WHAT IS WRONG WITH MONEY? AN ATTEMPT TO UNDERSTAND THE IMPACT OF CREDIT ON MONEY DEMAND ESTIMATIONS

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ABSTRACT

We examine alternative specifications of demand for money, which has shown inconsistencies since 1970s between its theoretical expectations and empirical findings. An important feature of this research is the introduction of subcomponents of monetary measures. Non-M1 portion of M2 and credit are positively related to income. One interesting finding is that the non-cash portion of M1 is not. Further, the introduction of credit improves money demand forecasts. We conjecture that these results may be explained by people moving assets from non-interest bearing accounts into savings accounts with simultaneous use of credit card loans. Hence, the need for new monetary aggregates.

INTRODUCTION

One of the building blocks in macroeconomic theory is undoubtedly the relation between the demand for money and a scale variable such as income and an opportunity cost variable such as interest rates. Empirical application and use of this equation raises questions about relevant variables. There may be several candidates for all three components of this equation, namely M1 or M2 or some other measure of money may be used as a dependent variable. Of particular interest in economic policy, and to central bankers who control the monetary instruments of that policy, is the definition of money or the definition of monetary aggregate to be targeted and/or tracked. What is the best measure of the demand for money?

After the famous "missing money" phenomenon of [26], correctly estimating and hence forecasting monetary aggregates has stirred a very heated discussion in the literature, which has seen its spillover to the policy circles. How to define a reliable monetary aggregate, and how to estimate a stable monetary relationship are the type of questions that have dominated the field together with a multitude of solutions suggested.

The purpose of this paper is to try to analyze several monetary aggregates in expectation of discovering possible deficiencies in these definitions and basically point to a credit component which will hopefully account for some of the discrepancies between theoretical expectations and empirical findings of money demand relations. Our approach is to begin with broader definitions of monetary aggregates such as M1 and M2, and to proceed to more disaggregated definitions such as cash. The reason we look into the components of monetary aggregates is to identify the problematic part(s) in their specifications. That is hoped to answer two questions: One: What are the problems, if any, with the simple summation of monetary components to make up larger aggregates? And two: If the empirical results do not coincide with the theoretical expectations, then where does the problem lie?

In the remainder of the paper, we review the relevant literature, lay out the theoretical foundations for our empirical research, present our data, carry out estimations, propose possible solutions to the problems encountered in the empirical research with a self-criticism and conclude with a section with a recap of our findings overall.

LITERATURE REVIEW

One of the most important issues in the monetary literature concerns choosing the “right” monetary aggregate to carry out empirical research. The research of [28], [46] of [33] advocates different measures of money such as M1 and M2 from many alternatives ranging from M1, M2, M3 to monetary base.

Meanwhile, real GDP, real GNP, wealth, and even consumption ([42] and [14]) or wages have been used as scale variables. Obviously, too, are the many measures of interest rates and rates of returns to measure the opportunity cost of holding money. Sometimes a short run and sometimes a long run interest rate is used as exemplified by the 3 month Treasury bill or Commercial paper rate, Corporate bond rate, and others. The choice between T-bill and Commercial paper does not seem to affect results ([55]). It has also been argued by [39] that not much difference between the yield on a short term instrument and that on a long term one exists. He further suggests that simple opportunity cost concepts should be used in empirical work rather than the complex ones such as “term structure of interest rates” as is done in [31] since “the results on the role of the opportunity cost of money holding on the demand for money are not all that sensitive to the precise measure chosen.” [39] also reports that the expected inflation in low inflationary economies such as the US does not seem to play a role in demand for nominal balances. And nominal money demand is found to be proportional to the price level according to a considerable size of literature. This justifies an estimation of real money demand, i.e. with unitary price elasticity of nominal money demand assumption, as a function of any interest variable, and a scale variable.

Macroeconomic theory is as mute about the dynamics of the equation as it is about the “right” variables to choose in applying the theory. That is why, the choice of lag is, from a theoretical perspective, also an ad hoc assumption[1].

All in all, the models estimated until the mid-70’s provided substantial support for the theoretical models. [25] reported substantial overforecasts of money demand in the 1970's to explain why the results of his money demand estimation through the mid-1970’s had turned out to be inconsistent with his earlier ([26]) work through the 1960’s.

Since then, quite a few fixes were suggested to account for the so-called “missing money.” For example, [29] used food stamps as a substitute for money. The introduction of newly developed financial instruments was seen as the culprit by many, and a relentless effort was put forth to “correct” money demand equations by including the “best” proxy for financial innovations. For example, [12], among others, found that the volume of electronic fund transfers was a good proxy for the state of financial innovations. Financial innovations, which bring about institutional changes in the economic systems, affect the stability of money demand relations ([39]). [51], [63], [65] and [52] all showed the negative impact of financial innovations on the demand for money. Computerization of the payments system as a financial innovation was studied by many authors, such as [20], [45], [27], [44] and [43], where all concluded that computerization produced a positive impact on cash management, thus leading to lower levels of money demand due to technological innovations.

As an alternative financial innovation example, credit card usage is analyzed by many researchers such as [16], [13], [64] and [41]. [20], [64], [12] and [22] conclude that money demand and credit cards are negatively related. [56] which report that both small businesses and large retailers welcome the new media of exchange with integrity assurance and minimal expense thanks to inexpensive technologies, which made the usage of cards more convenient.

Some researchers suggested that the simple addition of monetary components was a fundamental mistake, which could be corrected by alternative measures of money such as a Divisia index, leading to many papers on "Divisia money"[2] . Realizing the fact that there are so many different types of checkable accounts with various requirements imposed on them such as maximum number of checks a month or certain maintenance fees, the cash and checkable deposits were considered imperfect substitutes. Since currency and deposits may differ in transactions costs, risk of loss, and ease of concealment of illegal or tax-evading activities, separate demand functions for currency and demand deposits should be estimated ([24]). Out of this huge literature, it is fair to say that convincing evidence of the stability of money, defined in any way, is yet to be discovered.

THEORETICAL FRAMEWORK AND PRACTICE

The theoretical model, which serves as a basis to many empirical studies, is the famous quantity equation:

$$MV=PY \quad (1)$$

or in real terms

$$M/P=(1/V)Y \quad (2)$$

The behavior of velocity, V, determines the shape of the relationship to a large extent. If there is a long run (stable) relationship between real money and real income, as claimed by the permanent income hypothesis, then velocity becomes constant in the long run, i.e. $V = \overline{V}$, and the simplest equation to estimate becomes:

$$m=a+b*y \quad (3)$$

where *a* is a constant, *b* is the income elasticity of money demand when *m* and *y* are money demand and real income in log, respectively. The conventional is wisdom is to find a positive intercept and also a positive income elasticity in empirical work. If, however, velocity is not constant, i.e. $V \neq \overline{V}$, then it may be formulated as a function of the interest rate, *V= V(R)*, which leads to the following estimation:

$$m=c+d*R+e*y \quad (4)$$

where *R* is the nominal interest rate, assuming a linear relationship between velocity and the interest rate. *c*, *d* and *e* are the coefficients. As said above, *c* and *e* are positive while *d* is expected to be negative. The alternative could be a loglinear relationship between V and R. But the results, which are available from the authors upon request, are not substantially different with the latter formulation. [17], [8] and [35] show that the equation 4 type specification fits M1 and cash definitions of money while equation 3 would be a better way to estimate M2.

DATA

We study money demand relations for five different periods for comparison purposes, especially to compare to results of [28] and [33], henceforth HR and HJ respectively[3] for which all the data can be conveniently found in St Louis Fed's web site [61] located at www.stls.frb.org/fred/index.html:

(1959:01-1974:12): prior to the missing money period
(1959:01-1981:12): prior to the structural break in early 1980's
(1959:01-1988:12): whole period of HJ and HR
(1968:01-1998:03): credit data period
(1959:01-1998:03): our whole period.

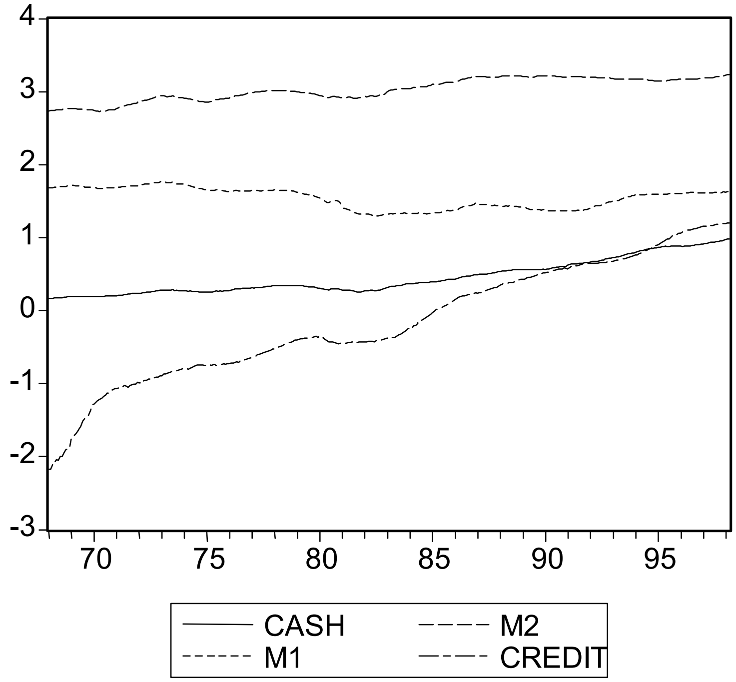
Cash (currency), M1 and M2 are seasonally adjusted (SA) money stock variables in billions of dollars. The consumer price index, CPI, which is also SA, for all urban consumers for all items, with a base year of 1982-84=100, is used as the price deflator. The SA disposable personal income in billions of dollars is used as the income variable, Y. We choose personal income because it is available monthly. T-bill rate, TR, in this paper represents the 3-month Treasury Bill rate, calculated as averages of business days in the secondary market. As the credit variable, we use the SA revolving credit (Total Revolving Credit Outstanding), CRED. The "credit data period" is basically the period for which the data are accessible for CRED. Obviously, the starting point of data on credit determines the length of some of the experiments.

At the beginning of the credit data, there seems to be two shifts in the data, which we interpret as a data definition problem. Apparently some new categories of financial institutions are added to the definition at these points in time. Non-availability of figures from newly added financial institutions does not mean that they did not provide this service (revolving credit) to their customers before. But rather the data were not collected from them. This is also confirmed via our correspondence with the maintainer of the data set in question. To partially avoid this problem, the credit data set is smoothed to eliminate these breaks. Due to difficulties involved in the interpretation of revolving credit, a better variable would probably be a direct measure of credit such as VISA and/or MasterCard usage in the market. But as far as we know, it is not publicly available. However, we perform a check on the results by using another credit concept, namely domestic nonfinancial debt, DEBT, later in the paper. We employ prime rate, PR, as a proxy to represent the interest rate charged on credit[4].

ESTIMATION AND RESULTS

We, first, estimated econometric relations as specified in equations 3 and 4 above for M1 and M2 covering periods mentioned above with the help of [36], [37] and [38]. The results[5], as found in the literature before, show that theoretically expected outcomes can be obtained for the earlier periods, but things fall apart for the recent data periods. Especially for periods starting in 1968:1, an insignificant cointegration vector or the wrong signs on the income or interest terms are at least an indication of a discrepancy between the theoretical expectations and the empirical foundations.

Figure 1
Log Of Real Cash, M1, M2, And Credit



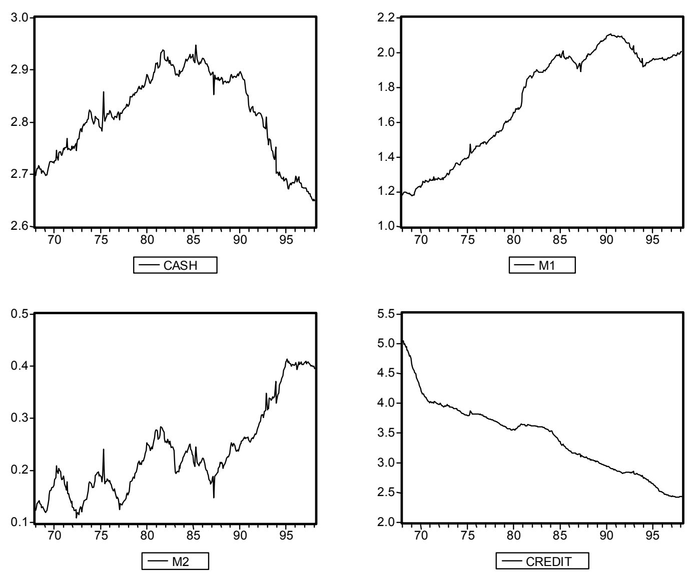
In a well-specified demand relation, the price of the alternative good or service must be taken into account to correctly identify the impact of each independent variable on the dependent variable. Otherwise the signs, sizes and/or significance of the coefficients on the included variables would be unreliable, and the error term would have non-white noise characteristics. The deterioration of the estimation for the most recent data may be related to the omission of an alternative to (substitute for) money, specifically credit, which may render unstable the previously known monetary relations if omitted from the estimation. As a matter of fact, the increase of credit in recent years is very dramatic as represented in Figure 1, suggesting that the credit has taken the place of money at least partially. Hence, we include prime rate into the estimation process for the periods starting in 1968:1 because prime rate is the price of a substitute for money, namely credit. This gains us the ability to see the effect of credit on money demand. The theoretically expected coefficient on the prime rate in money demand equation is positive since money and credit are substitutes. The results are presented in Table 1. However, the inclusion of a proxy for credit to represent its price does not solve the problems encountered in earlier studies. Usually, the broader definition of money, M2, performs better in terms of obtaining almost unitary income elasticity for most of the experiments. One should note that the theoretically significant cointegration vector obtained for M2 with the inclusion of prime rate is basically due to the presence of T-Bill rate together with the Prime rate in the same equation. Thus, as the results in Table 1 show there is also a long run relationship between the two rates, suggesting that no further information about M2 and other variables in the process can be acquired from the cointegration vector.

Table 1
Estimated Cointegration Vectors Between Money, Income, T-Bill Rate And Prime Rate

VARIABLES	PERIOD	OPT LAG	# OF CVs	M; TR, PR; Y
M1; TR, PR, Y	1968:01-1974:12	1	1	1; 0.03 (0.02); 0.02 (0.03); -0.11 (0.20)
M1; TR, PR, Y	1968:01-1974:12	2	1	1; 0.03 (0.01); 0.004 (0.01); -0.14 (0.10)
M1; TR, PR, Y	1968:01-1981:12	2	2	1; 0; 0.09 (0.20); 0.34 (0.20) 0; 1; -1.42 (1.22); -2.75 (1.22)
M1; TR, PR, Y	1968:01-1988:12	2	2	1; 0; 0.07 (0.01); 0.46 (0.08) 0; 1; -1.20 (0.06); -2.18 (0.61)
M1; TR, PR, Y	1968:01-1998:03	2	2	1; 0; 0.10 (0.01); 0.26 (0.08) 0; 1; -1.03 (0.09); -3.26 (0.48)
M2; TR, PR, Y	1968:01-1974:12	1	1	1; 0.01 (0.01); 0.05 (0.02); -1.04 (0.20)
M2; TR, PR, Y	1968:01-1974:12	2	1	1; 0.01 (0.01); 0.04 (0.01); -1.01 (0.06)
M2; TR, PR, Y	1968:01-1981:12	2	1	1; 0.12 (0.08); -0.15 (0.10); -1.27 (0.24)
M2; TR, PR, Y	1968:01-1988:12	2	2	1; 0; 0.01 (0.002); -0.91 (0.03) 0; 1; -1.29 (0.04); -1.79 (0.60)
M2; TR, PR, Y	1968:01-1998:03	2	1	1; 0.19 (0.05); -0.22 (0.06); -1.2 (0.16)

Standard errors are shown in parentheses. Number of cointegration vectors (CVs) is determined at the 5% level of significance.

Figure 2
Velocity Concepts



An interesting observation is about the pattern of the inverse of velocities. By definition, the inverse of velocity shows the ratio of a monetary aggregate (or credit) to nominal income. Figure 2 graphs the log of velocities of monetary aggregates such as cash, M1 and M2, and that of credit. As is apparent from Figure 2, only credit shows a steady rise in its ratio over income while M1 and M2 lack a systematic pattern[6].

Table 2
Ur Tests On Velocity Terms

VARIABLES	OPT LAG	MAX LAG	-ADF	-ShC	CONCLUSION
VCASH	2	25 (5)	0.49 (0.03)	9.51 (9.55)	UR
VM1	1	25 (5)	-0.12 (-0.29)	9.18 (9.21)	UR
VM2	1	25 (5)	1.86 (1.69)	9.41 (9.44)	UR
VCRED	6	25 (6-10)	4.83	9.04	NO UR
VCRED	5	5	5.30	8.77	NO UR

OPT LAG stands for the optimum lag length as determined by the Schwartz criterion, ShC. MAX LAG refers to the maximum lag assumed in the estimation. ADF is the ADF test statistic with a constant and a time trend as suggested by Figure 3. A unit root at 5% level of significance is coded as UR in the Conclusion column. Or else, NO UR (no unit root in data). The 5% critical value for tests with a time trend included is –3.42.

In this study, we suggest that financial innovations have changed the standard assumptions about the relation between money, and income and interest. We further suggest that consideration of credit can explain some of these anomalies. This means a change in the institutional structure of the economy. In a sense, it is to confirm that the velocity of money is not constant. Actually, as is clear from Table 2[7], there is a support for a stable velocity for credit rather than money because the velocities of the monetary aggregates have unit roots in them while the velocity of the credit is free from the unit root. Notice here that the natural log of velocity (VCASH, VM1, VM2 or VCRED) is defined to be the difference between the natural log of real income and the natural log of real Cash/M1/M2/Credit for the time period of 1968:01-1998:03. Thanks to the definition of velocity, however, this experiment tests two hypotheses jointly, viz. the unitary income elasticity of money demand and the zero coefficient on interest. For all measures of money, i.e. cash, M1 and M2, this hypothesis fails to pass the test. As mentioned before, [17], [8] and [35] contend that because the velocity of narrow definition of money is not stable, a relationship depicted by equation 4 fits better for the estimation of M1, whereas M2 should be estimated by a relationship illustrated by equation 3 because its velocity is expected to be stable over time. In the next set of estimations (Table 3), however, the data do not seem to support a long run relationship between money and income. This is so because there is no cointegrating relation between either M1 and income or M2 and income while there is a significant cointegration vector between credit and income. As opposed to unexpected outcomes from estimations involving money, one would obtain the expected sign for income elasticity in Credit equations irrespective of interest rates employed as shown in Table 4.

These findings between money and income as opposed to credit and income support findings of [15] and [21][8]. On the other hand, [9] finds that money is much more highly correlated with the growth rate of income than credit in the period of stable money demand relations, i.e. 1953-1973. They use GNP as the income variable, M1 as the indicator of money, and "the sum of intermediated borrowing by households and businesses" as the credit variable. The correlation becomes almost identical during 1974:1-1979:3. However, in the following period, 1974:4-1985:4, a sharp decline in the correlation between money and income is observed while there is a slight decline in the correlation between credit and income. The results do not change when a real rather than a nominal variable is used.

Table 3
Cointegration Between Money Variables, Credit And Income

VARIABLES	OPT LAG	# OF CV {CV}
M1, Y	2	0
M2, Y	1	0
CRED, Y	1	1: {-3.34 (0.09) }

OPT LAGs dictated by the ShC are used. # OF CV represents the number of significant cointegrating vectors at the 5% level of confidence. If any is found, then it is reported within the curly brackets. Standard errors are within the parentheses. Time period is 68:01-98:03.

Table 4
Cointegration Vectors Between Credit And Other Variables

VARIABLES	# OF CV	CV
CRED, PR, Y	1	1; 0.02 (0.01); -3.43 (0.09)
CRED, TR, Y	1	1; 0.02 (0.01); -3.39 (0.09)
CRED, PR, TR, Y	2	1; 0; 0.03 (0.01); -3.34 (0.11) 0; 1; -1.18 (0.04); -2.31 (0.45)

OPT LAGs dictated by the ShC are used. # OF CV represents the number of significant cointegrating vectors at the 5% level of confidence. Standard errors are within the parentheses. Time period is 68:01-98:03.

Table 5
Cointegration Analysis Of The Components Of Money

VARIABLES	# OF CV	CV
CASH, PR, TR, Y	2	1; 0; 0.08 (0.03); -1.49(0.29) 0; 1; -1.02(0.14); -4.61(1.35)
DD, PR, TR, Y	2	1; 0; 0.12 (0.02); 1.16 (0.11) 0; 1; -1.04 (0.09); -2.71(0.47)
TD, PR, TR, Y	1	1; 0.36 (0.13) ; -0.45 (0.16); -2.05 (0.38)

OPT LAGs dictated by the ShC are used. # OF CV represents the number of significant cointegrating vectors at the 5% level of confidence. Standard errors are within the parentheses. Time period is 68:01-98:03.

These anomalies about the elasticities in money demand equations warrant further research into the components of the relations under consideration. For that, we will evaluate the individual components of M1 and M2 to detect the place of irregularity. A breakdown of the narrowly defined money may be formulated as

$$M1=CASH+DD \quad (5)$$

where Cash stands for currency in the hands of public, and DD for the "non-cash portion of M1" or (transactions balances). Likewise the broad definition of money may be stated as

$$M2=M1+TD \quad (6)$$

where TD is the "non-M1 portion of M2" or (savings balances).

Table 5 shows that there is a well-defined relationship between cash and, income and interest rates. Furthermore, that there are two cointegration vectors conveys the idea that we have information far beyond what is brought to us by (TR, PR) relationship alone. But non-cash portion of M1, i.e. DD, has a negative relationship with real income. More concisely,

$$DD=D(TR, Y) \quad (7)$$

where the partial derivatives of DD with respect to its arguments, income and interest rate as represented by the T-Bill rate, are both negative. In other words, as income rises, over time, people prefer to get out of checkable accounts.

FIGURE 3
M1 AND ITS COMPONENTS: CASH AND NON-CASH PORTION OF M1 IN LOGS.

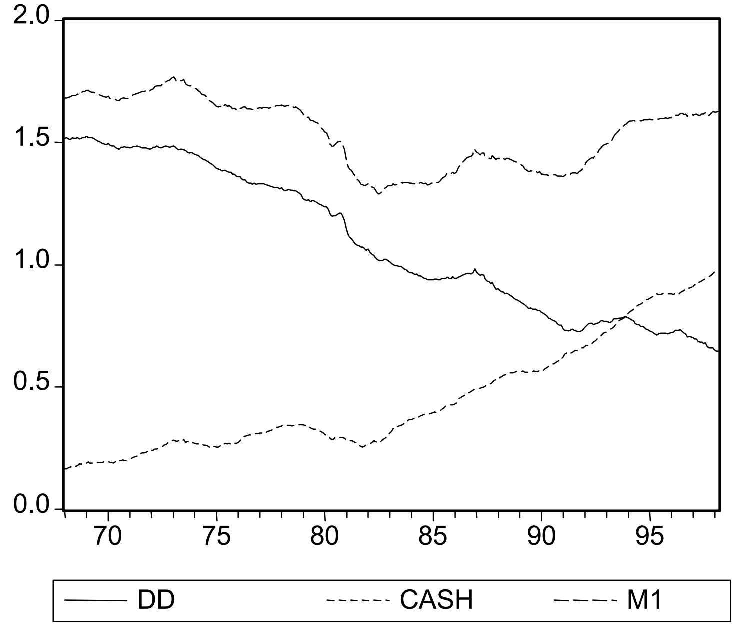


Figure 3 implies that the decrease in M1 was due to a decrease in DD first, and then the increase in it came from the increase in cash. Why do people get out of DD? We suggest that they instead use credit in payment for goods and services. That way they can continue earning interest on their savings at the bank until they pay the credit card bill, usually a period later. Maybe for small levels of income (or, better to say, wealth) and of interest, the household would not worry about the interest earnings as much. However, as they get wealthier, their spending also increases, amounting to more sizable sums. The interest earnings for that amount might be quite high. Additionally, as [8] points out, "technological advances in financial management enable people to economize more easily on their money," which would lead us to the above observations about the behavior of the components of monetary aggregates. A simultaneous observation should be a positive relationship between credit and income, which is clearly found above. Specifically,

$$CRED=CR(R, Y) \tag{8}$$

where the partial derivatives of CRED with respect to its arguments are $CR_1<0$, while $CR_2>0$ as Table 5 shows. Then the answer to the question "*what do people do with their funds when they get out of DD?*" is simply that they go to TD:

$$TD=TD(Y) \tag{9}$$

where the derivative of TD with respect to income is positive as shown in Table 5.

After all these analyses, the legitimate question to ask would be if there was a structural break in money demand relations after 1980's. It is well known that 1980's witnessed quite a few liberalizations in the financial sector such as legalization of interest earning checking accounts. Additionally, financial innovations such as ATM have overcome some legal barriers in the banking sector (such as limitations on the number of branch offices in states) on one hand, and they obviously gave a lot of freedom in money management to individuals, on the other.

Assuming that the structural break happened after 1981:12[9], a VAR of real monetary aggregate, real income and the 3-month T-Bill rate with a dummy whose value is zero until 1981:12 and 1 thereafter is treated as the unrestricted regression. Exclusion of the dummy in the above VAR would be called the restricted regression. If there is actually a structural change in the data after the mentioned period, then the dummy must be significantly contributing to this relationship. To test this possibility, we run a likelihood ratio test, Π, in the following form[10]:

$$\Pi=(N-K)[LOG(\Gamma_R)-LOG(\Gamma_U)] \tag{10}$$

where N stands for the number of observations, K for the number of variables in each unrestricted equation, Γ_R (Γ_U) for the determinant of the estimated variance-covariance matrix of the restricted (unrestricted) equation. It is quite clear from Table 6 that the null hypothesis of "no structural change" is strongly rejected for both M1 and M2 because the calculated chi-square value is larger than the tabulated one, more so in the case of narrow definition of money.

Table 6
Structural Change Analysis

	Γ_R	Γ_U	8
M1	2.23E-10	2.15E-10	16.84
M2	1.05E-10	1.03E-10	8.87

The period covered is 1959:01-1998:03. Two lags are used in VARs as indicated by OPT LAGs. N equals 469, and K 8. The $\Pi_{(3)}$=7.81 where 3 is the degrees of freedom.

IMPLICATIONS OF FINDINGS

The message of this paper is a simple one: The traditionally suggested money demand relations are, at best, very shaky. Two lines of research must be followed: One is the attention needed to be given to the components of the monetary aggregates. New developments in the financial sector change people's behavior that cannot be captured by the widely used monetary aggregates. The second approach, which is perhaps an offshoot of the previous one, should be to construct new monetary aggregates to reflect theoretical expectations. A little attempt in that direction below, *which is only suggestive*, shows that when monetary aggregates are broadened to include credit the cointegration vectors turn out to be much closer to the expectations. However, a word of caution is in order here: Since money and credit for banks are in different sides of a balance sheet, the problem of double counting may arise with the inclusion of credit to a monetary aggregate. This may also be problematic for non-bank credit because retail money market funds, whose liabilities are in M2, hold much of the commercial paper issued by finance companies, which lend to consumers, on the assets side of their balance sheets. A way to alleviate these concerns with the help of accounting concepts is presented below.

Table 7
Cointegration Analysis With
The New Monetary Aggregates

VARIABLES	# of CVs	(M*; PR; TR; Y)
M1*	2	1; 0; 0.11 (0.02); -2.82 (0.17) 0; 1; -1.14 (0.05); -2.35 (0.44)
M2*	2	1; 0; 0.02 (0.01); -4.03 (0.17) 0; 1; -1.19 (0.04); -2.48 (0.47)

Cointegration between monetary aggregates, and PR, TR and Real Income. OPT LAGs dictated by the ShC are used. # OF CV represents the number of significant cointegrating vectors at the 5% level of confidence. Standard errors are within the parentheses. Time period is 68:01-98:03.

The new (and larger) M1, M1*, and M2, M2*, are constructed as the natural log of (M1 + Credit), and that of (M2 + Credit), respectively. In both cases, we find two cointegration vectors with negative interest and positive income coefficients (Table 7). The first vector in both M1* and M2* cases yields monetary aggregate as a function of T-Bill rate and income. However, if we consider the fact that T-Bill rate and prime rate are also cointegrated, we can produce a third vector as a linear combination of two significant vectors. Hence, by subtracting the second cointegration vector in the table, which shows the relationship between interest rates, in the M1* case one obtains a cointegration vector of (M1*; PR; TR; Y) = (1; -1; 1.25; -0.47); and in the M2* case it yields (M2*; PR; TR; Y) = (1; -1; 1.21; -1.55). Another way of expressing these ideas, since PR and TR are correlated generates the following representations for M1* and M2*:

$$M1^*=(PR-TR)-0.25TR+0.47Y$$
$$M2^*=(PR-TR)-0.21TR+1.55Y.$$

That says that the (new) narrow definition of money demand is inelastic with respect to income, which comes close to a Baumol-Tobin type model's expectation of income elasticity of money demand, but the (new) broadly defined money demand is elastic[11].

One way of overcoming the accounting anomaly presented into the study by the inclusion of M*'s is to construct variables similar to the "liquidity" idea of accounting. Liquidity in accounting is defined as "having enough money at hand to pay the bills when they are due, and to take care of unexpected needs for cash" ([49, p. 239]). In other words, it is the short term debt repayment ability of the agent. There are two widely employed measures of liquidity, namely the *working capital* and the *current ratio*[12]. The former is defined as the difference between current assets and current liabilities. The latter, however, is the ratio of current assets to current liabilities. Current liabilities, in turn, are considered to be the liabilities which must be satisfied within a year (or the operating cycle, whichever is longer), while current assets, on the other hand, are those that "will be realized in cash, or that will be used up within one year" ([49, p. 240]). The liquidity ratios are used to judge the cash flow prospects of the entities subject to this analysis, because they are considered as good indicators of the economic agent's ability to pay off its bills when they are due. These are the short run debt paying ability of the economic agent because debts are paid out of working capital or a variant of it.

We construct a measure of the macroeconomy's liquidity in the accounting sense briefly outlined above, and test its econometric properties vis-à-vis that of the other monetary aggregates known in the literature (and analyzed here above). We also compare its forecasting performance against other variables. Our macroeconomic liquidity aggregate is a ratio of money to credit[13]. We will try to unearth the relationship between this variable, and the interest rates and real income. This is different from the above formulation in that one can better discern the reaction of money and credit to changes in the explanatory variables. The results for the log of, M1/credit, M1/CRED, and M2/credit, M2/CRED, are represented in Table 8. In both cases, one obtains three cointegration vectors, through which the first one shows that income elasticity of money demand is negative (and larger than unity). That is to say, people prefer to use more credit rather than money as their income rises, a result which was already expressed above.

Table 8
Cointegration Vectors For The Ratio Of Money Over Credit Estimations

VARIABLES	# of CVs	CV (Money/Credit; PR, TR, Y)
M1/CRED	3	1; 0; 0; 3.39 (1.00) 0; 1; 0; 15.69 (8.89) 0; 0; 1; 15.31 (7.40)
M2/CRED	3	1; 0; 0; 3.55 (0.37) 0; 1; 0; 8.49 (4.59) 0; 0; 1; 9.11 (3.79)

The optimum lags of 2 have been used in the process as indicated by OPT LAGs.

Table 9
Mses For Various Monetary Aggregates

VARIABLES	13*MSE	RMSE	RMSE/SD
M1	0.00411	0.064109	0.455266
M1+CRED	0.01497	0.122352	0.162076
M1/CRED	0.20265	0.450167	0.377303
M2	0.00743	0.086197	0.558917
M2+CRED	0.00311	0.055767	0.058628
M2/CRED	0.00054	0.023238	0.024001
CRED	0.0000063	0.00251	0.003115

The optimum lags of 2 have been used in the process as indicated by OPT LAGs. SD stands for the standard deviation of the variable.

Furthermore, we present in Table 9 a simple forecast analysis. These forecasts are obtained by, first, estimating a VAR for money (or credit), income, prime rate and treasury bill rate for the period of 1968:01-1997:02. Then, the values for money (or credit) for the remainder of the sample, i.e. 1997:03-1998:03, are forecasted for all the variables mentioned in the table. These forecasts show that at least for the broader monetary aggregates, one can obtain better forecasts by adding credit to the already available monetary definitions. Amazingly, credit variable is seen to have a very powerful forecasting ability.

ONE LAST CHECK ON RESULTS

In this section we will test our results against several other possible variables. It is, in a sense, a self-criticism. The problems can be briefly outlined as follows: It is well known that post-1990's have experienced an increase in demand for the US dollar abroad (see for example, [53] and [54]). This may call into question the validity of the results above regarding especially the cash component of money demand because maybe we are modeling a demand function for cash, which is not entirely dependent on domestic factors. It is quite difficult, however, to exactly determine the domestic component of cash demand. [53] suggest several methods to approximate the domestic (foreign) component of cash demand.

In this paper, we assume that the domestic component of cash demand in the US can be reasonably deduced by making use of cash demand in another country whose domestic economy is fairly similar to that of the US. [53] takes Canada as a suitable benchmark for comparison because "Canadian currency is not used outside of Canada to any significant degree" and many facets of US and Canadian markets are similar, making the induced domestic demand for their respective currencies have similar patterns.

Table 10
Cointegration Results Among Several Aggregates

VARIABLES	PERIOD	OPTLAG	# OF CV	CV
CASH, CANCASH	68:1-89:12	2	1	1, -1.36 (.35)
DOMCASH, Y, TR	68:1-97:9	2	1	1, -1.15 (.12), .07 (.02)
LMZM, Y, MZMRATE	74:1-98:3	2	0	1, -.99 (.13), .06 (.02)
M2, Y, M2OWN	68:1-98:3	2	0	1, -.72 (.05), -.02 (.01)
DEBT, CRED	68:1-98:3	3	1	1, -.48 (.02)
DEBT, Y	68:1-98:3	2	0	1, -1.68 (.13)
DEBT, TR, Y	68:1-98:3	3	0	1, .11 (.16), -1.02 (.92)
DEBT, PR, Y	68:1-98:3	3	0	1, .003 (.002), -.96 (.06)
DEBT, TR, PR, Y	68:1-98:3	3	1	1, .01 (.02), 0.21 (.55), -1.34 (1.2)

LMZM is the log of real MZM (i.e. deflated by CPI) and MZMRATE is the opportunity cost of holding MZM. MZM is seasonally adjusted. LM2 is the log of real M2, and M2OWN is its opportunity cost. MZM RATE and M2OWN are "weighted averages of the rates received by households and firms on the assets included in the aggregates." These alternative opportunity costs are relative to the 3-month Treasury constant-maturity yield. (See website mentioned in the text.) CANCASH is the log of real Canadian cash. Canadian cash is defined to be "Currency outside banks" with series B1604 (seasonally adjusted). DOMCASH is the composite of US cash before 1990s to which appended is the US cash "corrected" for foreign demand. DEBT is the natural log of real domestic nonfinancial debt. OPT LAGs dictated by the ShC are used. # OF CV represents the number of significant cointegrating vectors at the 5% level of confidence. Standard errors are within the parentheses. Time frame is dictated by the availability of data, and shown under the PERIOD column.

We estimate a cointegrational relationship between the US Cash, and Canadian dollar, Cancash, in the pre-1990's era, and we assume that, for domestic purposes, this relationship survives. As shown in Table 10, this cointegration vector is found to be (1, -1.36), which is statistically significant. Hence, we can make up a new currency series for the US cash demand, Domcash, which corresponds to the cash definition used earlier for pre-90's era but estimated for post-90's era. After that, we estimate another cointegrating relationship between this newly obtained cash data, and income and interest rate. It turns out that the "domestic demand" for cash is positively related with income, and negatively related with the interest rate, (Table 10). This shows that the results obtained before remain unaltered by foreign demand for cash.

The next point of contention may be the specification of opportunity cost of holding money balances[14]. Much liberalization in the financial sector has changed the opportunity cost of holding money. For example, interest bearing NOW accounts were allowed in the early 1980s, which implied that the opportunity cost of holding non-cash M1 balances fell below the 3-month Treasury bill rate. With regards to M2, the lifting of deposit interest rate ceilings on small time deposits and the introduction of money market mutual funds and MMDAs (Money Market Deposit Accounts) imply that the opportunity cost of holding M2 is not well tracked by the level of 3-month Treasury bill rate. The suggestion in that direction is to use a spread between T-bill rate and the average yield on money balances (See, for example, [32], [59], [40] and [47].) However, this is not considered a problem for currency since an open market interest rate is clearly a good proxy for the opportunity cost of holding currency, but rather for broader definitions of money.

The problem with M1 is further deepened with the existence of "sweep accounts." Under this program, many banks and other depository financial institutions can transfer their demand deposits into MMDAs if they are above "some" levels overnight to earn interest on them. This practice would affect M1 but not M2 since MMDAs are part of M2. That is why, M1 is largely replaced by MZM (Money, Zero Maturity), which includes zero maturity, or immediately available, components of M3, for analytical purposes[15].

To tackle these aforementioned problems, we searched for a cointegrational relationship between MZM, income and the opportunity cost of MZM. There is no significant cointegration vector in that relationship, even though an insignificant one shows that MZM is positively related with income (as a matter of fact, MZM has unitary income elasticity), and negatively related with its opportunity cost. The results for M2, income, and its opportunity cost also show that M2 is positively related with income, and negatively related with the interest rate. However, this cointegration vector, too, is insignificant. Table 10 presents all these results.

All these checks have shown that the anomalies obtained before in the paper were not due to some misspecification errors in estimation of monetary aggregates, but rather to more fundamental issues such as the omission of credit from the estimation process since the results with even the "corrected" aggregates do not reverse the earlier findings.

As a last point of checking our results, we experiment with a different concept of credit, specifically domestic nonfinancial debt, Debt, which is defined to be the "total credit market liabilities of the US Treasury, federally sponsored agencies, state and local governments, households and firms except depository institutions and money market mutual funds" by the Federal Reserve. This credit aggregate is obviously much more comprehensive than revolving credit. First of all, the credit concept used earlier, Cred, and Debt have a significant cointegration vector, and are positively related with each other (Table 10) implicating a similarity in economic behavior. Even though the income elasticity of Debt has turned out to be positive (even around unity) and the coefficient on interest negative, we failed to find a significant cointegration vector for these relationships. Suspecting the power of the test, we constructed new variables with the help of cointegration vectors found in Table 10 for Debt, and income and interest variables viz.

$$DEB \equiv DEBT-1.684281*Y+1.473615 \quad (11a)$$
$$DEBT \equiv DEBT+0.110458*TR-1.0161*Y-1.453903 \quad (11b)$$
$$DEBP \equiv DEBT+0.044358*PR-1.469633*Y+0.362107 \quad (11c)$$
$$DEBTP \equiv DEBT-.35147*TR+.294623*PR-2.443859*Y+3.598388 \quad (11d)$$

The pictures of the newly defined debt concepts indicate the stationarity in all of them except DEB, meaning that a cointegrational relation may exist. To quantify the graphical observations, we ran a unit root test on each of these variables by using Augmented Dickey Fuller test. The results, shown in Table 11, point out that DEBP and DEBTP are stationary at least at 10% level of significance. That is to say, Debt, income and prime rate, on one hand, and Debt, income, T-Bill rate and prime rate, on the other hand, seem to have a stable long run relationship[16].

Figure 4
Newly Defined Debt Concepts

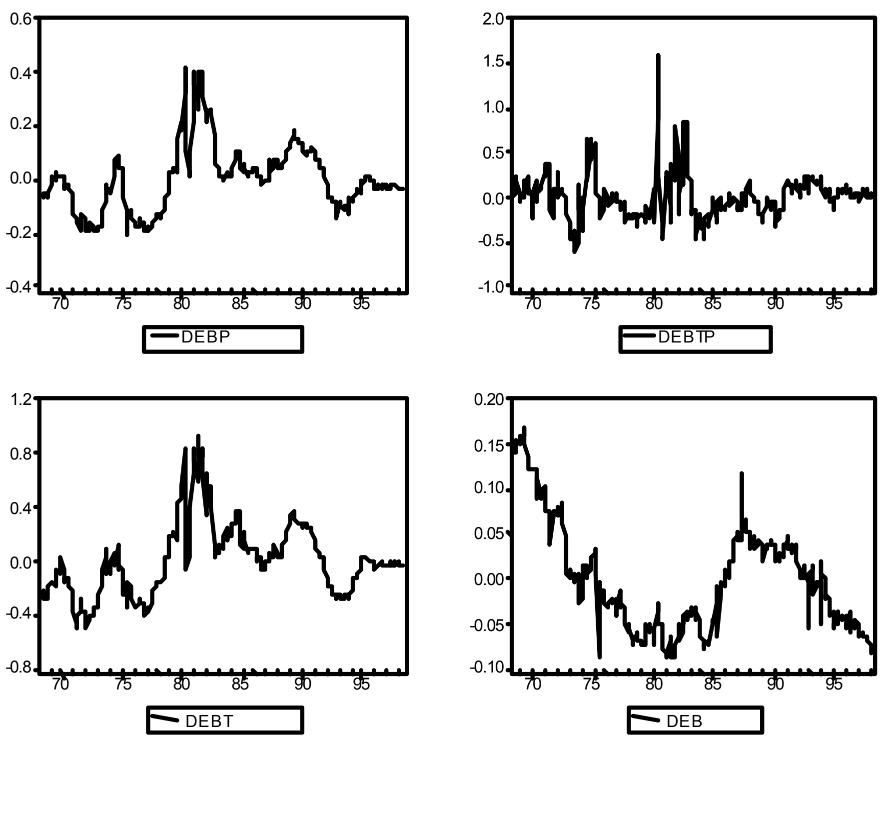


Table 11
Unit Root Tests On Debt Variables

Variable	OPT LAG	TREND, CONSTANT	ADF
DEB	2	t	-2.17
DEBT	2	t, c	-2.53
DEBP	2	c	-2.72
DEBTP	2	c	-6.50

The definitions of the variables are given in the text. OPT LAGs dictated by the ShC are used. The decision whether to include of time trend, t, and/or constant, c, in the test is based on Figure 4. The 5% critical value with constant is -2.87 and the 10% critical value is -2.57. Likewise, the 5% critical value with constant and time trend is -3.42 and at 10% it is -3.14. ADF refers to the Augmented Dickey Fuller test result with conditions specified in OPT LAG and TREND/CONSTANT columns.

EMPIRICAL LESSONS AND CONCLUSIONS

In this paper, we studied one of the fundamental relations in macroeconomics, which is the relation between money and certain other variables such as income and interest rate. The theoretical equations, which relate money to above-mentioned variables, have left quite a few points blank regarding estimation. For example, which definition of money or income or interest rates to be used? Or what are the dynamics of the equations to be estimated? A quick look into the literature has shown that there are attempts to use several monetary aggregates, income variables and interest concepts with various lags.

Estimations produced reasonably acceptable results from a theoretical perspective for periods before 1970's, after which the stability of money has come forward as a question in the literature. Many suggestions have been made in the literature to obtain a stable money demand equation as the theoretical models expected. None of them, however, has satisfactorily answered all the questions asked. We have shown that the usually known monetary relations cannot be empirically obtained from the current monetary definitions. We believe that several issues need to be addressed today for a more acceptable money demand equation to be produced out of the empirical research. First of all, due to the financial innovations, and the reformations in the financial sector after 1980's, the traditionally accepted "narrow" definition of money, which is used for transactional purposes should be amended to also include credit purchases, namely credit card transactions. Otherwise, the non-cash portion of M1 has lost its peculiarity as being held for the transactional purposes since one can use a credit card whose payment is due after a period (a month or so) to do the purchases while his savings can earn interest in the bank for the period in question. We have shown in this section that if M1 and M2 are broken into pieces as "cash" vs. "non-cash" portions of M1, and "M1" and "non-M1" portions of M2, one can observe that cash has a positive relationship with the income, and so does non-M1 portion of M2. Non-cash portion of M1, though, has a negative relationship with the income. This last feature puts into disarray the generally accepted relations between M1 and income, and hence between M2 and income so that we either could not find a cointegrating relation between income and money as in the case of M2 or could find an unexpected one as in the case of M1.

However, when considered individually, the above results mean that cash is used for transactional purposes alongside with credit because credit, too, produced convincing results such as a negative interest elasticity of credit demand and a positive income elasticity of credit demand. But as income goes up, people demand less money (and more credit) because the opportunity cost of holding money becomes higher. Instead, they withdraw from DD accounts, only to move into TD accounts. This change in relations was also confirmed with a structural break test, which indicated a change in the money demand structure after 1980's. The inclusion of credit has shown to improve the forecast performance of the variables.

These results indicate a new definition of monetary aggregate is warranted in the light of new regulations and advances in the financial markets.

ENDNOTES

1. [19] develop a Fourier dynamic system to estimate money demand relations.
2. See, among others, [34], [7], [5], [11], [57],[58]. Also [2],[3] and [4] in the Federal Reserve Bank of St. Louis *Review*, January/February 1997 examines the methodology and theory behind the Divisia index while providing sources for the raw data. [6] talks extensively over aggregation and similar issues, some of which are addressed in this paper. [1] is an earlier research into the aggregation question.
3. Actually, HR's data set starts in 1953, and that of HJ in 1915.
4. Approximately 53% of the credit card issuing institutions report that their interest rates are based on prime rate among 9 options ([18]).
5. We carried out the customary unit root tests a la [10] prior to the cointegration analysis. All the results are available from the authors upon request.
6. As an example to the influence of the credit, [18] reports that "both the amount and the share of all credit card debt held by large credit card banks increased substantially from 1995. Outstanding credit card balances at large credit card banks increased about 25 percent from 1995 to 1996 and the share of all credit card debt held by these banks increased about 6 percentage points from 71 percent."
7. It should be noted that both ShC and ADF numbers in the table are the negative of the actual numbers.
8. Friedman's credit is "domestic nonfinancial credit, including the total outstanding credit market indebtedness of all US public and private sector borrowers other than financial intermediaries," which corresponds to DEBT in our paper. All the results are calculated with the assumption of maximum 25 lags except for VSCRED, for which MAX LAG between 5 and 10 in addition to 25 lags are tried. The results with 5 lags are presented in parentheses if different from the 25 lag case.
9. Actually the analysis is carried out for a range of dates starting from 1980:1 until 1982:7, on a monthly basis, as the possible break points. The existence of structural break is supported for all experiments. The results are available from the authors.
10. See [50] for an alternative method of testing for structural break in US money demand.
11. We experimented with M1* and M2* for periods starting in 1968:1 and ending in 74:12, 81:12, 88:12 in addition to the 1968:-98:3 period, consecutively. Except the period of 1968:1-1974:12, the shortest range, all others produced the same signs for both interest and income and were two standard deviations of each other. The results are available from the authors.
12. A similar ratio is called the quick ratio. See [49, p. 779-780] for its definition. Also, [48] and [30] provide extensive discussions on the same topics at a relatively higher level. More on the issue with respect to the firms at a scientifically more involved level is to be found in [23] and [60], where the ratios mentioned in this paper together with other ratios in the accounting field are discussed.
13. One should note that our aggregate is a mix of current ratio and the working capital because the log of (Money/Credit) may also be expressed as log of money *less* log of credit. While the former conveys an idea similar to current ratio, the latter has an interpretation similar to working capital.
14. However, [39] shows that the complexity of interest rate concepts do not change results.
15. See [62].
16. Once again, the results of Johansen procedure and Augmented Dickey Fuller test contradict.

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