The M1-GNP Relationship: A Component Approach

The sharp decline in M1's velocity in 1982 and early 1983 caused considerable concern about whether the money-income relationship had become so unstable that monetary targeting was no longer a viable approach for the implementation of monetary policy More recently, however, the return of M1's velocity to a more normal trend raised the opposite question of whether M1 should be reinstated to its former role in the policy process Indeed, after greatly reducing the weight given M1 in the policy process in 1982 and then monitoring rather than targeting M1 in 1983, the Federal Open Market Committee (FOMC) once again gave M1 equal weight alongside M2 and M3 in the July 1984 policy review Clearly, understanding the reasons for the breakdown in the money-income relationship in 1982 and 1983 as well as some assessment of whether recent, more normal trends can be expected to persist are important for policy purposes

What caused the money-income relationship to break down? Some analysts have suggested that the cause was the introduction of nationwide NOW accounts, while others have pointed to the variability of M1 growth [1] Thus far, however, not much effort has been made to identify which components of GNP might not be contributing to GNP growth the same way as in the past when M1 growth changes [2] Also, not much work has been done on the question of whether M1 growth that comes from NOW accounts has a different effect on spending than does M1 growth that comes from currency and demand deposits As a result, in this paper, the sources of the breakdown in the money-income relationship are explored in two ways first, by looking at the GNP component effects of changes in M1 growth, and second, by looking at the different effects that M1 less NOW accounts (M′) and NOW accounts have had on the growth of GNP and its components [3]

The primary conclusion is that the relationships between several of the GNP components and money have changed In part this results from the consideration that M1 growth due to NOW accounts has considerably less effect on various spending categories than does M1 growth due to M′ The breakdown in the money-income relationship also reflects in part a significant change in the cyclical pattern of M1 velocity After the different effects on GNP of M′ and NOWs are allowed for, velocity exhibited its normal cyclical pattern during the 1982 recession, but deviated sharply from past patterns

[1] Rik W Hafer, "The Money-GNP Link Assessing Alternative Transaction Measures" Federal Reserve Bank of St Louis *Review*, March 1984 Michael T Belongia, "Money Growth Variability and GNP," Federal Reserve Bank of St Louis *Review*, April 1984 For other explanations of the 1982-83 deviation of velocity from past trend, see "Monetary Targeting and Velocity," Conference Proceedings, Federal Reserve Bank of San Francisco, December 1983

[2] The sectoral effects of changes in M1 growth had been the topic of research interest in the past For more detail, see David Meiselman and Thomas D Simpson, "Monetary Policy and Consumer Expenditures The Historical Evidence," in *Consumer Spending and Monetary Policy The Linkages*, Federal Reserve Bank of Boston, June 1971

[3] M′ was derived by subtracting the other checkable deposit component of M1 from total M1 The other checkable deposit component of M1 includes some other minor series in addition to NOW accounts such as savings subject to automatic transfer In this article, the term "NOW accounts" is used rather than the term the "other checkable deposit component of M1"

during the first year of the recovery in 1983 Moreover, once the different effects on spending from M′ and NOWs as well as typical cyclical movements in velocity are allowed for, M1 variability no longer appears to be a significant explanation of the weaker-than-expected growth of GNP over 1982 and 1983 A detailed set of conclusions is presented at the end of this article

Theoretical causes of the breakdown

Before analyzing the possible sources of the breakdown in the money-income relationship statistically, it might be worthwhile to ask at a theoretical level what could have caused the sharp decline in M1 velocity A simple IS-LM model can be used to illustrate some possible causes

$$(1) \quad Y = -cr + X$$
$$(2) \quad M1 = -ar + bY + Z$$

where

M1 = narrow money stock (exogenously determined, Footnote 4)
r = interest rate
Y = income
Z = money demand shift
X = autonomous expenditures
a,b,c = structural parameters

If equations (1) and (2) are combined to derive the reduced form for income, the following equation results

$$(3) \quad Y = \frac{c}{a+bc} M + \frac{a}{a+bc} X - \frac{c}{a+bc} Z$$

This equation resembles reduced-form equations used to estimate income growth as a function of current and lagged money growth and autonomous expenditures (which are usually found to be insignificant) Money demand shifts, Z, are implicitly assumed not to occur and are therefore not included in the reduced form, although in theory, if they could be satisfactorily measured, they should be included Other variables sometimes included are supply side shocks such as the relative price of energy and hours lost due to strikes When this equation is estimated, the constant term is about equal to long-run average growth of velocity, and the sum of the coefficients on the growth of current and lagged money stock is roughly equal to one (Footnote 1) Hence, this equation, as it is usually estimated with a lag covering about one year, is a convenient tool for analyzing unusual movements in velocity over the longer run without over-emphasizing quarter-to-quarter volatility in M1 [4]

[4]Over the years, many objections have been raised about the reduced-form approach In particular, even though the Federal Reserve has set M1 targets since the early 1970s, that is not the same as saying that M1 has been exogenously determined over the entire period Rather, M1, like income, is an endogenous variable

From equation (3) it can be seen that 5 factors, individually or in various combinations, could have caused income to be unusually weak relative to money growth in 1982 and 1983

(1) The interest elasticity of expenditures (c) declined
(2) The interest elasticity of money demand (a) increased
(3) The income elasticity of money demand (b) increased
(4) There was a shift in the money-demand function (Z)
(5) There was a decline in autonomous expenditures (X)

Given the rapid pace of financial innovation and deregulation in recent years including the introduction of NOW accounts nationwide in 1981, it is possible that one or more of the key elasticities (a, b, or c) has changed or that the money demand function itself has shifted [5] The effects of NOW accounts on the reduced-form equations for GNP and its components will be studied in the next section Moreover, since velocity growth is known to have a cyclical pattern, weakening during recessions and growing very rapidly during the first years of recoveries, it is possible that some of the apparent breakdown in the money-income relationship could be due to the deep recession in 1982 and the rather strong recovery in 1983 and 1984 In the third section of this paper, the error pattern from the reduced-form equation is analyzed to see whether there are any cyclical factors that systematically affect the accuracy of the reduced-form equation [6] In the final section, the

Footnote 4, continued

and the correlation observed in the "reduced-form" equation results from both variables responding in a systematic way to other factors in the economy Nevertheless, as long as this money-income relationship is stable, M1 can play a useful role in the policy process even if it is not exogenously determined, if for no other reason than it might serve as a leading indicator of what income will do Hence, the "reduced-form" equation relating income growth to current and past money growth is a convenient tool for examining the instability in velocity over 1982 and 1983 Because the reduced-form model is being used in this paper, the discussion is often in terms of "money causing or determining income" even though the underlying process is much more complex

[5]For more detail on this see John Wenninger, 'Financial Innovation A Complex Problem Even in a Simple Framework," this *Quarterly Review*, Summer 1984 Also see Thomas D Simpson, "Changes in the Financial System Implications for Monetary Policy," *Brookings Papers on Economic Activity*, 1984-IV

[6]In a recent paper, John Tatom tested for this in an equation for velocity using the gap between real GNP and potential GNP He did not, however, try to incorporate the effect in the more conventional reduced-form equation Moreover, when his equation is simulated for 1982 and 1983 it tracks 1982 fairly well But for 1983, it overpredicts velocity growth by 4 2 percentage points, suggesting that there are other explanations for the recent breakdown in the *(p 8)*

question of whether the increased variability in M1 growth since 1979 could be a factor that explains the sharp decline in M1's velocity is explored briefly.

Reduced-form equations using components

But before these other factors are allowed for, the sharp decline in M1's velocity in 1982 and early 1983 is analyzed using the more standard equation in which nominal income growth is specified as a function of current and past M1 growth. The initial statistical exercise undertaken in this section is quite straightforward. First, total GNP growth is broken down into the growth due to each of its components. In other words, the growth rates of the individual components are not used, but rather the contribution of each component to total GNP growth.[7] In that way, when the component contributions of GNP growth are regressed on M1 growth, the sum of the coefficients across component contributions equals the coefficient obtained when GNP itself is regressed on M1 growth. Thus, for a given change in out-of-sample M1 growth it is possible to see which components are no longer contributing to total GNP growth as in the past, and hence the sources of the breakdown in the overall money-income relationship can be identified.

Looking at the relationship between components of GNP and M1 is somewhat unconventional, since at a conceptual level M1 growth is typically viewed as a determinant of nominal aggregate demand without much concern about the sectoral composition of the nominal income growth. Moreover, if the money-income relationship had remained stable, it could be argued that there would be no need to examine the relationship between money and the components of GNP, since, by controlling money the Federal Reserve is attempting to keep nominal income growth at a noninflationary rate. Therefore, the Federal Reserve should not be that concerned about the sectoral composition of that growth. However, when the aggregate relationship breaks down in such a dramatic way as in 1982 and early 1983, it seems quite natural to look at the relationships between M1 and the individual components of GNP to see whether the problem can be traced to changed behavior in certain sectors of the economy that might have undergone structural change This exercise, in turn, might yield some insights into the causes of the breakdown in the aggregate equation, insights that might be useful in the future.

Of course, the source of the problem might not be with GNP and its components, but rather with M1 and its components. NOW accounts have become a larger proportion of M1 in recent years, and since NOW accounts pay explicit interest, consumers may be holding transactions as well as savings balances in them. This, in turn, could mean that M1 growth due to NOW accounts might not have the same effect on GNP and its components as M1 growth due to currency and demand deposits (M'). Therefore, in addition to regressing GNP growth and the component contributions of GNP growth on M1 growth, equations were also reestimated using two independent variables, the contributions of M' and NOW accounts to total M1 growth.[8] By repeating the exercise in this fashion it is possible to see not only which GNP components are not responding to M1 growth the same way as in the past, but also whether the components of M1 growth have different effects on GNP and its components. If M1 growth from increases in NOW accounts has a different effect on GNP or on its components than M1 growth from currency and demand deposits, then the Federal Reserve perhaps should react to M1 growth differently depending upon the sources of its growth.

Table 1 shows the results of regressing GNP growth and the component contributions to GNP growth on current and lagged M1 growth for the period from 1948-II to 1979-IV.[9] The results in the first row suggest that a one percentage point increase in M1 growth will be associated with an increase in GNP growth of about 1.1 percentage points Of that 1.1 percentage point increase

Footnote 6, continued

money-income relationship since 1982 For more detail on the 1982-1983 simulation as well as other explanations for the decline in velocity in 1982 and early 1983, see John A Tatom, "Alternative Explanations of the 1982-1983 Decline in Velocity," in *Monetary Targeting and Velocity*, Conference Proceedings, Federal Reserve Bank of San Francisco, December 1983

[7] An example might help explain the variables being used here For ease of illustration, let income (Y) have two components, consumption (C) and investment (I) The change in income (ΔY) is equal to the change in consumption (ΔC) plus the change in investment (ΔI) Or in equation form, $\Delta Y = \Delta C + \Delta I$ If both sides of this equation are divided by Y, the result is $\Delta Y/Y = \Delta C/Y + \Delta I/Y$ This last equation says that the percentage change in income can be accounted for by the increase in consumption as a percent of income and by the increase in investment as a percent of income In other words, if income increases 10 percent, 7 percent might be due to the increase in consumption and 3 percent due to the increase in investment If $\Delta Y/Y$, $\Delta C/Y$, $\Delta I/Y$ are regressed on M1 growth ($\Delta M/M$), the following equations would result $\Delta Y/Y = a_1 + b_1 \Delta M/M + V_1$, $\Delta C/Y = a_2 + b_2 \Delta M/M + V_2$, $\Delta I/Y = a_3 + b_3 \Delta M/M + V_3$, where a_1, a_2 and a_3 are intercept terms, b_1, b_2 and b_3 are the coefficients on money, and V_1, V_2 and V_3 are error terms Since $\Delta Y/Y = \Delta C/Y + \Delta I/Y$, it is also true that $\Delta Y/Y = (a_2+a_3)+(b_2+b_3)\Delta M/M + (V_2+V_3) = a_1+b_1 \Delta M/M + V_1$ This means that the intercept terms, coefficients and error terms in the component equations add up to the intercept term, coefficient and error term in the aggregate equation Hence, when studying the stability of the money-income relationship in recent years, this approach enables us to identify which components are no longer contributing to GNP growth the same way as in the past when M1 growth changes

[8] These series were constructed the same way as the component contributions to GNP growth (Footnote 7)

[9] Throughout this paper, a polynominal distributed lag of current M1 growth and 4 lags is used The polynominal is second order, *(p 10)*

Table 1

Reduced-Form Estimates Using M1 Growth

1948-II to 1979-IV

	M'†	(t)	$\bar{R}^2$	Average Error* 1980-I to 1981-IV	1982-I to 1984-II	1980-I to 1984-II
(1) GNP growth	1 11	(6 75)	0 30	−0 2	−4 8	−2 8
GNP growth due to						
(2) Durable consumption	0 08	(1 27)	0 04	−0 5	0 1	−0 2
(3) Nondurable consumption	0 28	(6 35)	0 23	−0 4	−1 5	−1 0
(4) Services	0 21	(10 23)	0 45	0 9	−0 2	0 3
Investment in						
(5) Structures	0 07	(4 96)	0 17	0 2	−0 6	−0 2
(6) Durable equipment	0 17	(5 12)	0 18	−0 4	−0 7	−0 6
(7) Residential structures	0 06	(1 70)	0 25	−0 7	0 1	−0 7
(8) Business inventories	0 10	(0 77)	0·007	0 3	−0 2	0
(9) Net export	0 02	(0 54)	−0 009	0 3	−1 1	−0 5
(10) Federal Government purchases	0 06	(0 87)	−0 002	0 3	−0 3	−0 1
(11) State and Local purchases	0 06	(3 74)	0 09	−0 1	−0 4	−0 3

*Out-of-sample errors

†Sum of coefficients obtained from regressing GNP growth and the contributions to GNP growth from its components on a polynominal distributed lag of M1 growth (current quarter and 4 lagged quarters)

Table 2

Reduced-Form Estimates Using Component Contributions to M1 Growth

1948-II to 1984-II

	M'†	(t)	NOW†	(t)	$\bar{R}^2$	Average Error* 1980-I to 1981-IV	1982-I to 1984-II	1980-I to 1984-II
(1) GNP growth	1 13	(6 96)	0 66	(3 50)	0 29	1 5	−1 6	−0 2
GNP growth due to								
(2) Durable consumption	0 10	(1 67)	0 06	(0 84)	0 05	−0 3	0 2	0
(3) Nondurable consumption	0 27	(6 38)	0 12	(2 47)	0 22	0 3	−0 4	−0 1
(4) Services	0 19	(8 26)	0 24	(9 12)	0 43	0 7	−0 4	0.1
Investment in								
(5) Structures	0 06	(3 53)	0 05	(2 76)	0 13	0 2	−0 4	−0 1
(6) Durable equipment	0 18	(5 76)	0 09	(2 43)	0 18	0	−0 2	−0 1
(7) Residential structures	0 08	(2 58)	0 03	(0 79)	0 30	−0 5	0 3	0
(8) Business inventories	0 15	(1 23)	0 10	(0 69)	−0 004	−0 1	0 2	0 1
(9) Net export	−0 003	(0 07)	−0 06	(1 18)	−0 009	0 7	−0 6	0
(10) Federal Government purchases	0 05	(0 68)	0 03	(0 34)	−0 02	0 4	−0 2	0 1
(11) State and Local purchases	0 06	(3 83)	0 01	(0 54)	0 08	0 2	−0 1	0

*In-sample errors

†Sum of coefficients obtained from regressing GNP growth and the contributions to GNP growth from its components on polynominal distributed lags of the contributions to M1 growth of M' and NOW accounts (current quarter and 4 lagged quarters)

in GNP growth, 1/2 percentage point comes through nondurable consumption expenditures and consumption of services (rows 3 and 4). Also important are the contributions from investment in durable equipment and structures (rows 5 and 6). Durable consumption expenditures and residential structures, with t statistics between 1.3 and 1.7, seem to be somewhat less systematic sources of the response of GNP to changes in M1 growth. Changes in M1 growth do not appear to affect GNP growth through inventories, net exports or Federal Government purchases—consistent with what most analysts would expect. Somewhat surprisingly, however, state and local government purchases appear to be significantly influenced by changes in M1 growth.

The right-hand side of Table 1 shows the average out-of-sample errors in projecting GNP and the component contributions for two periods: 1982-I to 1984-II (the period of greatest difficulty in forecasting GNP with M1 growth), and the period 1980-I to 1981-IV when forecasting GNP with M1 growth was quite accurate on average despite changes in the Federal Reserve's operating procedure, the introduction of nationwide NOWs, and the use of credit controls.[10] Looking at the first equation, which regresses total GNP growth on M1 growth, the average error in the first period was virtually zero, while in the second period it was −4.8 percentage points. The regressions for the component contributions suggest that in the earlier period M1 growth predicted GNP growth accurately because of offsetting errors among the components, whereas in the second time period almost all the sectors (except for durable consumption and residential structures) have negative average errors. Looking only at those relationships that were significant over the 1948 to 1979 period, the breakdown in the money-income relationship since 1982 can be traced primarily to nondurable consumption expenditures, investment in structures and durable equipment, and state and local government expenditures These four components show significant bias after 1982-I and account for 65 percent of the total average error of −4.8 percentage points. Clearly, the breakdown in the money-income relationship has not been caused by some unusual behavior in just one or two sectors, but rather is a broad-based development.

Can this widespread phenomenon be traced to different responses to M1 growth depending upon whether it is due to increases in M′ or NOW accounts? Table 2 sheds some light on this question. The first regression shows that total GNP growth does respond differently to M1 growth depending on the source of that growth. M1 growth due to NOW accounts appears to have only about 60 percent of the impact on GNP growth that M1 growth, due to increases in M′, does. In terms of the component contributions, different responses can be seen for nondurable consumption, durable equipment spending, residential structures and state and local government spending. Why should aggregate demand as well as the demand for some of the components of GNP respond differently to changes in M1 growth coming from M′ and NOW accounts? The reason why NOW accounts have a smaller impact on spending than M′ may be because the demand for NOW accounts has a greater interest elasticity than the demand for M′. Hence, consumers will not require as large a decline in interest rates to hold a given increase in NOW accounts as they would have in the past to hold the same amount of additional demand deposits. The smaller decline in interest rates, in turn, means a smaller response in spending to changes in NOW accounts than to changes in M′.[11] Moreover, as NOW accounts have become a larger fraction of M1, the interest elasticity of the demand for aggregate M1 has been also increased.[12]

How accurate are forecasts of GNP growth based on past M1 growth once the different effects of M1 and NOW accounts are allowed for? The far-right hand side of Table 2 provides a rough answer to this question by looking at the in-sample errors over the 1980-I to 1984-II period. For the period as a whole (1980-I to 1984-II), the in-sample errors in predicting GNP growth and the contributions of its components have been quite small when different effects of M1 growth are allowed for, depending upon the source (far right hand column). For subperiods and individual years within this longer period, however, some of the average errors were still fairly large. This suggests that, while over a long period of time, one can perhaps obtain a rough estimate of the different effects of M1 growth depending upon the source, over shorter periods those different effects are not likely to be constant. Thus, even though it appears

Footnote 9, continued

constrained on the far right to zero No attempt was made at this point to search for the "best lag structure" for each component of GNP Alternative lag structures at the aggregate level as well as at the component level are likely to produce somewhat different results Rather, the purpose of this exercise was to see if, by just using a simple lag structure, it would be possible to point to a certain component of GNP as causing the recent breakdown in the money-income relationship

[10]While a case could be made to break the period into pre- and post-nationwide NOWs in 1981-I, the errors from the reduced-form equation do not show any significant bias until 1982 Indeed, some analysts argue that NOWs did not distort M1 and hence there was no need to adjust M1 for NOWs in 1981 See, for example, John Tatom, "Recent Financial Innovations Have They Distorted the Meaning of M1?", Federal Reserve Bank of St Louis *Review*, April 1982

[11]For more on this, see Wenninger, *op cit* In that article, a case is made that NOW accounts could well be increasing the interest elasticity of the demand for M1, at least temporarily Also see Simpson, *op cit*

[12]From the simple IS-LM model presented earlier, it can be seen that an increase in the interest elasticity of the demand for M1 would reduce the responsiveness of income to changes in money growth

that changes in M1 growth due to NOW accounts have less effect on GNP than M1 growth due to M', the exact magnitudes probably have changed somewhat over time. This, of course, makes it difficult to use any sort of an "adjusted M1" for policy purposes.

Cyclical shifts in the reduced-form equation

The next question to be examined is whether the role assigned to NOW accounts in explaining the breakdown in the money-income relationship instead reflects the cyclical behavior of velocity. Over the cycle, velocity is usually very weak (or declines) during recessions and grows very rapidly during the first years of recoveries. If this cyclical behavior of velocity systematically affects the accuracy of the reduced-form equation over the business cycle, then the role of NOW accounts in explaining the breakdown in the money-income relationship over the most recent cycle (1982-83) might have been overstated.

To see if this cyclical velocity effect has played such a role, zero-one dummy variables for recessions and first years of recoveries were included in the aggregate reduced-form equations from Tables 1 and 2. Equations 1 and 3 in Table 3 are the same as the first equations in Tables 1 and 2 respectively. In the top part of Table 3, the effects of using cyclical dummies are shown for reduced-form equations in which M1 growth is the monetary variable. The bottom half of Table 3 shows the results when cyclical dummies are incorporated into a reduced-form equation in which M1 growth is divided into growth due to M' and NOW accounts. Looking first at the top of the table, the dummy variables for recessions and first years of recoveries are significant (equation 2). The $\bar{R}^2$ is considerably improved by including these variables, suggesting that reduced-form equations with M1 growth as the independent variable have had significant cyclical error patterns in the past.

Once these cyclical effects are allowed for, does M1 growth still appear to have different effects on GNP depending whether the M1 growth comes from NOW accounts or M'? The bottom half of Table 3 provides an answer by showing the results when the equations in the top half are estimated through 1984-II and M1 growth is broken down into its two components, as was done in Table 2. Even after allowing for cyclical swings in velocity, M1 growth due to NOW accounts still appears to have less effect on GNP growth than does M1 growth due to M' (compare equations 3 and 4). The difference between the two coefficients, however, is not as great in equation 4 as in equation 3. Nevertheless, the difference is still sufficiently large (0.32 percentage point in equation 4 compared to 0.47 in equation 3) to cause some concern that NOWs are a different type of monetary variable than M'.

After allowing for cyclical effects and the different effects of the components of M1, how accurate has the money-income relationship been in recent years? Table 4 contains the in-sample errors in predicting GNP growth for each calendar year over the 1982-I to 1984-II period with the reduced-form equations in Table 3 (equations 1 and 2 were reestimated through 1984-II). The results from equations 1 and 2 (in which M1 growth was used) show that allowing for just cyclical effects did reduce the average errors over the entire 1982-I to 1984-II period All of the improvement, however, came from 1982; the equation with the cyclical dummies

Table 3

Cyclical Effects on the Money-Income Relationship

1948-II to 1979-IV										
	(1)	Y	=	3 0 (4 0)	+1 11 M (6 8)				$\bar{R}^2$	= 0 30
	(2)	Y	=	4 5 (5 1)	+0 86 M (5 3)	−5 2 Rec (4 8)	+3 7 FYR (3 6)		$\bar{R}^2$	= 0 49
1948-II to 1984-II										
	(3)	Y	=	3 0 (4 0)	+1 13 M' (7 0)	+0 66 NOW (3 5)			$\bar{R}^2$	= 0 29
	(4)	Y	=	4 8 (5 6)	+0 82 M' (5 1)	+0 50 NOW (2 9)	−5 1 Rec (5 1)	+3 3 FYR (3 4)	$\bar{R}^2$	= 0 48

Where
Y = quarterly growth rate of nominal GNP
M = polynominal distributed lag of M1 growth
Rec = zero-one dummy variable for recessions
FYR = zero-one dummy variable for first year of recoveries
M' = polynominal distributed lag of M1 growth due to M1 less NOW accounts
NOW = polynominal distributed lag of M1 growth due to NOW accounts

Table 4

Average In-Sample Prediction Errors

In percent, from equations in Table 3

	Equation 1* (M1 only)	Equation 2* (M1 and Cyclical Dummies)	Equation 3 (M′, NOWs)	Equation 4 (M′, NOWs and Cyclical Dummies)
1982	−7 8	−1 8	−4 2	−0 4
1983	−3 7	−5 2	−1 9	−4 4
1984 (first half)	2 7	3 0	4 2	3 9
Entire Period	−4 1	−2 2	−1 6	−1 1

*Reestimated through 1984-II

(equation 2) was less accurate in 1983 than the one without (equation 1), and they have been about equally accurate thus far in 1984 So while it is possible to improve the money-income relationship with cyclical dummies, the relationship still has not been stable since 1982-I, and in particular 1983 was a difficult year to explain GNP growth in terms of M1 growth

Are these conclusions appreciably changed if one also allows for the different effects of NOWs and M′ as well as the cyclical velocity shifts? Comparing the errors from equations 3 and 4, respectively, to the ones from equations 1 and 2 helps answer this question For the entire 1982-I to 1984-II period the average errors are reduced in each case by allowing for different impacts of NOWs and M′ from −4 1 to −1 6 percentage points for equations 1 and 3 which do not have cyclical dummies, and from −2 2 to −1 1 percentage points for equations 2 and 4 which include the cyclical dummies The average errors are also reduced for the individual years 1982 and 1983 for each of these sets of equations By and large, these results are broadly consistent with the notion that NOW accounts have altered the way in which the economy responds to changes in M1 growth even after cyclical effects are allowed for

But that does not mean that the instability in the money-income relationship in 1982 and 1983 has been fully explained For equation 3, which allows for different effects of M′ and NOWs, but not for cyclical velocity shifts, the average error in 1982 was −4 2 percentage points and in 1983 it was −1 9 percentage points While including the cyclical dummy variables (equation 4, Table 4) reduces the overall average error somewhat, the effect is basically to reverse the relative size of the average errors in 1982 and 1983 In other words, rather than becoming smaller in absolute value in 1983 than in 1982, the average error becomes larger in absolute value when these cyclical dummies are included This suggests that while the different effects of M′ and NOWs and cyclical dummies can go a long way in explaining the 1982 instability in the money-income relationship (equation 4), the 1983 error remains largely unexplained As a matter of fact, the average error of −4 4 percentage points for 1983 is not that much larger in absolute value than the coefficient on the dummy variable for first years of recoveries estimated through 1979 (3 7), suggesting that basically 1983 did not have the normal increase in velocity for the first year of the recovery that would have been expected from past patterns Hence, a case can be made that the recent instability in the money-income relationship can be traced in part to the different effects M′ and NOWs have on GNP growth and in part to a breakdown in past cyclical velocity patterns

While the component responses to M′ and NOW accounts have been examined and cyclical velocity swings allowed for in the aggregate equations, the question of which GNP components account for the cyclical swings in velocity—and hence which ones might account for the breakdown in the money-income relationship in 1983—still remains to be analyzed To answer this question, the component equations in Table 2 (incorporating separate effects for M′ and NOWs) were reestimated using the zero-one cyclical dummies that were used in equations 2 and 4 in Table 3 as well as a dummy variable for 1983 (D83) so the large negative average error from equation 4 in Table 4 for 1983 can be accounted for [13]

[13]Including a separate dummy variable for 1983 in effect prevents the large error for 1983 from affecting the other coefficients, in particular the coefficient on the dummy variable for first years of recoveries which had dropped from +3 7 to +3 3 when the sample period was extended (Table 4) With the 1983 data unable to affect the other coefficients because of this dummy variable the size of the average error for 1983 (as measured by the coefficient on the dummy variable) increases from −4 4 in Table 4 to −6 0 in Table 5 With

From Table 5 it can be seen that the cyclical swings in overall velocity are due primarily to business inventories Inventories, while not correlated with money growth, have a pronounced cyclical impact on GNP accounting for 35 percent of the weaker-than-expected GNP growth during recessions and for virtually all of the stronger-than-expected GNP growth during the first years of recoveries. Some other components mirror the GNP cyclical patterns in one of the stages, but it appears that inventories are the primary reason behind the overall pattern Which components appear to be behind the instability of the money-income relationship in 1983? As it turns out, the error is spread across several components with consumption components accounting for 43 percent of the total average error, and investment in structures also an important factor As was the case earlier for the entire 1982-I to 1984-II period, the breakdown in the money-income relationship in 1983 cannot be traced to unusual behavior of a single component

Even though the 1983 instability in the money-income relationship suggests that the normal cyclical pattern in M1 velocity has at least temporarily broken down, one cannot rule out alternative explanations In particular, nationwide NOW accounts have been in existence for only about 3½ years, and perhaps the coefficient estimated for it here in the money-income relationship still has not stabilized, but rather is still evolving to some long-run value. The negative average error in 1983 would suggest that the size of the coefficient in absolute value could still be declining. If this is true, it would suggest that rather than using an intercept shift for 1983, as was done in Table 5, the appropriate procedure would be to allow for the coefficient on NOWs to change over time. Since a zero-one intercept shift was significant for 1983, the statistical results would show a significant change in the NOW account coefficient if it was allowed to shift rather than the intercept in 1983 However, if the negative error in 1983 was attributable to drift in the coefficient on NOW accounts, then one might expect the negative errors to continue into 1984. The errors, however, are positive over the first half of 1984 (Table 4), suggesting that the negative errors in 1983 are probably associated with a breakdown in the usual pattern of velocity in the first year of the recovery rather than a drift in the coefficient on NOW accounts In any case, this can only be resolved in some more definite sense after more experience with NOW accounts And with NOW accounts scheduled for further deregulation in 1985 and 1986, it will be quite a while before anyone can be confident that the relationship between the economy and NOW accounts is fully understood. Hence, only limited consolation can be taken in the return of M1's velocity to a more normal trend over the past year or so.

Footnote 13, continued

the dummy variable for 1983 in the aggregate equation, the difference between the coefficient on M1 growth due to M′ and the coefficient on M1 growth due to NOW accounts is the narrowest of any of the regressions estimated, only about 0 20 percentage point as compared to 0 32 and 0 47 percentage point for equations 4 and 3 in Table 3 This reflects the consideration that NOW accounts have been making an important contribution to M1 growth for only a few years and, including the dummy variable for 1983, prevents the 1983 experience from affecting the coefficient on NOW accounts not only at the aggregate level but also at the component level as well Hence, if it were possible to find a variable that explained the 1983 error in the reduced-form equation quite well, the different effects on spending from M1 growth due to M′ and NOW accounts might not appear as significant as shown in Table 2 for the aggregate equations or the component equations In terms of F tests for differences in coefficients, the hypothesis that the sum of the coefficients on M′ is the same as the sum of the coefficients on NOW accounts is rejected at the 95 percent confidence level for equation 3 in Table 3, at the 90 percent level for equation 4 in Table 3, but not for equation 1 in Table 5

Variability in M1 growth

Finally, while a case can be made that the recent breakdown in the money-income relationship is in part due to NOW accounts and unusual cyclical movements in velocity, the question still remains whether the increased variability in M1 growth in recent years is also part of the explanation for the weaker-than-expected growth in GNP (see footnote 1 for references that make this case). Table 6 contains some regression results that might help shed some light on this question

Equation 1 is a reduced-form equation estimated through 1979-IV using M1 growth only (for this shorter sample period, measures of M1 variability were not significant) If this equation is estimated through 1984-II including a measure of M1 variability (equation 2, Table 6), it comes in significantly with a negative sign, suggesting that the increase in M1 variability has reduced income growth and therefore could be a factor behind the sharp decline in M1's velocity[14] Moreover, the sum of the coefficients on M1 growth remains at about the same value as in the earlier period, and the $\bar{R}^2$ stays at 0 38

That, of course, still leaves the question of whether M′ and NOWs would still show different effects on GNP growth once the increased variability in M1 growth has been allowed for Equation 3 in Table 6 is the same as equation 4 in Table 3, except that, in addition to allowing for cyclical velocity shifts and different effects on spending growth from M′ and NOWs, it also includes

[14]The measure of "money variability" used here was a five-quarter moving average of the squared deviations of the current quarter's M1 growth rate from the average of the previous four quarters A nine-quarter distributed lag was used in the regression Any measure of M1 variability is arbitrary, and no claim is made that the results obtained here would hold for all possible measures For example, if the lag is shortened from nine to five quarters, the M1 variability measure is not significant

this measure of money variability.[15] However, in this equation, where money variability is in some sense allowed to "compete" with alternative explanations of the breakdown in the money-income relationship, it becomes insignificant. While it might be possible to construct some alternative measure of M1 variability that could compete better with these alternative explanations of the breakdown in the money-income relationship, the results here do not suggest that M1 variability has been an important factor behind the breakdown in the money-income relationship once other factors are allowed for. The results still point to different effects from M′ and NOWs and a breakdown in the usual cyclical pattern in

[15]The sample period also begins later because of the longer lag on the M1 variability measure. Hence, the 1949-50 business cycle is excluded from the sample period and this affects the coefficients on the dummy variables for recessions and first years of recoveries relative to the comparable regression in Table 3

Table 5

Reduced-Form Estimates Using Component Contributions to M1 Growth and Zero-One Cyclical Dummy Variables

1948-II to 1984-II

	M′*	(t)	NOW*	(t)	Rec	(t)	FYR	(t)	D83†	(t)	$\bar{R}^2$
(1) GNP growth	0 88	(5 8)	0 69	(3 9)	−4 94	(5 4)	3 63	(4 0)	−5 95	(2 6)	0 51
GNP growth due to											
(2) Durable consumption	0 06	(1 0)	0 03	(0 4)	−0 63	(1 6)	0 80	(2 1)	−0 32	(0 3)	0 10
(3) Nondurable consumption	0 25	(5 4)	0 17	(3 0)	−0 46	(1 6)	−0 08	(0 3)	−1 19	(1 7)	0 23
(4) Services	0 22	(9 2)	0 29	(10 1)	0 27	(1 8)	0 13	(0 9)	−1 37	(3 8)	0 48
Investment in											
(5) Structures	0 04	(2 5)	0 09	(4 5)	−0 43	(4 3)	−0 02	(0 2)	−0 96	(3 9)	0 29
(6) Durable equipment	0 11	(3 5)	0 07	(1 9)	−1 01	(5 2)	0 19	(1 0)	0 07	(0 2)	0 34
(7) Residential structures	0 06	(1 8)	−0 03	(0 7)	−0 20	(1 0)	0 77	(3 8)	0 50	(1 0)	0 39
(8) Business inventories	0 04	(0 3)	−0 04	(0 3)	−1 76	(2 3)	3 21	(4 3)	−0 41	(0 2)	0 19
(9) Net exports	0 006	(0 1)	−0 02	(0 3)	0 04	(0 1)	−0 52	(1 7)	−0 48	(0 6)	0 003
(10) Federal Government purchases	−0 01	(0 2)	0 11	(1 3)	−1 15	(2 6)	−0 86	(2 0)	−1 37	(1 2)	0 04
(11) State and Local purchases	0 09	(5 7)	0 03	(1 5)	0 41	(4 1)	−0 007	(0 7)	−0 41	(1 7)	0 19

*Sum of coefficients obtained from regressing GNP growth from its components on polynominal distributed lags of the contributions to M1 growth of M′ and NOW accounts (current quarter and 4 lagged quarters)

†A dummy variable set equal to one for 1983, zero elsewhere

Table 6

M1 Variability and the Money-Income Relationship

(1)	Y	=	2 3 (3 2)	+1 17 M (7 8)							$\bar{R}^2$	=	0 38
(2)	Y	=	3 0 (4 3)	+1 14 M (8 2)	−0 11 VAR (3 0)						$\bar{R}^2$	=	0 38
(3)	Y	=	3 7 (4 4)	+0 94 M′ (6 6)	+0 63 NOW (2 3)	−4 0 Rec (4 7)	+1 9 FYR (2 4)	−0 006 VAR (0 1)			$\bar{R}^2$	=	0 52

Where
- Y = quarterly growth rate of nominal GNP
- M = polynominal distributed lag of M1 growth
- Rec = zero-one dummy variable for recessions
- FYR = zero-one dummy variable for first year of recoveries
- M′ = polynominal distributed lag of M1 growth due to M1 less NOW accounts
- NOW = polynominal distributed lag of M1 growth due to NOW accounts
- VAR = polynominal distributed lag of a measure of M1 variability (Footnote 14)

velocity as the most important factors behind the sharp decline in M1's velocity in 1982 and early 1983 [16]

Conclusions

In sum, the primary conclusions of this article are

- The breakdown in the money-income relationship at the aggregate level since 1982 appears to be spread across several components of GNP Hence, it is not possible to say that the breakdown reflects an unusual development in a single component.

- One reason for the breakdown appears to be that M1 growth due to NOW accounts has a smaller impact on GNP and on some of its components than does M1 growth due to M' This could be because the demand for NOW accounts has a larger interest elasticity than the demand for M' Hence, smaller changes in interest rates are now required to prompt the public to hold a given amount of additional money balances The smaller change in interest rates, in turn, means that spending will not respond as much to a given change in M1 growth as in the past, causing velocity to appear unusually weak

- Allowing for this smaller impact of NOW accounts on spending in an ex post sense produces relatively small average errors in predicting GNP (or the component contributions) over the entire period from 1980-I to 1984-II.

- However, the relatively large negative error that remained for 1982 after allowing for the different effects of M' and NOWs suggests that there may be systematic cyclical influences on velocity not captured in the reduced-form equation.

- If cyclical shifts in velocity are allowed for in reduced-form money-income equations, M' and NOW accounts still show different effects on GNP growth, although the difference is somewhat smaller

- However, while adding cyclical dummies to the reduced-form equation that allows for different effects from M' and NOWs virtually eliminates the 1982 error, it still leaves a substantial negative error for 1983 This suggests either that the different effects from M' and NOWs are not constant over time or that there has been a fundamental change in the cyclical behavior of velocity

- These results seem to argue for caution in interpreting M1 for policy purposes, particularly since the effects of NOW accounts could change again in 1985 and 1986 as the remaining regulations on these accounts will be eliminated.

- When NOW accounts become fully deregulated, it could turn out that the interest elasticity of the demand for NOW accounts will be lower than currently and also lower than the interest elasticity of the demand for M' because the rates paid on NOWs will tend to move with market rates.[17] That means larger changes in rates will be required to induce consumers to hold a given amount of additional NOW account balances or M1 balances. Hence, a given change in NOW accounts will be associated with larger changes in spending than estimated here. This, then, means that if the relative effects of NOWs and M' on GNP growth are examined in a reduced-form equation at some future date, the opposite result of what was reported here might be found, that is, M1 growth due to NOWs might have a larger impact on GNP than M1 growth due to M'.

- It does not appear that GNP growth has been significantly lowered by increased variability in M1 growth once the different effects of M' and NOWs on GNP are allowed for, along with cyclical shifts in velocity

- By and large, it appears that it will take a considerable amount of time before there is enough experience with NOW accounts to be reasonably sure of their relationship to the economy.

[16]In a sense, attributing the breakdown in the money-income relationship in part to a deviation in velocity from normal cyclical patterns still begs the question of what is actually behind that part of the breakdown in the money-income relationship In other words, it is not possible to state precisely what economic development caused the deviation in velocity from past patterns during the first year of this recovery even though it was possible to account for the deviation in terms of the components of GNP Hence, it might be more accurate to state the conclusion as follows the apparent breakdown in the reduced-form money-income relationship in 1983 was not due to the cyclical error pattern this equation has shown on average in the past and, in part, remains unexplained

[17]For more detail, see Wenninger, *op cit*, and Simpson, *op cit*

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