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The Information Content of Credit Aggregates

Bharat Trehan*

Knowledge of changes in private credit aggregates is useful in interpreting the money/GNP relationship because it helps to distinguish shifts in asset demands by households from changes in the demand for transactions balances by firms. This is necessary because both these changes have the same impact on money and interest rates but have different implications for future GNP.

There exists a large body of work documenting movements in narrowly defined money (M1) as leading movements in economic activity. The monetarist tradition regards this as evidence of causation, running from money to GNP. However, even casual empiricism suggests that this relationship has not been very stable recently. The first example is the sharp decline in the velocity of M1 over the second half of 1982 and the beginning of 1983 (see Judd, 1983, for a discussion). The second example is the sharp slowdown in the growth rate of money during the second half of 1983 (when money slowed from a 12.4 percent annual rate in the first half to a 7.2 percent rate in the second), which was followed by an unusually high rate of GNP growth in the first half of 1984. (For a more formal analysis of recent shifts in the money-GNP relation see Simpson, 1984.)

These episodes underline the need for obtaining information beyond that contained in the monetary aggregate when predicting future output. Towards that end, this paper examines what information can be obtained from movements in credit aggregates. A simple model is sketched out in which the money-output relationship over the business cycle is motivated in a way that is the opposite of the usual monetarist story. Changes in money growth precede changes in output as firms increase their demand for transactions balances in order to finance plans to increase future output.

Within this framework, we first examine the relationship between money and credit. Changes in both credit and money precede changes in output, and we show that changes in credit provide information in addition to that provided by both monetary aggregates and interest rates. Our findings indicate, in fact, that without knowledge about what has happened to private credit, it is difficult to determine what a change in money growth means for the future course of economic activity. In contrast, the connection between government borrowing and future economic activity is not as clear-cut, and the empirical results indicate that government borrowing does not provide reliable information about future economic activity.

The key point of this paper is that information on credit can help distinguish between disturbances to money demand—money demand "instability", in other words—and disturbances to credit demand, which also affect the stock of money because the demand for credit is in fact a demand for payments media. Positive disturbances to either will lead to increases in the quantity of money and to a rise in interest rates. However, the future course of economic activity depends upon precisely where the disturbance originates. Information on credit aggregates is useful because it provides a means for pinpointing the source of the disturbance. Em-

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pirical analysis supports this hypothesis. Section IV presents equations for real and nominal GNP as well as equations for M1 velocity, and shows that changes in several types of private credit are significant in explaining changes in those variables.

I. Households' Demand for Money

Since households operate under a wealth constraint, any change in money holdings not accompanied by a change in wealth must be matched by an opposite change in the holdings of other assets. In the simplified model considered below, the only other asset available to households consists of loans to firms. Thus, an increase in the demand for money must be offset by a decrease in the supply of loans. More generally, the point is that changes in households' asset demand for money will affect credit market conditions. Below, we show how this leads to a role for credit aggregates in predicting future activity.

Before doing that, however, it is useful to examine what factors can cause changes in households' demand for money and to discuss how relevant these factors are likely to be. Intuitively, it appears that expectations about future conditions are important determinants of the households' demand for money. For instance, Friedman and Schwartz state that expectations of instability due to the outbreak of war cause money demand to go up.[1]

Perhaps a more obvious example of a period during which the household demand for money will increase significantly is a recession. When a recession occurs, or is perceived as likely to occur, individuals tend to become more cautious and to retain money balances since they think that there is a greater chance of being unemployed. Furthermore, the more severe or prolonged the recession, the greater the shift in households' expectations of future income. As a consequence, the increase in money demand will be higher as well.

Some evidence consistent with this hypothesis is provided by the behavior of velocity during recessions. (Recall that velocity is defined as the ratio of real GNP to real money balances, so that an increase in money demand due to expectational factors leads to a decline in velocity.) The first example is the behavior of velocity during the period from late 1982 through early 1983. The fact that the 1982 recession was the worst since the Great Depression and that it followed very closely on the heels of the recession in 1980 must have made a substantial psychological impact on households, leading to an increase in money demand.[2] Exactly the same thing happened during the Great Depression: M1 velocity declined practically continually from the first quarter of 1929 to the first quarter of 1933, with the sharpest declines occurring in three of the last four quarters of this period. While both the examples above are rather extreme, they provide some support for the hypothesis that expectational factors are important determinants of money demand.

Previous researchers have, of course, considered the role of movements in various credit aggregates in forecasting economic activity. Perhaps the most well-known is the work done by Benjamin Friedman (see Friedman, 1985, and the references there). In contrast to the approach below, his work focuses on the determinants of asset demands to show why credit aggregates matter. It relies heavily upon the observed stability of the debt-income ratio in the post-war period (see Friedman, 1981). Friedman also showed that movements in domestic nonfinancial debt contained information at least as useful as any of the monetary aggregates about movements in GNP. However, subsequent empirical research has shown that at least some of his results hinge upon econometric technicalities (see Porter and Offenbacher, 1983, and Froewiss and Judd 1979). Moreover, the ratio of nonfinancial debt to income has been rising since 1980.

II. A Simplified Model

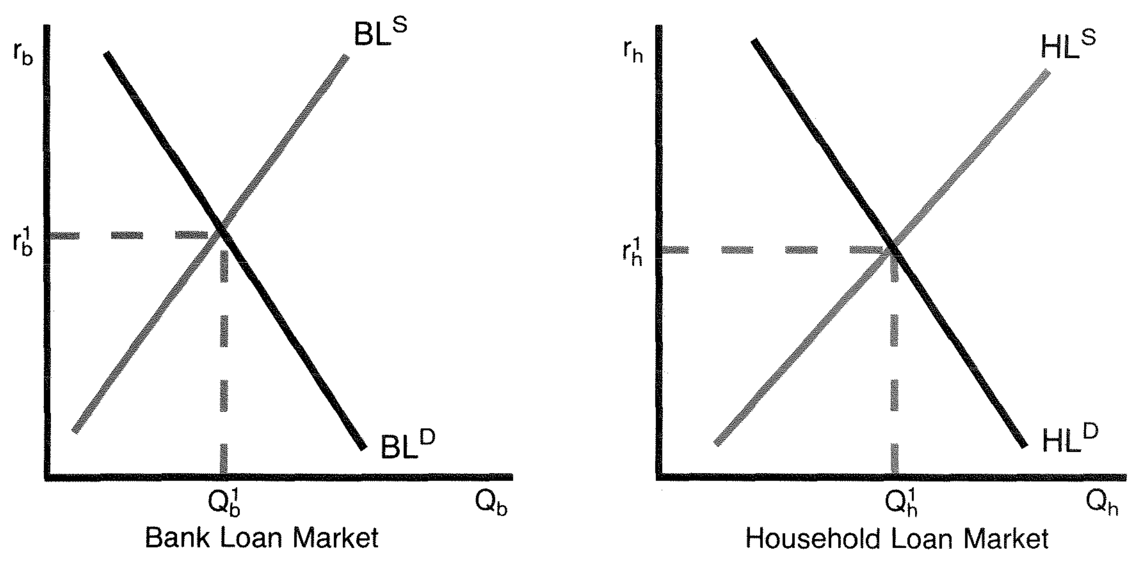
The importance of information about credit aggregates can be shown in a simple framework in which there are only three types of decision-makers: firms, households and banks.

In this framework, we assume that firms desire to increase output levels as a result of positive shocks to productivity (King and Plosser, 1984). Positive shocks to productivity could occur, for instance, when new technology makes it profitable for firms to increase production.

Because production planning and implementation takes time, firms wishing to produce more tomorrow must begin accumulating the needed productive resources today. Not all the funds needed by a firm are likely to be available internally, so it must borrow. It is worth pointing out that this accumulation of money balances for future use is what Keynes called the finance motive for holding money, describing it as the "coping stone" of the liquidity theory of money demand.

Businesses have two sources from which to borrow: banks and households. It is assumed, for simplicity, that households do not borrow from banks, although they add to or reduce their holdings of bank balances by withdrawing or depositing currency. (It is also assumed that the supply of currency is perfectly elastic, that is, the monetary authority supplies the amount of currency demanded.) Thus, firms are the only borrowers. Which source firms draw on for their funds, however, is critical in determining how money and credit behave and, in particular, in determining which will be a better indicator of future economic activity. In the event firms borrow from banks, new transactions deposits are created that add to the stock of money outstanding. In contrast, business borrowing from households simply transfers transactions deposits from households to firms. In the former case, both money and credit are affected; in the latter, only credit.

Figure 1
Credit Market Equilibrium



We turn, now, to a diagrammatic exposition of the analytic framework in this paper. Three markets are of interest in the model: the market for bank loans; the market for household loans, that is, lending by households to firms; and the market for bank deposits. In Figure 1, only the markets for bank loans and household loans are shown. The deposit market is redundant in the sense that developments in the deposit market can be incorporated in what happens in either the household loan or the bank loan market.

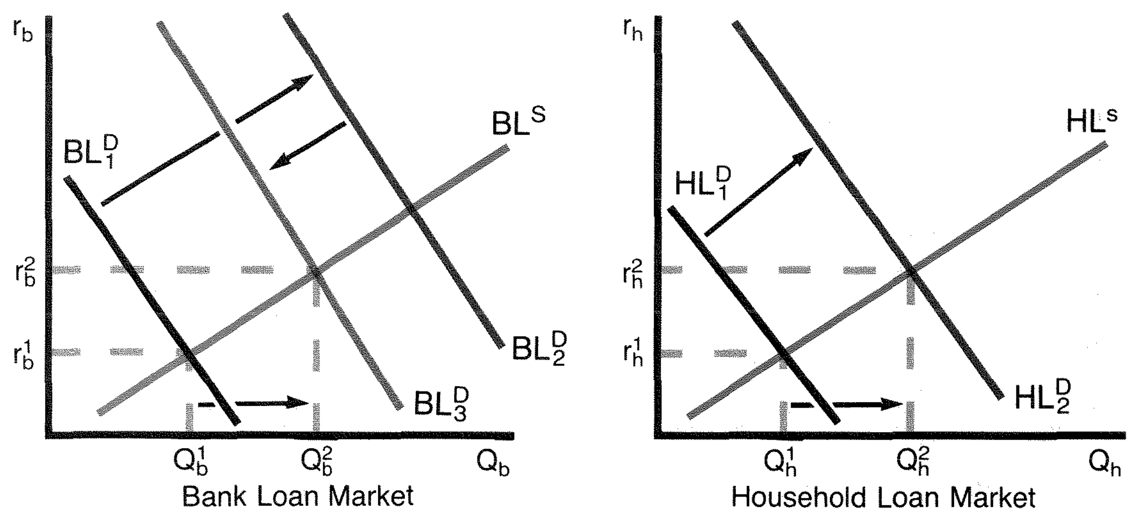
In the market for bank loans, Figure 1a, firms' demand for bank loans is represented by BL^D. The quantity of bank loans demanded increases with a lower bank loan rate, r_b. Also, BL^D is implicitly a function of the rate households charge for loans to businesses, with a higher household loan rate, r_h, increasing firms' demand for banks' loans.

The supply of bank loans varies directly with the rate of interest on loans and inversely with the rate that banks must pay for their deposits, r_d. An increase in r_b induces banks to lend more, creating new deposits for funding. The reserves necessary to support the new deposits come from several sources: from an inflow of currency from the public as banks raise the rate they are willing to pay on deposits; from banks reducing their holdings of excess reserves; and from partial accommodation of the increase in bank credit by the monetary authority.[3] Notice that the bank loan supply curve is based on maximizing behavior by the banks and, in the absence of rigidities or imperfections, this implies equilibrium in the bank reserves market.

Figure 1b shows the market for household lending to firms. Business demand for loans from households, HL^D, is negatively related to the rate charged on these loans, r_h, and (implicitly) positively related to the rate firms must pay for bank loans, r_b. The supply of household loans, HL^S, responds positively to r_h. It is negatively related to the rate banks pay on deposits, r_d, with households offering a smaller supply of loans to businesses when banks pay a higher return on deposits.

We are now in a position to examine why changes in the quantity of credit provide useful

Figure 2
An Increase in the Demand for Credit



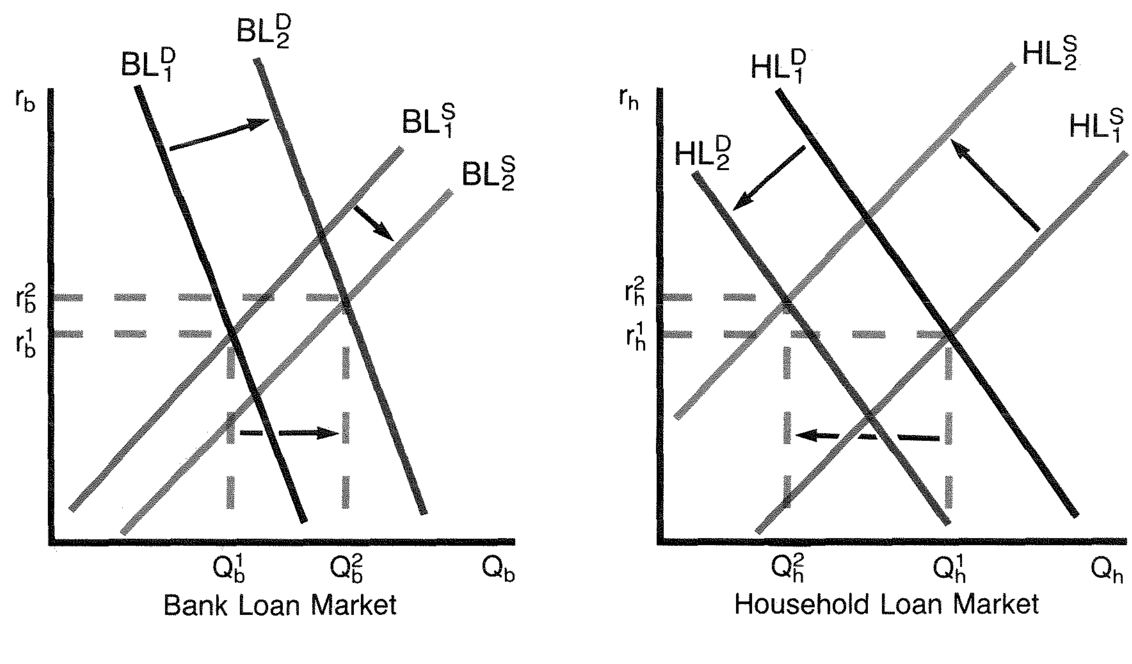
information about the future course of the economy. To see this, two different situations are contrasted below.

Consider, first, what happens when firms decide to supply greater output in the next time period. If the increased demand for credit is manifested first in the market for bank loans, the demand curve BL^D shifts from BL_1^D to BL_2^D. The resulting increase in r_b forces some firms into the nonbank market, that is, HL^D shifts out. Consequently, r_h increases. Arbitrage between the two loan markets will continue until interest rates are brought back into equality.[4] In equilibrium, the quantity of both bank and nonbank loans has increased and so has the rate of interest. Since loans are positively related to deposits, both deposits and money supply are higher as well. In the context of the present model, both the interest rate and the money supply provide evidence of increased demand for credit and predict increased output in the next period.

Now, consider an alternative scenario. Assume that household demand for money increases, so that the supply of credit by households declines. In Figure 3 below, two things happen. First, the HL^S curve shifts from HL_1^S to HL_2^S.

Second, since households do not lend this money to firms, but hold it as deposits, banks can use the money to make new loans. Thus, the bank loan supply curve shifts from BL_1^S to BL_2^S. Note that the increase in loan supply by banks will be smaller (in absolute terms) than the decrease in loan supply by households for two reasons. First, households will not increase deposit holdings by the exact amount of the increase in money demand (or decrease in loan supply) because part of their money holdings will be held as currency. Second, banks will not be able to lend out the entire amount of the increase in deposits because of the existence of reserve requirements.

Figure 3
An Increase in the Household's Demand for Money



Now, as a result of these shifts, r_h exceeds r_b. Therefore, firms will begin to move from the household loan market to the bank loan market. As a result HL^D moves in and BL^D moves out. Thus, the two rates move towards each other and equilibrium is restored when the two are equal. At the new equilibrium, interest rates will be higher than before. This follows because as a result of a decrease in the willingness to lend, total credit supply has declined with no shift in the demand for credit. The new equilibrium interest rates are r_b^2 and r_h^2. Since bank loans have increased, the quantity of money will be higher as well.

Thus, as far as the impact on money and interest is concerned, this scenario is no different from the first one. But the implications for future GNP are entirely different. In the first case, higher interest rates and money were indicators of a future rise in GNP. In the second, there is no such implication. Indeed, to the extent that higher interest rates discourage economic activity, future GNP will be *lower* in this case.

The only way to discriminate between the two cases is to look at the credit aggregates. Non-bank credit (household lending) increases in the first, but declines in the second. This difference in performance provides a way of discriminating accurately between the two cases. Movements in total private credit—bank plus non-bank lending—similarly allow one to discriminate between the two.[5]

It is tempting to conclude that changes in government borrowing will play the same sort of role as private borrowing did in the model above. However, for this to be true, changes in government borrowing must be causally related to changes in future economic activity. An important reason that this may not be true has to do with the procyclical nature of the budget deficit. During recessions, for example, tax revenues decrease while outlays increase because of higher cyclically sensitive government expenditures such as unemployment benefits. Thus, government borrowing goes up during periods when income is low. However, this borrowing is intended to cushion household income from cyclical vagaries and does not directly influence future output. This source of borrowing will, therefore, offset any positive correlation between future output and federal borrowing due to the other federal expenditures. Thus, it is likely that changes in federal borrowing will not provide useful information about changes in future output.

III. Empirical Tests

The discussion above is based primarily on two hypotheses. First, firms borrow money to increase production over the course of the business cycle. Thus, changes in credit lead changes in economic activity. Further, since firms satisfy part of their needs by borrowing from banks, and since loans by banks and demand deposits are positively correlated, changes in money lead changes in economic activity as well. Second, the household demand for money function is subject to shifts due to changes in expectations. These shifts in the money demand function will be reflected in the demands for other financial assets, such as the financial liabilities of firms.

Thus, movements in private credit should provide significant information about future activity and also be important in explaining money growth. This section presents empirical tests for both these propositions.

First, several alternative "forecasting" equations for real output have been estimated with the intent of testing whether changes in private credit predict changes in output. These equations are similar to those presented in earlier work, for instance, Friedman (1983). The basic equation includes real federal high employment expenditures and real money balances as explanatory variables. To this, the real rate of interest and alternative credit measures have been successively added and tests made to determine the significance of the additional variables.

Second, essentially the same equation has been estimated for nominal GNP. The attraction in estimating such an equation is that the results are directly comparable to previous research. For instance, the well-known "St. Louis" equations (from the Federal Reserve Bank of St. Louis) also regress GNP on money and High Employment Federal Expenditures. (Note, however, that the St. Louis equations view money as being exogenous, that is, all changes in money are viewed as being policy-induced.)

Finally, an equation for velocity is estimated to test the money demand implications. The velocity equation is derived from a money demand specification in which the demand for money is expressed as a function of income and interest rates and in which nominal money balances adjust to desired balances with a lag. Different credit variables are then included in this basic equation to determine whether they help predict movements in velocity.

Quarterly data was used over the period 1959:Q1 to 1984:Q2. The beginning date is dictated by the availability of the M1 series. The interest rate used is the three-month Treasury bill rate. All credit variables are expressed as flows. Of the different measures of credit employed below, the widest aggregate is Domestic Nonfinancial Debt (which is the variable used by Benjamin Friedman). This is decomposed into Federal Debt and Private Debt (the latter is not strictly accurate since it includes state and local government borrowing).

Finally, two other measures are also considered—total loans by commercial banks and total loans by financial institutions other than banks. This is in line with the discussion above, which distinguished between bank and nonbank sources of credit. Obviously, these variables are not ideal for the purpose at hand. For instance, because banks may, in the short run, vary managed liabilities such as Certificates of Deposit when the volume of loans changes, the loans-to-money link may not be as tight. Similarly, loans by financial institutions serve only as a proxy for loans by households.

Consider now, the real GNP equations in Table 1. The dependent variable is the rate of growth of real GNP. For all independent variables, except the rate of interest, the GNP deflator has been used to transform nominal values to real values. The real rate of interest has been obtained by subtracting the expected rate of inflation (in terms of the GNP deflator again) from the nominal rate of interest. The expected rate of inflation is itself obtained by estimating a univariate time series equation for inflation. (An alternate method for obtaining the real rate, where actual inflation was used instead of expected inflation, produced results that were essentially the same as those reported below.) All independent variables are included in growth rate terms, except for the interest rate, which is included as a difference.

Current and two lagged values have been included for all explanatory variables (except the lagged dependent variable and the time trend). For four of these variables (money, private credit, the Treasury bill rate and loans by financial institutions), this length was selected by imposing the condition that the F statistic (for the null hypothesis that current and lagged values of the variable being tested are all zero) have a marginal significance level of at most 0.05 and that the standard error of the equation not increase when additional lags were added. The same lag length was chosen for the other credit aggregates to ensure comparability. It should be pointed out that for these latter variables, the results will not change if the lag length is altered. Finally, only one lag for the dependent variable was included since the second lag is insignificant across all specifications.

Table 1 presents summary statistics for these equations. For each independent variable (including lags), I report the marginal significance levels for the F test. The marginal significance level (M.S.L.) can be can be interpreted as the probability that the variable under consideration has no impact on GNP. Conventionally, the variable is regarded as significant if this probability is less than 0.05. Thus, in the first equation the M.S.L. for the F test on money is 0.0001, which implies that the probability that changes in money have no impact on GNP is extremely small. Equation 1 also includes real federal high employment expenditures, which do not seem to affect output significantly. Notice that Durbin's h statistic shows significant evidence of serial correlation. The second equation adds the real rate of interest to Equation 1. The explanatory power of the equation increases, while the serial correlation declines.

In Equations 3 through 7, different credit variables are added to the set of explanatory variables in Equation 2. Equation 3 includes the rate of growth of private credit. Notice that the credit variable is highly significant and that the h statistic (testing for the presence of serial correlation) is close to zero. Also notice that the M.S.L. on lagged real GNP jumps to 0.8. In Equation 4, the rate of growth of federal borrowing is included. This variable is clearly insignificant and $\bar{R}^2$ is actually lower than in Equation 2. In the next equation, total domestic nonfinancial debt is also insignificant, although it is more "significant" than federal debt. From the last two equations, it can be seen that loans by financial institutions have somewhat greater explanatory power for real GNP than do loans by commercial banks.

Some simple tests to examine the stability of the coefficients on the credit variables were also carried out. The sample was split at two different places to see whether there was any evidence of a structural break. The first split was at 1971:Q2, where Sims (1980) found evidence of a structural break in a system that included output, money growth, and prices. Second, the data was also split at 1979:Q3 to examine whether the change in operating procedures by the Federal Reserve at that time had any impact. Tests were then carried out to examine whether the coefficients of the credit variables (at a specific lag as well as for all lags taken together) had changed.

TABLE 1
Real GNP Equations—Summary Statistics
Sample 1959(Q4)–1984(Q2)

	Equations						
	1	2	3	4	5	6	7
Credit Variable Included	—	—	PVT	FED	TOT	TLFI	TLCB
Explanatory Variables	Marginal Significance Levels of Explanatory Variables						
M1	.0001	.0001	.001	.0001	.0001	.0001	.0001
HEXP	.13	.12	.03	.13	.10	.02	.051
TBR		.007	.04	.01	.007	.12	.02
CDT			.0002	.76	.18	.003	.04
RGNPL1	.055	.04	.8	.03	.056	.058	.17
TIME	.27	.18	.03	.24	.13	.09	.09
$\bar{R}^2$	.370	.433	.532	.415	.440	.498	.464
MSE(X10^2)	.661	.596	.487	.608	.582	.522	.558
Durbin's h	1.69	1.22	0.34	2.09	.07	.84	.98

Notes: (1) All variables are in real terms and in rates of growth, except that the rate of interest term is included as a difference. HEXP is federal high employment expenditure. CDT represents the credit variable. To see which credit variable is included in a particular equation, look at the top of the relevant column. Thus, in equation 3, PVT (that is, private credit) is included. FED is federal borrowing and TOT is total domestic nonfinancial borrowing. FITL is total loans by financial institutions and CBTL is total loans by commercial banks. The current value and two lags have been included for each of these variables. RGNPL1 is the lagged dependent variable.

(2) The Marginal Significance Level (M.S.L.) for a particular variable can be interpreted as the probability that the variable has no impact on the dependent variable (real output in this case). Conventionally, a variable is considered important in a particular equation if it has a M.S.L. of .05 or less.

For the split at 1971:Q2, it was possible to reject the hypothesis of no shift at the 5 percent level only for the contemporaneous value of domestic nonfinancial debt (TOT) and for the first lag of loans by commercial banks. For the split at 1979:Q3, the federal debt variable shows evidence of a shift at all lags individually and together, a result that is not very surprising given the large Treasury borrowings of recent years.

Summary statistics for the nominal GNP equations are presented in Table 2. The variables are defined in the same way as in Table 1, with the exception that all variables are now expressed in nominal terms. (Neither lagged values of GNP nor a time trend were significant here.)

Once again, the rate of interest is significant in predicting changes in nominal GNP. Adding private credit improves the fit of the equation even futher. Notice that adding federal borrowing reduces $\bar{R}^2$ again and that the total debt variable has a M.S.L. of .25. Both the loan variables, total loans by financial institutions (TLFI) and total loans by commercial banks (TLCB), are significant at 1 percent.

The significant credit variables were also tested to see if the coefficients had shifted over time. For the break at 1971:Q2, it was not possible to reject stability for any of the coefficients. For the break at 1979:Q3, the private debt and commercial bank loan variables show no evidence of a shift, while TLFI does.

Consider, now, Table 3 which presents the results for the velocity equation. As discussed above, the estimated equation is derived from a money demand equation, with the additional constraint that the coefficient on real income in the estimated money demand equation equal 1.[6] The first equation includes only the rate of interest and a lagged money term. Successive equations then add different credit variables. Table 3 also shows that while private credit is significant in predicting velocity, neither federal nor total credit are. Total loans by financial institutions are significant here (as in the GNP equations) but loans by commercial banks are not.

Credit variables in the velocity equation were also tested to see if they showed any signs of a shift. However, for neither the break at 1971:Q2 nor the break at 1979:Q3 can the hypothesis of no shift be rejected.

TABLE 2

Nominal GNP Equations—Summary Statistics
Sample 1959(Q4)–1984(Q2)

	Equations						
	1	2	3	4	5	6	7
Credit Variable Included			NPVT	NFED	NTOT	NTLFI	NTLCB
Explanatory Variables	Marginal Significance Levels of Explanatory Variables						
M1	.0001	.0001	.0002	.0001	.0001	.0001	.0001
NHEXP	.10	.04	.0052	.064	.056	.005	.013
NTBR		.0001	.0008	.0001	.0002	.002	.0001
NCDT			.0005	.80	.25	.010	.013
$\bar{R}^2$	.318	.451	.539	.439	.458	.502	.499
MSE(X10^2)	.753	.607	.509	.620	.599	.550	.554
D.W.	1.54	1.63	1.86	1.59	1.74	1.72	1.81

Notes: See notes to Table 1 for explanations. The variables are the same as in Table 1 except that they are all measured in nominal terms.

TABLE 3
M1 Velocity
Sample 1959(Q4)–1984(Q2)

	Equations					
	1	2	3	4	5	6
Credit Variable Included		PVT	FED	TOT	TLFI	TLCB
Explanatory Variables						
Constant	.623	.578	.609	.595	.596	.563
NTBR	.267	.206	.267	.255	.216	.249
NTBR1L	.481	.438	.480	.475	.430	.478
NTBR2L	.064	.076	.068	.053	.006	.079
CDT		.015	−.0002	.005	.0045	.0017
CDT1L		.016	−.0001	.004	.0015	.0016
CDT2L		−.003	.00	.005	.0067	−.0002
M1LP	−.126	−.253	−.105	−.165	−.216	−.122
	Marginal Significance Levels					
NTBR	.0001	.0001	.0001	.0001	.0001	.0001
CDT		.01	.65	.72	.02	.10
M1LP	.22	.02	.31	.14	.04	.23
$\bar{R}^2$	.363	.413	.353	.351	.405	.385
MSE(X10^2)	.775	.714	.786	.789	.724	.749
D.W.	1.80	1.95	1.76	1.86	1.92	1.94

Notes: The dependent variable is the growth of velocity. See Tables 1 and 2 for an explanation of variables. M1LP is the lagged money term. NTBR1L is NTBR lagged one quarter, NTBR2L is NTBR lagged 2 quarters.

IV. Conclusions

This paper has presented some theoretical arguments and empirical evidence to show that changes in private credit will provide useful information about changes in future output and M1 velocity. Previous analyses of the money/GNP relationship have often tended to focus on the asset demand for money and, consequently, emphasized the substitutability between money and credit. In contrast, explicit attention was paid earlier in this paper to the need for money to carry out transactions. In this framework, it is easy to see how money and credit can vary in the same direction—because the demand for credit can be viewed as a demand for payments media.

For the policymaker, this means that information about changes in money and interest rates alone is not sufficient for predicting what will happen to output. To determine the implications of a change in money, it is important also to know how the credit aggregates are behaving. The evidence presented above is also specific about what credit aggregates are useful. It indicates that changes in federal government borrowing are not significantly related to GNP, while several measures of private credit are. The most recent example of the phenomenon captured in these tests is what happened in late 1982 when declining output was accompanied by rising money but falling private borrowing.

Although the analysis above has focused on recessions as periods when changes in (private) credit aggregates are likely to provide significant information, the underlying logic can be applied more widely. The argument of this paper has been that changes in credit provide a direct means to determine whether the money demand function has shifted (regardless of the source of the change), and that this knowledge is necessary to interpret the money-output relationship properly.

FOOTNOTES

1. Friedman and Schwartz (1982, p. 39), when specifying the arguments of the money demand function, state "another variable that is likely to be important empirically is the degree of economic stability expected to prevail in the future. Wealthholders are likely to attach considerably more value to liquidity when they expect economic conditions to be unstable than when they expect them to be highly stable . . . For example, the outbreak of war clearly produces expectations of instability, which is one reason war is often accompanied by a notable increase in real balances. . ."

2. Others have also suggested the possibility of a shift in the money demand function during the 1982 recession. For example, Axilrod (1984), when discussing the decline in velocity in 1982, states "During part of the period, economic uncertainties may have heightened precautionary demands for cash." Later, he says that he expects velocity to increase in the near future, which "would be consistent with the view that some of the previous decline was a reflection of precautionary demand for cash balances, balances that can be expected to be unwound as confidence in the economy is restored." Similarly, Simpson (1984, p. 259) says "In late 1981 and early 1982, the demand for NOW accounts, passbook savings, and other very liquid assets in household portfolios strengthened while transactions demands weakened and rates dropped only moderately, perhaps reflecting a desire to be better able to cushion an earnings disruption, which at that time seemed more likely."

3. The shape of the bank loan supply curve depends upon the monetary authority's behavior. To see this, consider the two extremes of behavior by the monetary authority. Assume first that the monetary authority accommodates all increases in credit demand, which would happen, for instance, if it were trying to peg the interest rate. In such a situation, the supply curve of bank loans would be horizontal, because the monetary authority stands ready to supply all the reserves for deposit (and loan) expansion.

The other extreme is where the monetary authority does not accommodate any cyclical increase in credit demand. Such a situation may occur, for instance, if the authority is following a fixed money growth rule. In this case, banks can increase loans only by inducing the public to hold more deposits. The supply curve for loans would then be much steeper and, given a limit to the amount of deposits that individuals wish to hold, would ultimately become vertical.

The assumption in the text is that the authority's behavior lies somewhere in between these two extremes. It can also be shown that changes in the credit aggregate convey significant information even if the monetary authority follows one of the above policies.

4. The analysis suppresses the shift in bank loan supply due to a change in r_h and a similar impact of r_b on household loan supply. These effects arise through the deposit market. For example, if the rate on bank loans goes up, banks are likely to begin offering higher rates on demand deposits. As a result, households will decrease loan supply and increase deposit holdings.

5. It is interesting to examine whether the model sketched above is robust to some generalizations. Consider, first, the assumption that demand deposits are the only liabilities of banks. In a more general setting, one would also have to consider other liabilities such as certificates of deposit (CDs). Does the existence of CDs destroy the positive link between loans and demand deposits? Intuitively, the answer appears to be no. If it is true that banks face rising marginal costs to increasing either demand deposits or CDs, banks will increase both types of liabilities together. In equilibrium, the bank must face the same marginal cost for both liabilities, otherwise it is always possible to decrease costs by substituting the cheaper liability for the more expensive. Thus, it is unlikely that the amount of bank loans will increase significantly without an increase in demand deposits.

Consider next, the implications of allowing households to hold a third asset in addition to loans and money, say equity. In this case, increased demand for liquidity will not be matched exactly by a decrease in the supply of loans to firms. Instead, households will reduce equity holdings as well. Once again, the household is unlikely to obtain the necessary balances by selling equity holdings only. Since the shift in liquidity preference does not alter the relative price of loans to equity, holdings of both will be reduced. Thus, the qualitative result is unchanged—firms must still turn to the banking sector for loans.

6. The demand for nominal money can be written (in log form) as

$$M_t^* = \alpha y_t - \beta R_t + P_t$$

where M_t^* denotes desired nominal money balances,
y_t denotes real income,
R_t denotes the nominal rate of interest, and
P_t denotes the price level

Then, under the assumption that actual money balances do not adjust at once to desired, we have

$$M_t - M_{t-1} = \lambda(M_t^* - M_{t-1}).$$

Substituting this in the equation above gives

$$M_t = \lambda(\alpha y_t - \beta R_t) + (1-\lambda) M_{t-1} + \lambda P_t.$$

Next, subtract P_t from both sides to obtain an expression for real balances.

$$M_t - P_t = \lambda(\alpha y_t - \beta R_t) + (1-\lambda)(M_{t-1} - P_t).$$

Imposing the condition that the coefficient on real income is 1 and transposing gives an expression for velocity that is the estimated Equation 1 of Table 3.

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