	-0.068
	(0.038)	(0.050)	(0.046)
σ^2_ε	5163.4	5301.0	12790.4
	(459.3)	(885.8)	(1477.4)
σ^2_ν	279.2	542.7	514.0
	(12.5)	(40.9)	(28.1)
σ^2_η	2889.4	5618.1	6274.9
	(279.2)	(615.7)	(874.7)
LNL	-19238.4	-9269.9	-11415.4
N of Obs	735	331	404

Figures in parenthesis are standard errors.

(1) Whole Sample
(2) Head of household high school grad or less in year 3
(3) Head of household with at least college credits in year 3

Rather than the wealthy, it is the poor that can afford to reduce their demand deposits when permanent income goes up. Their α is a significant -0.158 while for the wealthy it is a small -0.003 and

not significantly different from zero.

The result seems to assert the idea that the poor households tend to keep their savings "in the bank" in low (even negative) interest earning assets. As wealth increases, other avenues of investment open up and households then tend to keep their deposits at a fixed level (& almost zero) when permanent income changes. A test of the robustness of this liquidity constraint interpretation is reported in the next section.

3.2 JUSTIFICATION OF THE RESULTS

The two main results of (1) a negative permanent response to lifetime income and (2) high sensitivity to transitory income are at variance with the oral tradition in this field. The permanent income elasticity is generally thought to be at least one and previous studies have generally shown little sensitivity of money balances to transitory income measured as the residual from actual income of adaptive permanent income.

The first question to be answered is: how comparable is the data set used? To definitively answer the question I have estimated a demand for money equation of the conventional form.

The results are in Table 3 and 4. There is only one equation reported in these two tables; the large number of explanatory variables has necessitated breaking up the results into two tables. Table 3

TABLE 3

Cross-Section Regression - I

Dependent Variable - Log of Real Demand Deposits
(First Part of Results - Rest in Table 4)

Explanatory Variable	Estimated Coefficient (Standard Error)
The Constant Term	-1.393* (0.583)
Age of Head of Household	0.034* (0.003)
Family Size	-0.127* (0.017)
Dummy for Bond Ownership (1 if true)	-0.110* (0.055)
Dummy for Stock Ownership (1 if true)	0.229* (0.057)
Dummy for Home Ownership (1 if true)	0.007 (0.065)
Dummy for Managerial Occupation (1 if supervisor, manager, or self-employed)	0.192* (0.062)
Dummy for Wife in Labor Force (1 if true)	-0.240* (0.052)
Dummy for Urban Location (1 if live-in-city)	-0.492* (0.054)
Dummy for Expected Financial Condition Next Year (1 if worse or uncertain)	0.206* (0.077)
Dummy for Husband's Education (1 if college graduate)	0.090 (0.068)
Dummy for Wife's Education (1 if college graduate)	0.218* (0.087)

*Significant at the 5% level.

reports the coefficients of the purely demographic variables. Table 4 has the coefficients of the variables that have macroeconomic significance.[4]

TABLE 4

Cross-Section Regression - II

Dependent Variable - Log of Real Demand Deposits
(Continuation of Results from Table 3)

Explanatory Variable	Estimated Coefficient (Standard Error)
Log of Charges on Demand Deposits	-0.135* (0.061)
Log of Interest on Time Deposits	0.131 (0.229)
Log of Dividend Rate on Savings and Loan Shares	-0.274 (0.210)
Log of Rate on 3-Month Treasury Bills	0.174 (0.181)
Log of Real Disposable Income	0.636* (0.057)

*Significant at the 5% level.

N = 735 families for 4 years = 2490	
Standard Error of the Estimate:	1.345
Adjusted Squared Multiple Correlation:	0.186
F-Statistic	43.13

The results are unremarkable and are quite in keeping with published results elsewhere.[5]

The important thing to note is that the coefficient on disposable income is unambigously positive. This is true even when the regressions are calculated on the subpopulations used in the previous section. Calculations using only the fourth year of the panel data and estimating "permanent income" as a (declining) weighted average of past incomes in the manner of Peterson [1974] also confirms previous results that this method tends to raise the income elasticity to near 1.0 (the actual estimated value was a significant 0.91).

The data does seem to be comparable to those used in other studies. Moreover, the regression result does contradict the interpretation that the negative response of money balances to permanent income is a reflection of liquidity constraints. If indeed households experienced scale constraints which forces them to hold inordinately large demand deposits when they are poor, it should be reflected in the data across households as lower demand deposits for wealthier households. This is not the case.

Hamburger's [1966] is the only recent study I am aware of that has reported a negative coefficient for the wealth estimate, though most of these were insignificantly different from zero. Hamburger studied money holdings for households from the flow of funds accounts and allowed for adaptive adjustment for all the variables in the demand for money equation. His estimating equation was based on the percentage changes in the variables and thus a function of the first differences of these variables. Before Hamburger, Friedman [1959] found a negative relationship between "permanent" per capita money balances and "permanent" per

capita income for the years 1950-1958.

4. INSIGHTS INTO HOUSEHOLD BEHAVIOR

The use of a different expectation formation assumption seems to be principal cause for the radically different empirical results.

Permanent increases in wealth are accompanied by permanent reductions in demand deposits. A very natural interpretation is that the negative sign demonstrates that money is an inferior good in the household's investment opportunity set. This is quite at variance with previous interpretations that have arisen from estimates of the permanent income elasticity of money larger than 1. Indeed, Arrow [1970] cites these previous findings as evidence that the Arrow-Pratt measure of relative risk aversion might actually be increasing.[6] There is some evidence in this study, which attempted to use a more appropriate estimate of permanent changes in income (as a better estimate of changes in wealth), that relative risk aversion might actually be decreasing.

The negative wealth elasticity of money does imply that in the aggregate money velocity should be increasing. Indeed, the evidence is that after World War II money velocity in the U.S. has been increasing (see for example, Friedman and Schwartz [forthcoming]). The interpretation of reported positive income elasticities would be similar to the interpretation of the cross-section regression presented in the previous section. Increasing financial sophistication has actually

increased the monetization of the economy. Never households tend to use more money in their economic activity than previous ones.[7]

Graves [1976] gives four other possible reasons why the aggregate money-income relationship would be positive in the long term at the same time that each household might be reducing the fraction of its income in liquid assets. The first is that the rise in average cash balances is due to the dramatic fall in the size of households (5.23 to 3.42 persons from 1860 to 1957) coupled with "increasing returns to household size" for transactions balances. A second reason is the trend "toward after-tax income equality" (again coupled with an increasing return factor). A third reason is the increase in population mobility which tends to require each household to completely provide for its own liquidity needs. A fourth reason is the increasing rate of taxation.

Graves makes the point that estimating income elasticities over long time series requires the assumption that the utility functions of holders of money are constant through the period. One might also add that it requires the assumption that the "representative" transaction technology be constant.

Because the expectations assumptions of previous studies differ from those used in this study, no definitive reconciliation of the negative response of money balances by consumers and positive relationship between money and income in aggregate data is possible until the same type of assumptions are used on aggregate data. Research on this prob-

lem is being undertaken at the present time. The results being reported here must be treated as arising from basic research where the rational expectations ideas are tested on data from individual economic agents from whence these expectations originate.

None of these considerations should detract from the simple plausibility of the result obtained here: households reduce their money balances as they get wealthier because money is an inferior investment.

The estimated β confirms that money is indeed a "temporary abode of purchasing power". The coefficient of current transitory income is significantly different from zero. The strict Friedman hypothesis that money balances are not a buffer asset for transitory income is not supported.

This result is consistent with the inference that households seem to face high interest rates for lending and borrowing. The permanent income hypothesis as it applies to money demand requires that money balances be adjusted to some lifetime level for these balances. This is why the hypothesis would be violated if households simply kept a fraction of their current income in money balances. The estimated capitalized value of the current surprise in income, y_t^s, would be part of permanent income. When interest rates are high the increase in permanent income from y_t^s would be minute. If the previous result on lifetime income is correct, there should be a small (smaller in absolute value than $\hat{\alpha}$) negative response of money balances to the current sur-

prise in income. However, the estimated coefficient is positive.

The positive coefficient means that (1) interest rates tend to be high so that the negative permanent effect is negligible and (2) households really do temporarily put at least part of their income surprises into their money balances - instead of instantly spending them or investing them elsewhere immediately.

That the parameter γ is estimated to be significantly different from zero means that households do not seem to aggressively adjust their money balances to all information available at any point in time.

Because it does not use adaptive expectations, this study provides hard evidence that at the household level the speed of adjustment of money balances is truly protracted - and this drawn out reaction is independent of any slowness the estimate of the income process might have in adjusting to a "normal level".

One of the interesting results in Barro's series of studies on the effect of "unanticipated money" on macro-economy is that the price response to unanticipated money movements has a longer lag than the output response. Barro reconciled the difference using the hypothesis proposed by Darby [1972] that "temporary income has a strong effect on current money demand that dissipates only gradually".[8] In Barro's model, the equation of motion for the price level is derived from the demand for money equation. The gradual adjustment of money balances to these temporary influences rationalizes the observed longer speed of adjust-

ment of the price level relative to output.

The microeconomic evidence presented here on transitory income supports this rationalization.

It is hoped that the statistically important results presented here encourage other research into:

(1) The empirical issue of (the decomposition of) long-term trends in money velocity and

(2) The theoretical issue of the rationality behind slow adjustment of money balances by households to new information.

Appendix A

Estimates of Deterministic Paths

My best estimates of the functions of these deterministic paths are given in Table A. These equations show little explanatory power.

TABLE A

Estimates of Deterministic Influences

$$\Delta m_t = \underset{(223.9)}{96.91} - \underset{(10.85)}{4.68}\ AGE + \underset{(0.13)}{0.08}AGE^2 - \underset{(266.87)}{1.32}\ \Delta LOG\ (R) - \underset{(17.6)}{3.31}\ T$$

$N=2205 \qquad R^2=.001 \qquad F(2200,4)=0.59$

$$\Delta y_t = \underset{(961.01)}{1102.01} - \underset{(46.65)}{16.70}\ AGE - \underset{(0.55)}{0.01}\ AGE^2 - \underset{(74.38)}{21.77}\ T$$

$N=2205 \qquad R^2=0.0066 \qquad F(2200,3)=3.18$

( ) - Standard Error

T = 2 for 1966-1967, 3 for 1967-1968, 4 for 1968-1969

R is Charges on Demand Deposits.

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FOOTNOTES

1. These objections were raised implicitly since Muth's stated purpose for the above cited article was to show how good an approximation adaptive expectations were to a more general approach.

2. See Hall and Mishkin [1980].

3. The very negativeness of α seems to indicate that demand deposit holders do have large enough balances to afford a reduction when lifetime prospects improve and that the fraction of permanent income in demand deposits could be large.

4. Except the rate on three-month treasury bills which there were only four data points, the cross-section interest rate variables were obtained by the same method and sources used by Feige [1964] which provides an interest rate every year for each state of the U.S.

5. Some of the studies are Feige [1964], Feige and Swamy [1974], Lee [1966], Hartley [1966], and Cohen [1967], which used statewide observations in pooled cross-section; Kichline [1968], Edwards [1965], Kardouche [1969] and Hammond [1979] based on Standard Metropolitan Statistical Area (SMSA) data while Lee [1966], Peterson [1974], and Drescher [1977] used household data. Except for the Drescher dissertation, these studies are comprehensively surveyed in the Hammond reference above. Feige [1974] also has an excellent survey.

6. Friend and Blume [1975], using panel data similar to that used in these study, concluded that relative risk aversion seems to be constant unless that part of the household assets that arise from home ownership is considered 'riskless' in which case relative risk aversion would be decreasing.

7. Friedman and Schwartz use the same explanation for the pre-1914 period for the U.S.

8. Barro [1978], p. 568.