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Searching for a Stable M2-Demand Equation

by

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ABSTRACT:

The Federal Reserve Board's error-correction model of M2 demand fails to explain much of the recent weakness in money growth. By slightly generalizing the Board model, however, its performance both prior to and during the recent episode of "missing money" can be substantially improved. The results suggest that weakness in M2 growth has been primarily due to a long-run trend toward more efficient use of M2 balances together with a normal response to a growing gap between long-term interest rates and M2 deposit rates.

Over the period from 1964 through 1989, there is a very high correlation between the income velocity of the M2 monetary aggregate and the opportunity cost of holding M2 balances, where the latter is measured by the difference between the 3-month Treasury bill rate and the average rate of return on M2 deposits. Since 1990, however, this relationship appears to have broken down: the velocity of M2 has been rising even as M2's opportunity cost has been falling. See Figure 1. Similarly, the Federal Reserve Board's model of M2 demand, which assumes a stable long-run relationship between velocity and the T-bill-deposit-rate spread, has systematically overpredicted the growth rate of M2 in recent years. The apparent breakdown of the historical linkages between M2 and the economy has led the Federal Open Market Committee (FOMC) to downwardly revise its 1993 M2 target growth ranges and deemphasize M2 in the policy making process (Greenspan 1993).

This paper examines the stability, predictive performance, and fit of two modified versions of the M2-demand model used by the Federal Reserve Board. The modified models explain significantly more of the movement in M2 than does the Board model. This improvement is evident both before and during the recent period of missing money. Indeed, the missing money problem largely disappears using the modified models. Furthermore, in the modified models, unlike the Board model, there is little evidence of structural instability.

The modified models differ from the Board model in two key respects: (1) they allow for a quadratic rather than a linear trend in the relationship between the velocity of M2 and M2's opportunity cost and (2) they allow substitution between M2 and non-M2 assets to be driven not just by the difference between Treasury-bill rates and M2 deposit rates but, also, by the difference between long-term bond rates and M2 deposit rates. In addition, one of the models uses household expenditures on non-durables and services, rather than GNP, as a long-run scale variable. Importantly, both the coefficient on the square of time and the weight attached to the long-term bond rate are statistically significant even prior to the period of missing money.[1]

The results reported here suggest that the recent weakness in M2 growth has been primarily due to a long-run trend toward more efficient use of M2 balances together with a normal response to a growing gap between long-term interest rates and M2 deposit rates. Other factors--such as the activities of the Resolution Trust Corporation (RTC), disintermediation, and households' evident aversion to debt--have played at most a secondary role in sluggish M2 growth. The bottom line is that it has not been the behavior of M2 that has been unusual in recent years so much as it has been the behavior of long-term interest rates relative to short-term and deposit interest rates.

Feinman and Porter (1992) take an approach similar to that adopted here, modeling M2's opportunity cost as the difference between a weighted average of competing interest rates and a weighted average of own interest rates, where both sets of weights are estimated along with the rest of the money-demand equation.[2] Unfortunately, data limitations force Feinman and Porter to use a money demand equation that has been stripped of its short-run dynamics. Furthermore, Feinman and Porter do not allow for any long-term trend in the

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[1] In contrast, Mehra (1992)--using a model that differs from the Board's principally in that it is formulated in real rather than nominal terms--finds that the 10-year Treasury bond rate has a statistically significant effect on the demand for M2 only when the sample period extends into the 1990s. More on Mehra's model later.

[2] The competing rates include the yields on 5-year Treasury notes and 30-year Treasury bonds, and the interest rate charged on 48-month auto loans. The own rates include the rates of return available on other checkable deposits, savings accounts and money market deposit accounts, certificates of deposit, and money market mutual funds.

money-demand equation they estimate. As a result of these omissions, the Feinman and Porter model exhibits clear symptoms of structural instability.[3]

Section 1 provides a quick overview of the Board's M2 model and demonstrates the model's inability to account for the recent weakness in M2 growth. Section 2 presents the modified models and compares their performance to that of the Board model. Section 3 discusses the role of RTC activity, the slowdown in consumer borrowing, and disintermediation in explaining the current episode of missing money. Section 4 examines whether there might not have been a missing-money episode in the early 1960s. A summary of major results, with policy discussion, concludes the paper.

1. THE CORPUS DELICTI

A detailed description of the Federal Reserve Board's M2 demand model can be found in Moore, Porter, and Small (1990). Briefly, the model assumes that there is a stable long-run relationship between the income velocity of M2 and M2's opportunity cost, where the latter is measured as the difference between the yield on 3-month Treasury bills and the average rate of return on M2 deposits. M2 growth tends to accelerate when velocity is above its long-run equilibrium value and to decelerate when velocity is below its long-run equilibrium value. Money growth is also influenced by near-term movements in M2's opportunity cost and consumer spending, and by regulatory changes such as the introduction of money market deposit accounts (in December 1982) and credit controls (1980).

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[3] Feinman and Porter's estimates of intercept and error-correction coefficients change by more than two standard errors when they extend the end of their sample period from 1989:Q4 to 1992:Q2. Estimated values of several interest-rate weights also change by more than two standard errors.

Formally, the Board model takes the form:

$$\Delta^2 m_t = c_{2A}D83Q1 + c_{2B}D83Q2 + c_{2C}DCON + c_4(v_{t-1} - v^*_{t-1}) + c_5\Delta oc_t + c_6(\Delta x_t - \Delta m_{t-1}) + c_{6A}(\Delta x_{t-1} - \Delta m_{t-1}) + c_{6B}(\Delta x_{t-2} - \Delta m_{t-1}) + e_t \quad (1)$$

$$v^*_t = c_0 + c_1 t + c_2 DMMDA_t + c_3 oc_t \ , \quad (2)$$

$$oc_t = \ln(R3MO_t - RM2_t) \quad (3)$$

where Δ and Δ^2 are first-difference and second-difference operators, respectively, e_t is a random error term,

$m \equiv \ln(\text{nominal M2})$

$D83Q1 \equiv$ dummy equal to 1 in 1983:Q1 to control for MMDAs

$D83Q2 \equiv$ dummy equal to 1 in 1983:Q2 to control for MMDAs

$DCON \equiv$ 1 in 1980:Q2 when credit controls imposed
-1 in 1980:Q3 after credit controls lifted

$v \equiv \ln[\frac{1}{2}(GNP + GNP_{-1})/(\text{nominal M2})]$

$R3MO \equiv$ yield on 3-month Treasury bills

$RM2 \equiv$ average interest rate paid on M2 balances

$x \equiv \ln(\text{nominal personal consumption expenditures})$

$DMMDA \equiv$ dummy equal to 1 beginning in 1982:Q4,

and where it is presumed that c_3 and c_4 are both positive. In practice, equations 2 and 3 are substituted directly into equation 1, and then the combined equation is estimated using ordinary least squares.

The second and third columns of Table 1 present estimates of the Board model over the period from 1964:Q1 through 1986:Q4 and the period from 1964:Q1 through 1989:Q4, respectively.[4] In both columns, the coefficient on v_{t-1} is statistically significant and of the expected sign, indicating that money growth does, indeed, tend to acclerate when velocity exceeds its long-run equilibrium value. The negative coefficient on oc_{t-1} indicates that, as expected, long-run velocity is an increasing function of M2's opportunity cost. (The implied long-run elasticity of velocity with respect to changes in the opportunity cost is -.0104/.178 = -.058 over the sample period ending in 1986 and -.0107/.191 = -.056 over the sample period ending in 1989.) The coefficient attached to the time variable suggests that the velocity of M2 has exhibited a small upward trend after controling for movements in M2's opportunity cost.

When the sample period is extended through the end of 1992, problems become apparent. Thus the coefficients of oc_{t-1} and v_{t-1} reported in the fourth column of Table 1 differ from their counterparts in the second and third columns by more than two standard errors. The same is true of the constant term. The fit of the equation markedly deteriorates. When an additive dummy variable is introduced into the money demand equation over the post-1989 sample, as in the fifth column of the table, the coefficient attached to the dummy is highly significant. The magnitude of this coefficient indicates that money growth has been over three percentage points per year lower in the post-1989 period than can be accounted for by the Board

[4] The starting date for the sample is that customarily used by the Board staff (Moore, et. al. 1990). Because I use after-tax rather than pre-tax interest rates in calculating the opportunity cost of holding M2 balances, the coefficient estimates reported in Table 1 are trivially different from those reported by, for example, Duca (1993, forthcoming).

model.

As a further test of the structural stability of the Board model, the model was re-estimated after including a dummy variable for each observation since the beginning of 1990. If the model is stable, the dummy variables should fail to be jointly significant (Dufour 1980). More generally, by examining the pattern of coefficients attached to the dummy variables, one can get some idea whether the Board model has been consistently off target, or has failed only in one or two quarters. Results are reported in Table 2.

The hypothesis that the coefficients of the dummy variables are equal to zero is rejected at the one-percent significance level. The coefficients are consistently negative in sign. Individual coefficients are statistically significant in 1990:Q4 and from 1991:Q3 through the end of 1992. The implied shortfall in M2 growth is fairly small in 1990 (just under 2.0 percent, annualized), but rises to over 7.0 percent in 1992.

Taken together, these results provide compelling evidence that the Federal Reserve Board's M2 demand model has broken down. The model has been overpredicting M2 growth since the beginning of 1990--significantly so since the middle of 1991. The prediction errors have, if anything, gotten larger through time.[5]

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[5] Results very similar to those reported in Tables 1 and 2 for the Board model are also obtained using Mehra's model of real M2 growth (Mehra 1992, 1993). When a post-1989 dummy variable is introduced into Mehra's model, it is negative and statistically significant at well under the 1-percent level. Individual Dufour dummy variables are consistently negative, and are statistically significant at the 5-percent level from 1991:Q3 through 1992:Q4. Collectively, the Dufour dummy variables are significantly different from zero at the 5-percent level. Thus Mehra's (1992) claim that his model does not display significant post-1989 instability is quite sensitive to the sample period over which the model is estimated. (Mehra starts his sample in 1953:Q1 and ends it in 1992:Q2. My sample period begins in 1964:Q1 and runs through 1992:Q4.)

2. THE MODIFIED MODELS

2.1 The Generalized Income-Velocity Model

The recent unusually slow growth in M2 has been accompanied by a growing gap between long-term interest rates and M2 deposit rates, and by large flows of cash into the stock and bond markets. (For a plot of the long-term bond rate less the M2 deposit rate, see Figure 2.) These facts suggest that households may view stocks and longer-term bonds as substitutes for M2 deposits. To allow for this possibility, I introduced the rate of return on a long-term security into the formula for the opportunity cost of holding M2.[6,7] In the generalized model, equation 3 is replaced by:

$$oc_t = \ln[\beta R10YR_t + (1 - \beta)R3MO_t - RM2_t], \qquad (3')$$

where R10YR denotes the after-tax rate of return on 10-year Treasury bonds and where β is a parameter to be estimated. Note that equation 3′ reduces to the Board's specification when $\beta = 0$.

Equations 1 and 2 were also generalized. To allow for the possibility that the short-run dynamic impact of the new opportunity-cost variable might differ from that of the old opportunity-cost variable, an additional lagged change in the opportunity cost was introduced into equation 1. Thus, equation

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[6] An alternative approach is to expand the existing M2 aggregate to include bond market mutual funds or stock and bond market mutual funds. Interestingly, adjusting M2 for bond and stock funds does not, by itself, eliminate very much of the recent M2-growth shortfall (Duca 1993, forthcoming). For further discussion of the properties of an expanded aggregate, see Feinman and Porter (1992) and the Appendix.

[7] Hamburger (1977, 1983) was an early advocate of including rates of return on long-term securities as right-hand-side variables in money demand equations.

1 was replaced by

$$\Delta^2 m_t = c_{2A}D83Q1 + c_{2B}D83Q2 + c_{2C}DCON + c_4(v_{t-1} - v^*_{t-1}) + c_5\Delta oc_t + c_5'\Delta oc_{t-1} + c_6(\Delta x_t - \Delta m_{t-1}) + c_{6A}(\Delta x_{t-1} - \Delta m_{t-1}) + c_{6B}(\Delta x_{t-2} - \Delta m_{t-1}) + e_t . \quad (1')$$

Also, to allow for the possibility that the pace of financial innovation (as measured by trend growth in M2's velocity) might be accelerating, the linear time trend incorporated into the Board model was replaced with a quadratic time trend. Formally, equation 2 was replaced by

$$v_t^* = c_0 + c_1 t + c_1' t^2 + c_2 DMMDA_t + c_3 oc_t \ . \quad (2')$$

Table 3 presents estimates of the generalized M2 model. The format of the table is similar to that of Table 1, except that the estimated values of three additional coefficients are reported.

In all respects, the performance of the generalized model appears superior to that of the original Board model. The $\bar{R}^2$'s of the generalized equations are substantially higher than those of their counterparts in Table 1. The weight attached to the 10-year bond rate in the opportunity cost term and the coefficient of time squared are significant--both statistically and economically--even in sample periods that end well before the emergence of the missing M2. More generally, parameter estimates appear to be quite stable across sample periods: estimates are always within two standard errors of one another and are usually within one standard error. When a dummy variable is introduced over the post-1989 period (column 5), its coefficient is statistically insignificant. The point estimate of this coefficient is only one third the size of that reported in Table 1: the generalized model underpredicts M2 growth by only about 1-percent per year since 1989, as compared with an over 3-percent-per-year shortfall using the Board model.

The improved performance of the generalized model is also reflected in Table 4, which reports results from an estimation that includes a sequence of Dufour dummy variables. Note that the Dufour dummies are now both individually and jointly insignificant. Their estimated coefficients are, however, consistently negative, and there is still some tendency for their magnitudes to increase with time.

2.2 Using Consumption as the Long-Run Scale Variable

As noted earlier, the Board's M2 model allows movements in consumption to have a short-run impact on money growth, but uses smoothed GNP as its long-run scale variable. The fact that the recent slowdown in M2 growth has been accompanied by unusually weak consumption spending suggests that the assumption that it is GNP rather than some measure of consumption that drives long-run money demand merits closer examination.[8] Accordingly, I estimated a variant of the generalized M2 demand model in which nominal household expenditure on non-durables and services was used as both the long-run and

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[8] For evidence of the slowdown in consumption, see Blanchard (1993) and Perry and Schultze (1993). For a nice discussion of the practical and theoretical reasons for believing consumption might be a better scale variable than GNP, see Mankiw and Summers (1986).

short-run scale variable.[9] Results are reported in Table 5.

The $\bar{R}^2$'s reported in Table 5 are only slightly below those reported in Table 3, and remain well above those obtained using the Board model. Again, the estimated coefficients of the 10-year bond rate and of time squared are economically and statistically significant even in relatively early sample periods. Parameter stability appears to be excellent--better even than that obtained in the income-velocity version of the generalized model. With consumption as the long-run scale variable, no coefficient estimate varies by even as much as one standard error across samples. The estimated coefficient on the post-1989 dummy variable is identical in Tables 3 and 5: both models account for about two-thirds of the money growth left unexplained by the Board model. In Table 5, as in Table 3, the coefficient on the dummy variable is statistically insignificant.

The consumption-velocity version of the generalized model performs particularly well in the Dufour dummy test. As shown in Table 6, not only are the dummy variables both individually and collectively insignificant, they exhibit little or no tendency to grow in magnitude as the sample is extended. The dummy coefficients are, however, consistently negative in sign.

There are several notable differences between the parameter estimates in Table 5 and the corresponding estimates in Table 3. The error-correction coefficient (c_4), for example, is smaller in the consumption-velocity version of the generalized model than in the income-velocity version. On the other

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[9] The validity of the error correction approach hinges upon the stationarity of the term (v_{t-1} - v^*_{t-1}) in equation 1. The residuals from a regression of the log of the consumption velocity of money on variables from the right-hand-side of equation 2' are indeed stationary. Stationarity cannot be rejected even in the case where the coefficient of time squared is constrained to be zero.

hand, the long-run interest elasticity of the demand for money is somewhat larger in magnitude in the consumption-velocity model than in the income-velocity model.[10] The same is true of the weight, β, attached to the long-run interest rate.

2.3 A More Detailed Look at the Models' Recent Performance

Table 7 compares the mean errors and root mean square errors generated by the Board model over the post-1989 period with those of the generalized income-velocity and consumption-velocity models. Two sets of results are presented: one based upon model estimates over a sample period extending from 1964:Q1 through 1989:Q4, and the other upon model estimates extending from 1964:Q1 through 1992:Q4. According to column three of the table, when estimated over the 1964:Q1-1989:Q4 sample period the Board model overpredicts money growth from 1990 through 1992 by an average of over one percentage point per quarter. Over the same period, the generalized income-velocity model overpredicts money growth by between four and five tenths of a percentage point per quarter, and the generalized consumption-velocity model over predicts money growth by only a third of a percentage point per quarter. When the sample period over which the models are estimated is extended to the end of 1992, the performance of the generalized models improves further relative to that of the Board model: the Board model overpredicts money growth by an average of about 1.5 percentage points per year, as compared to an average

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[10] The long-run interest elasticity is found by dividing the coefficient of oc_{t-1} by the coefficient of v_{t-1}. (The latter coefficient is, of course, an estimate of c_4--the error correction coefficient.) In the income-velocity model, estimates of the long-run interest elasticity range from -.0164/.199 = -.082 to -.0150/.163 = -.092. In the consumption-velocity model, estimates range from -.0132/.130 = -.102 to -.0128/.120 = -.107.

overprediction of less than .3 percentage points per year using the generalized models. The generalized models account for over 80 percent of the missing money.

The root mean square errors displayed in the second and fifth columns of Table 7 provide an alternative measure of the performance of the models over recent quarters. In both columns, the root mean square error of the generalized income-velocity model is over 50 percent smaller than that of the Board model. The root mean square error of the generalized consumption-velocity model is over 70 percent smaller than that of the Board model.

Finally, Table 8 presents results from encompassing tests based on the recent performance of the money demand models. Model A is said to encompass Model B if forecasts obtained from Model A contain useful information that is not contained in the forecasts of Model B. If Model A encompasses Model B and Model B fails to encompass Model A, then Model A is clearly superior to Model B. As a practical matter, to determine whether Model A encompasses Model B one can regress Model B's forecast errors on the difference between the forecast errors of Model B and the forecast errors of Model A. If the coefficient on the difference in errors is statistically significant, then Model A encompasses Model B. Similarly, if a regression of Model A's forecast errors on the difference between the forecast errors of Models A and B yields a statistically significant coefficient, then Model B encompasses model A.[11]

The first two rows of Table 8 show that the generalized income-velocity model encompasses the Board model over the period of the missing money, whereas the Board model fails to encompass the generalized income-velocity

[11] For a detailed description of the encompassing test used here, see Chong and Hendry (1986).

model. That is, the forecasts of the generalized income-velocity model are unambiguously superior to those of the Board model over the three-year period from 1990:Q1 through 1992:Q4. Similarly, the results displayed in the third and fourth rows of Table 8 show that the generalized consumption-velocity model dominates the Board model. Finally, the fact that the difference in errors between the income-velocity and consumption-velocity models helps to explain the errors of the income-velocity model but not the errors of the consumption-velocity model shows that the forecasts of the consumption-velocity model are unambiguously superior to those of the income-velocity model.

In summary, judging between the models solely on the basis of their recent performance, the generalized consumption-velocity model of M2 demand significantly outperforms the generalized income-velocity model. Both the generalized consumption-velocity model and the generalized income-velocity model significantly outperform the current Federal Reserve Board model.

3. OTHER EXPLANATIONS OF THE MISSING MONEY

Duca (1993, forthcoming) has suggested that Resolution Trust Corporation (RTC) activity may be responsible for much of the weakness in M2 growth since 1989. There are two reasons why RTC activity might have an adverse impact on the demand for M2 deposits. First, when a thrift is "resolved," its depositors are forced to reallocate their portfolios sooner than would otherwise have been the case. In an environment where interest rates on new bank deposits have fallen, many of those who have deposits at a resolved thrift will choose to shift assets out of M2 and into the stock and bond markets. Second, as more and more thrifts are resolved, people become aware that there is a call risk associated with bank time deposits. This newly perceived call risk reduces the attractiveness of bank time deposits for any given spread between market interest rates and bank deposit rates.

During 1992, there was an additional special reason for weak M2 growth: for a time, the floor rate of return on 6-month savings bonds exceeded the rate of return available on short-term Treasury bills. This yield gap may have resulted in disintermediation--albeit disintermediation induced by an artificial floor on the return from an asset competitive with bank deposits rather than by an artificial ceiling on bank deposit rates themselves.

Duca finds that of several possible alternative measures of RTC activity, the measure that best accounts for the missing M2 is the change in the quarterly average cumulated stock of resolved deposits. He measures the incentive for disintermediation using a variable that equals either zero or the floor yield on 6-month savings bonds minus the yield on 6-month Treasury bills, whichever is greater. Table 9 reports estimates of the Board model, the generalized income-velocity model, and the generalized consumption-velocity model, each expanded to include Duca's RTC and disintermediation variables (denoted DRTC and DISINTER, respectively).

Results displayed in the second column of Table 9 confirm that both the RTC variable and the disintermediation variable are highly significant, and of the expected sign, when added to the Board model. However, when the same variables are added to the generalized models, their estimated coefficients are statistically insignificant and considerably reduced in magnitude (columns three and five). In contrast, the coefficient of time squared and the weight placed upon the 10-year bond rate in the opportunity cost formula are both statistically and economically significant in every regression in which they are included.

Qualitatively similar results are obtained when the RTC variable is replaced by a variable designed to capture the incentive for households to reduce debt by drawing down M2 deposit balances. The spread between the interest rates charged on consumer loans and the interest rates paid on M2 deposit balances has been unusually wide in recent years.[12] The phase-out of the tax deduction for interest on consumer installment loans has contributed to the widening of this gap, as have rising costs of depository intermediation. It seems plausible that households would respond to this unusually wide gap by using some of the funds that they would normally have placed in a bank account or certificate of deposit to reduce their outstanding credit-card balances, make larger-than-usual down payments on new cars and other consumer durables, and pay down their home-equity loans. In effect, a low level of consumer debt might serve as a substitute for a high level of M2 balances. In an effort to incorporate this margin of substitution into the money demand models, equation 3′ was generalized to allow the opportunity cost of holding money to depend upon the average interest rate on consumer installment debt, in addition to the yields on 3-month Treasury bills and 10-year Treasury bonds. The estimated weight attached to the consumer loan rate is listed as γ in the third and fifth columns of Table 9.[13] The reported results indicate that, like the RTC and disintermediation variables, the consumer loan rate is statistically insignificant when included in the

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[12] See Feinman and Porter (1992), Chart 3.

[13] In the regressions reported in Table 9, the consumer loan rate is assumed to have a zero weight prior to the period of missing money (i.e. prior to 1990:Q1). However, very similar results are obtained when the consumer loan rate is allowed to have a non-zero weight beginning in 1972, when consumer loan rate data first become available.

generalized money-demand models.

Although the RTC, disintermediation, and debt-paydown variables are statistically insignificant in the generalized models, their coefficients have the expected signs. Including these variables in the regressions somewhat improves the models' post-1989 fit. (Compare the mean errors and root mean square errors reported at the bottom of columns three through six in Table 9 to the corresponding errors reported in Table 7.) Furthermore, the inclusion of RTC, disintermediation, and debt paydown variables sometimes improves the stability of key parameters. Increased parameter stability is particularly noticable in the income-velocity version of the generalized money demand model.[14] Accordingly, one can not rule out the possibility that RTC, disintermediation, and debt paydown effects have contributed to the recent weakness in M2 growth. Any contribution from these sources has obviously been dwarfed, however, by the combined effects of a long-run tendency toward more efficient use of M2 balances and a growing gap between long-term interest rates and M2 deposit rates.

4. MORE MISSING MONEY?

As noted above, the Board staff typically uses a 1964:Q1 starting date for estimation of its M2 model. However, consistent M2 data are available all the way back to the beginning of 1959. When the sample period used to estimate the Board model is extended to include the pre-1964 data, evidence of

[14] For example, the error-correction coefficient (the coefficient of v_{t-1}) falls from .192 to .163 in Table 3 as the end of the sample period is extended from 1989:Q4 to 1992:Q4. With RTC, disintermediation, and debt paydown variables included in the regression, the same coefficient only drops to .184 or .186 (Table 9, columns three and four). Increased stability is also notable in the estimates of the interest-rate weighting parameter, β, and the coefficient of time squared.

a post-1989 breakdown in the model remains statistically significant. Moreover, tests indicate that the Board model seriously over-predicts M2 growth prior to 1964. Thus, using the Board model, there are <u>two</u> periods of missing money--one in the early 1990s and the other in the early 1960s. In contrast, the M2 growth predictions of the generalized income-velocity and generalized consumption-velocity models are without significant bias.

To test the sensitivity of the post-1989 missing money to a change in the starting date used in estimating the Board model, two regressions were run. One of these regressions included Dufour dummy variables extending from 1990:Q1 through 1992:Q4, and the other included a single dummy variable equal to one from 1990:Q1 through 1992:Q4. Results are displayed in Table 10. While only four of the Dufour dummy variables are individually significant, every Dufour coefficient is negative, and the hypothesis that all the coefficients are equal to zero is rejected at the 5-percent significance level. The single dummy variable has a coefficient that is negative and significant at the 1-percent level. Thus, our earlier conclusion that the Board model breaks down after 1990 is not sensitive to an extension of the sample period to include pre-1964 data.[15]

The second and third columns of Table 11 present evidence that the Board

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[15] I conducted similar exercises (with sample periods beginning in 1959:Q4) for the generalized income-velocity and consumption-velocity models, and for Mehra's model of real M2 growth. Dufour dummy variables that run from 1990:Q1 through 1992:Q4 are neither individually nor collectively significant in the generalized models. A dummy variable that equals one from 1990:Q1 through 1992:Q4 is also statistically insignificant when introduced into the generalized models. All four 1992 Dufour dummies are statistically significant at the 5-percent level in Mehra's model, and the F statistic for a joint test of the entire set of Dufour dummy variables is significant at the 10-percent level (but not the 5-percent level). When a dummy variable that equals one over the entire interval from 1990:Q1 through 1992:Q4 is introduced into Mehra's model, it is significant at well under the 1-percent level.

model breaks down, not just after 1990, but also prior to 1964. Again, two regressions were run, one with Dufour dummies in each quarter from 1959:Q4 through 1963:Q4, and the other with a single dummy variable equal to one from 1959:Q4 through 1963:Q4. The coefficients of the Dufour dummies are consistently negative in sign, and many are statistically significant. The hypothesis that the Dufour coefficients are all equal to zero is rejected at the 5-percent significance level. The coefficient of the single dummy variable is negative and statistically significant at the 1-percent level. Its point estimate indicates that the Board model over-predicts money growth by over 3 percent per year, on average, in the pre-1964 period. This shortfall is almost identical to that generated by the Board model in the post-1989 period (Table 1, col. 5).

As shown in columns four through seven of Table 11, when Dufour dummies are introduced into the generalized income-velocity and consumption-velocity models, individual coefficients are rarely significant. One cannot reject the hypothesis that the Dufour coefficients are, collectively, equal to zero. When a single dummy variable is introduced into the models, it too is insignificant. Thus, the generalized models succeed in explaining the pre-1964 missing money much as they succeed in explaining the post-1989 missing money.

The superior performance of the generalized models in the pre-1964 period is confirmed by encompassing tests. As shown in Table 12, the difference between the errors of the Board model and the errors of the generalized income-velocity model helps to explain the errors of the Board model but not the errors of the generalized income-velocity model. That is, the forecasts of the generalized income-velocity model are unambiguously superior to those of the Board model over the pre-1964 sample period. The forecasts of the generalized consumption-velocity model are also unambiguously superior to those of the Board model. On the other hand, the ranking of generalized consumption-velocity and generalized income-velocity models relative to one another is unclear.

5. SUMMARY AND IMPLICATIONS

Growth in the M2 monetary aggregate has been weaker than is consistent with widely used models of the demand for money. The results presented here suggest that nearly all of this recent weakness is attributable to a long-run trend toward more efficient use of M2 balances combined with a normal response to the growing gap between long-term interest rates and M2 deposit rates. Apart from its impact on the willingness of banks and other savings institutions to narrow the interest rate gap, the thrift resolution process has played at most a minor role in depressing growth in the demand for M2 balances. Similarly, insofar as households regard a low level of debt as a substitute for high M2 balances, the incentive to reduce debt by drawing down M2 deposits appears to be adequately captured by the spread between long-term bond rates and M2 deposit rates.

Both the presence of a quadratic trend in M2 velocity and the influence of long-term interest rates on M2 demand are discernable in sample periods that end well before the "missing M2" emerged as a problem. This fact provides some reassurance that the roles played by the trend and the long-term interest rate in explaining the missing money are not spurious. Nevertheless, time trends inevitably carry with them an aura of ad hockery. In future research, analysts may well wish to experiment with other, more direct proxies for the effects of financial innovation on the demand for money.[16]

The fact that a monetary aggregate is explainable does not necessarily mean that it can be used successfully as an intermediate target. To serve as an intermediate target, it is desirable that a monetary aggregate be both controllable and closely linked to a measure of economic activity that is of interest to policy makers. Insofar as the demand for M2 depends upon the spread between long-term interest rates and deposit rates--as results obtained here strongly suggest--and this spread is subject to unpredictable movements, the usefulness of M2 as an intermediate target is called into question. Adding to doubts about the usefulness of M2 targeting are results suggesting that the demand for M2 may be more reliably linked to a subcategory of consumption spending than to total output.

The fact that a money aggregate is explainable also does not necessarily mean that it can be used successfully as a leading indicator. However, Feldstein and Stock (1993) find that forecasts of economic activity improve when a money-demand-error-correction term is included in the forecasting equation. This result suggests that the better are our models of the demand for money, the better will be our ability to predict the economy.

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[16] Siklos (1993) reports some success using the ratio of non-bank financial assets to total financial assets and the currency-money ratio to capture long-term trends in velocity.

APPENDIX: WOULD ADDING BOND FUNDS TO M2 MAKE MOVEMENTS IN M2 EASIER TO EXPLAIN?

It is sometimes easier to expand the definition of money than to model the forces that are driving households away from traditional monetary assets. For example, M2 largely replaced M1 as a guide to monetary policy after the introduction of interest-bearing checking accounts blurred what had hitherto been a fairly clear-cut distinction between transactions balances and savings balances (Hetzel and Mehra 1989). Earlier, the definition of M2 had itself been broadened to include money market mutual funds (Simpson 1980). The evident breakdown of the Federal Reserve Board's M2 model, together with large recent inflows into stock and bond mutual funds, has stimulated economists to consider whether the current definition of M2 ought to be expanded to include some subset of stock and bond mutual fund assets (Duca 1993, forthcoming; Feinman and Porter 1992).

One issue addressed in this literature is whether an expanded M2 aggregate is more "explainable" than M2 as currently defined.[17] Duca (forthcoming) argues that an M2 aggregate expanded to include household bond funds (exclusive of IRA and Keogh accounts) is more explainable than current M2. In his analysis, Duca uses the Federal Reserve Board's standard money demand model, adjusted to control for RTC and disintermediation effects.[18] Results presented here suggest, however, that the Board's money demand model can be improved upon. It is natural to wonder whether bond-fund-adjusted M2

---

[17] Related issues are whether monetary aggregates other than M2 are superior indicators of future movements in output and inflation, and whether alternative monetary aggregates are sufficiently under the Federal Reserve's control to serve as intermediate targets. As yet, no consensus is apparent on the answers to these questions.

[18] Duca also includes a yield-curve variable in some of his regressions.

remains more explainable than conventional M2 in the context of the improved models. Briefly, the answer is "no."

Evidence that adding bond funds to M2 does not yield a more explainable aggregate is shown in Table A1. The top half of the table presents root-mean-squared errors obtained from models that exclude Duca's RTC and disintermediation variables. The bottom half presents similar results for models that include these variables. Models that are estimated using Duca's bond-fund-adjusted M2 have a "M2B" designation. Root-mean-squared errors calculated over the entire sample and calculated only over the period of missing money are presented for each model.

As noted by Duca, the Board model does a somewhat better job of explaining growth in M2B than it does of explaining growth in M2. This superior performance is especially evident over the period from 1990:Q3 through 1992:Q4, and is obtained regardless of whether or not RTC and disintermediation variables are included in the regressions.

Results are rather different in the context of the generalized income-velocity and generalized consumption-velocity models developed in this paper. Over the period of the missing money, both of the generalized models do a substantially better job of explaining growth in conventional M2 than in explaining growth in bond-fund-adjusted M2. Over the sample as a whole, the generalized models do as well explaining movements in conventional M2 as explaining movements in bond-fund-adjusted M2. Even in the bond-fund-adjusted M2 regressions, the generalized income-velocity and generalized consumption-velocity models yield root-mean-squared errors that are much lower than those obtained using the Board model or the Board model supplemented with RTC and disintermediation variables (a'la Duca).[19]

The findings presented in Table A1 do not establish that M2 should not be expanded to include assets held in bond market mutual funds. However, the case for expanding M2 to include bond funds cannot be based on an argument that M2B is more explainable than M2. Instead, it must be based either on evidence that M2B is more controlable than M2, or upon direct evidence that M2B is a better indicator of future movements in output or inflation than is M2.

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[19] Point estimates of the coefficients change little in the generalized models when conventional M2 is replaced by bond-fund-adjusted M2. As before, the coefficient of time squared and the weight attached to the 10-year Treasury bond in the opportunity cost formula are highly statistically significant. The coefficients of the RTC and disintermediation variables are insignificant in those regressions in which they are included.

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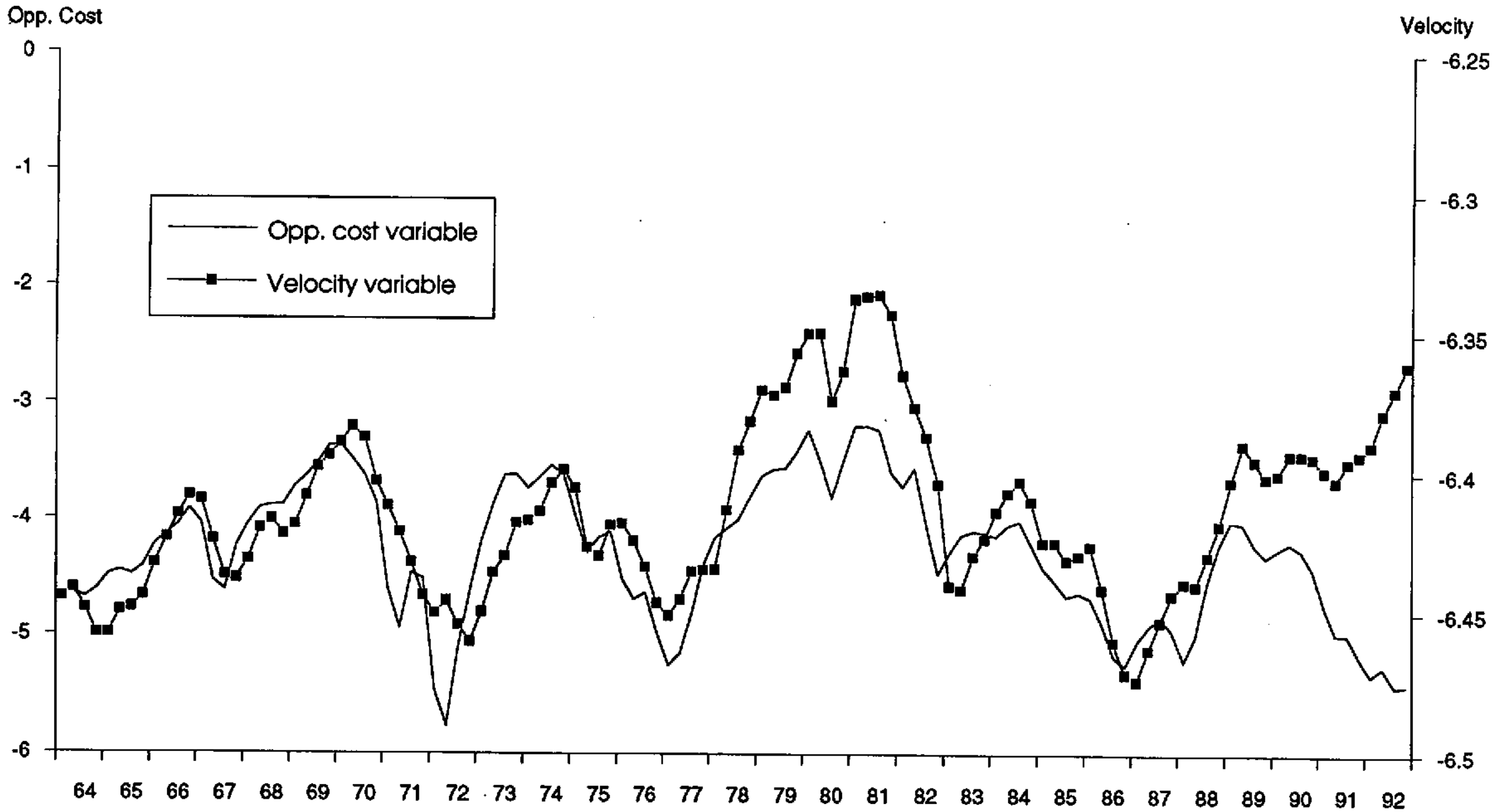
A.CSV Chart 1



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Velocity
Opp. cost variable
Velocity variable
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-1
-2
-3
-4
-5
-6
-6.25
-6.3
-6.35
-6.4
-6.45
-6.5
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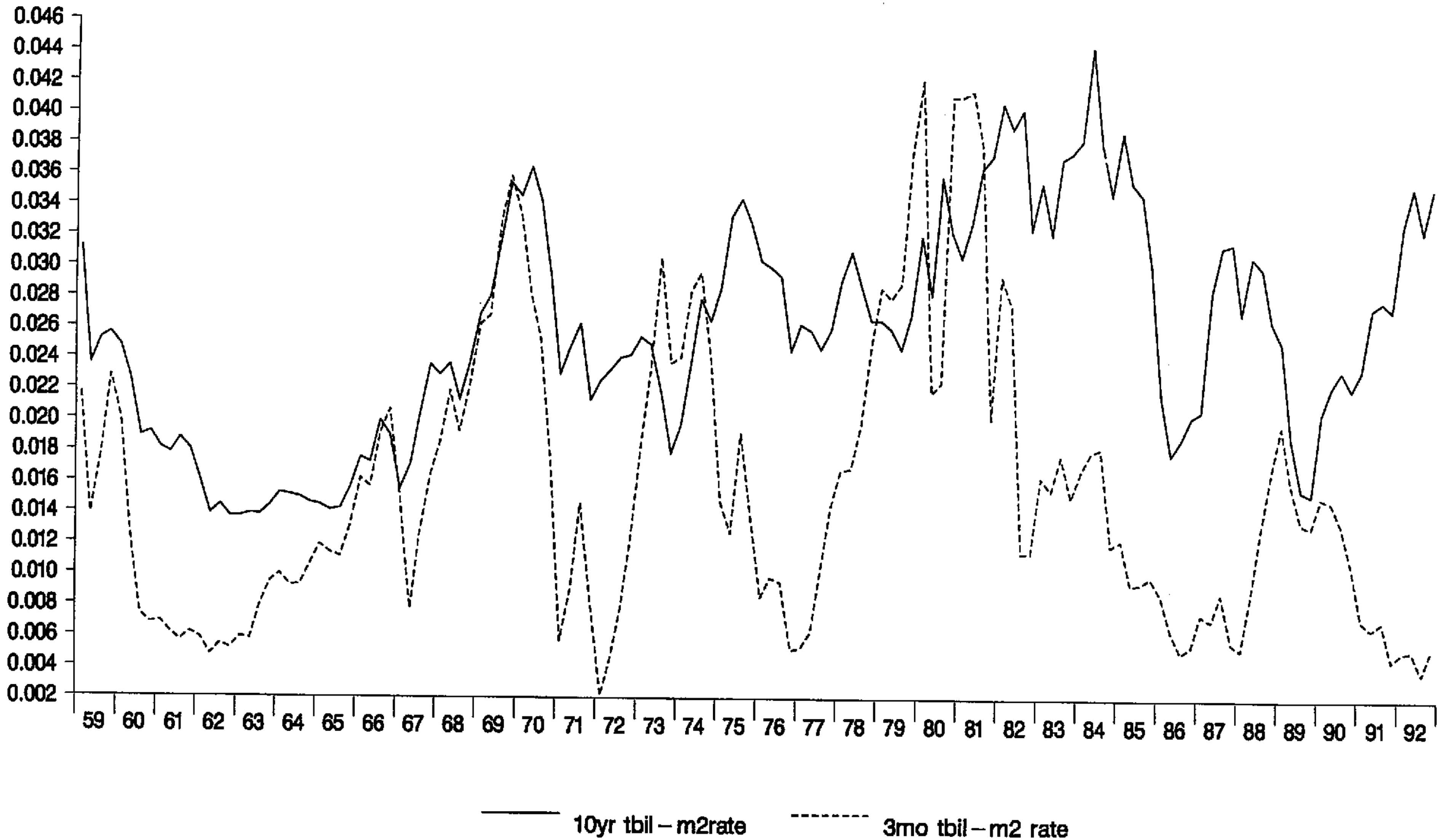
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59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92
10yr tbil – m2rate
3mo tbil – m2 rate

TABLE 1. Estimates of the Federal Reserve Board's M2 Demand Model

Variable	Sample Period 64:Q1-86:Q4	64:Q1-89:Q4	64:Q1-92:Q4	64:Q1-92:Q4
Constant	1.107**	1.194**	.642**	.930**
	(.182)	(.164)	(.152)	(.156)
Time×10^{-3}	-.108**	-.122**	-.0971**	-.103**
	(.032)	(.030)	(.0333)	(.031)
DMMDA	.00400	.00409*	.00206	.00383
	(.00208)	(.00195)	(.00217)	(.00204)
D83Q1	.0305**	.0307**	.0317**	.0311**
	(.0046)	(.0044)	(.0050)	(.0046)
D83Q2	-.00393	-.00309	-.00979	-.00830
	(.00532)	(.00505)	(.00557)	(.00515)
DCON	-.0100**	-.0104**	-.0116**	-.0109**
	(.0036)	(.0034)	(.0038)	(.0035)
oc_{t-1}	-.0104**	-.0107**	-.00521**	-.00763**
	(.0015)	(.0014)	(.00116)	(.00121)
v_{t-1}	.178**	.191**	.102**	.148**
	(.029)	(.026)	(.024)	(.024)
Δoc_t	-.00763**	-.00783**	-.00661**	-.00720**
	(.00144)	(.00133)	(.00147)	(.00136)
$(\Delta x_t - \Delta m_{t-1})$	.267**	.256**	.204**	.227**
	(.070)	(.064)	(.068)	(.063)
$(\Delta x_{t-1} - \Delta m_{t-1})$	.198**	.217**	.106	.136*
	(.072)	(.065)	(.070)	(.065)
$(\Delta x_{t-2} - \Delta m_{t-1})$	.0927	.0770	.0608	.0702
	(.0600)	(.0558)	(.0609)	(.0562)
Dummy 90:Q1-92:Q4	---	---	---	-.00806**
				(.00187)
SSE	.00146	.00158	.00233	.00197
RMSE	.00436	.00421	.00481	.00443
$\bar{R}^2$	.653	.665	.531	.600

* Significant at 5% level
** Significant at 1% level
Standard errors appear in parentheses.

TABLE 2. Dufour Test of the Structural Stability of the Board's M2 Model

Sample Period: 1964:Q1-1992:Q4

Date	Coefficient	Stnd. Error
1990:Q1	-.0017	.0044
1990:Q2	-.0050	.0043
1990:Q3	-.0037	.0044
1990:Q4	-.0089*	.0044
1991:Q1	-.0042	.0045
1991:Q2	-.0041	.0044
1991:Q3	-.0135**	.0044
1991:Q4	-.0118*	.0046
1992:Q1	-.0130**	.0048
1992:Q2	-.0211**	.0047
1992:Q3	-.0208**	.0049
1992:Q4	-.0186**	.0052

F Test $F_{12,89} = 3.521^{**}$

* Significant at 5% level
** Significant at 1% level

TABLE 3. Estimates of the Generalized M2 Demand Model with Income as the Long-Run Scale Variable

Variable	Sample Period 64:Q1-86:Q4	64:Q1-89:Q4	64:Q1-92:Q4	64:Q1-92:Q4
Constant	1.175** (.251)	1.146** (.225)	.951** (.205)	1.010** (.209)
Time$\times 10^{-3}$	.719* (.333)	.522* (.231)	.729** (.185)	.603** (.211)
DMMDA	.00974** (.00208)	.00817** (.00292)	.00918** (.00275)	.00836** (.00282)
D83Q1	.0333** (.0046)	.0322** (.0042)	.0327** (.0041)	.0322** (.0041)
D83Q2	-.00550 (.00510)	-.00371 (.00478)	-.00591 (.00452)	-.00535 (.00453)
DCON	-.00960** (.00344)	-.00966** (.00327)	-.00885** (.00314)	-.00887** (.00312)
oc_{t-1}	-.0164** (.0037)	-.0161** (.0032)	-.0150** (.0032)	-.0154** (.0032)
v_{t-1}	.199** (.042)	.192** (.037)	.163** (.035)	.171** (.035)
Δoc_t	-.0124** (.0030)	-.0118** (.0025)	-.0120** (.0025)	-.0118** (.0024)
$(\Delta x_t - \Delta m_{t-1})$	.250** (.067)	.257** (.062)	.249** (.057)	.251** (.056)
$(\Delta x_{t-1} - \Delta m_{t-1})$	.200** (.068)	.236** (.062)	.195** (.057)	.196** (.057)
$(\Delta x_{t-2} - \Delta m_{t-1})$	.0764 (.0587)	.0840 (.0538)	.0941 (.0502)	.0946 (.0500)
Dummy 90:Q1-92:Q4	---	---	---	-.00272 (.00219)
time$^2\times 10^{-5}$	-.365* (.154)	-.273** (.104)	-.360** (.084)	-.303** (.096)
Δoc_{t-1}	-.00398 (.00350)	-.00382 (.00306)	-.00723* (.00318)	-.00638* (.00311)
β	.287** (.096)	.250** (.074)	.326** (.057)	.307** (.058)

TABLE 3. Continued

SSE	.00123	.00132	.00143	.00141
RMSE	.00408	.00392	.00383	.00382
$\bar{R}^2$	.697	.710	.702	.704

* Significant at 5% level
** Significant at 1% level
Standard errors appear in parentheses.

TABLE 4. Dufour Test of the Structural Stability of the Generalized M2 Demand Model with Income as the Long-Run Scale Variable

Sample Period: 1964:Q1-1992:Q4

Date	Coefficient	Stnd. Error
1990:Q1	-.0011	.0042
1990:Q2	-.0028	.0042
1990:Q3	-.0016	.0043
1990:Q4	-.0068	.0043
1991:Q1	-.0012	.0044
1991:Q2	-.0009	.0045
1991:Q3	-.0070	.0046
1991:Q4	-.0040	.0048
1992:Q1	-.0042	.0050
1992:Q2	-.0098	.0053
1992:Q3	-.0086	.0055
1992:Q4	-.0073	.0055

F Test $F_{12,86} = .597$

* Significant at 5% level
** Significant at 1% level

TABLE 5. Estimates of the Generalized M2 Demand Model with Consumption as the Scale Variable

Variable	Sample Period 64:Q1-86:Q4	 64:Q1-89:Q4	 64:Q1-92:Q4	 64:Q1-92:Q4
Constant	.839** (.222)	.829** (.213)	.757** (.195)	.818** (.199)
$Time\times10^{-3}$	.651 (.347)	.671* (.267)	.822** (.225)	.717** (.242)
DMMDA	.00661 (.00337)	.00665* (.00296)	.00793** (.00265)	.00712* (.00274)
D83Q1	.0284** (.0046)	.0284** (.0043)	.0293** (.0041)	.0286** (.0041)
D83Q2	-.0129* (.0052)	-.0120* (.0049)	-.0131** (.0046)	-.0126** (.0046)
DCON	-.00688 (.00346)	-.00701* (.00338)	-.00641* (.00313)	-.00643* (.00312)
oc_{t-1}	-.0137** (.0038)	-.0132** (.0035)	-.0128** (.0033)	-.0133** (.0033)
v_{t-1}	.131** (.034)	.130** (.033)	.120** (.030)	.129** (.031)
Δoc_t	-.00941** (.00300)	-.00969** (.00272)	-.00967** (.00262)	-.00945** (.00256)
$(\Delta x_t - \Delta m_{t-1})$	.350** (.111)	.322** (.105)	.346** (.090)	.349** (.090)
$(\Delta x_{t-1} - \Delta m_{t-1})$	-.136 (.123)	-.105 (.115)	-.137 (.100)	-.131 (.100)
$(\Delta x_{t-2} - \Delta m_{t-1})$	.268** (.095)	.268** (.089)	.259** (.078)	.261** (.078)
Dummy 90:Q1-92:Q4	---	---	---	-.00272 (.00222)
$time^2\times10^{-5}$	-.354* (.164)	-.365** (.126)	-.430** (.109)	-.385** (.116)
Δoc_{t-1}	-.00649 (.00376)	-.00809* (.00343)	-.00993** (.00327)	-.00886** (.00323)
β	.356** (.118)	.358** (.086)	.404** (.068)	.383** (.069)

TABLE 5. Continued

SSE	.00125	.00141	.00146	.00143
RMSE	.00412	.00404	.00385	.00384
$\bar{R}^2$	.691	.691	.698	.700

* Significant at 5% level
** Significant at 1% level
Standard errors appear in parantheses.

TABLE 6. Dufour Test of the Structural Stability of the Generalized M2 Demand Model with Consumption as the Scale Variable

Sample Period: 1964:Q1-1992:Q4

Date	Coefficient	Stnd. Error
1990:Q1	-.0000	.0044
1990:Q2	-.0028	.0044
1990:Q3	-.0014	.0044
1990:Q4	-.0061	.0045
1991:Q1	-.0040	.0046
1991:Q2	-.0023	.0047
1991:Q3	-.0043	.0048
1991:Q4	-.0029	.0048
1992:Q1	-.0026	.0051
1992:Q2	-.0046	.0053
1992:Q3	-.0056	.0053
1992:Q4	-.0032	.0054

F Test $F_{12,86} = .254$

* Significant at 5% level
** Significant at 1% level

TABLE 7. Comparing the Recent Performance of the Alternative Models: Root Mean Square Errors and Mean Errors from 1990:Q1-1992:Q4

Model	Models Estimated 64:Q1-89:Q4			Models Estimated 64:Q1-92:Q4		
	RMSE	Mean Error	Reduction*	RMSE	Mean Error	Reduction*
Board	.01247	.01053	----	.00540	.00378	----
Income Velocity	.00553	.00447	57.5%	.00237	.00069	81.7%
Consumption Velocity	.00371	.00332	68.5%	.00145	.00067	82.3%

* Percentage reduction in mean error relative to the Board model.

TABLE 8. Comparing the Recent Performance of the Alternative Models: Forecast Encompassing from 1990:Q1-1992:Q4

Sample Period: 1964:Q1-1992:Q4

Independent Variable	Dependent Variable	T Statistic
$e_B - e_I$	e_B	7.819**
	e_I	1.703
$e_B - e_C$	e_B	9.148**
	e_C	1.149
$e_I - e_C$	e_I	4.282**
	e_C	.105

Notes:

$e_B \equiv$ residuals from Board model
$e_I \equiv$ residuals from generalized income-velocity model
$e_C \equiv$ residuals from generalized consumption-velocity model
* Significant at 5% level
** Significant at 1% level

TABLE 9. How Important are RTC, Disintermediation, and Debt-Paydown Effects?

Sample Period: 1964:Q1-1992:Q4

Variable	Board Model	Income-Velocity		Consumption-Velocity	
Constant	1.074** (.157)	1.093** (.212)	1.104** (.216)	.827** (.199)	.851** (.201)
Time×10^{-3}	-.116** (.030)	.552** (.204)	.586** (.217)	.696** (.242)	.715** (.242)
DMMDA	.00401* (.00196)	.00822** (.00277)	.00855** (.00281)	.00694* (.00274)	.00712* (.00273)
D83Q1	.0310** (.0044)	.0322** (.0041)	.0324** (.0041)	.0286** (.0041)	.0287** (.0041)
D83Q2	-.00519 (.00503)	-.00427 (.00454)	-.00438 (.00460)	-.0124** (.0046)	-.0125** (.0046)
DCON	-.0106** (.0034)	-.00907** (.00310)	-.00878** (.00312)	-.00663* (.00313)	-.00627* (.00314)
oc_{t-1}	-.00922** (.00128)	-.0160** (.0031)	-.0161** (.0031)	-.0133** (.0033)	-.0136** (.0033)
v_{t-1}	.172** (.025)	.184** (.035)	.186** (.036)	.130** (.031)	.133** (.031)
Δoc_t	-.00758** (.00131)	-.0120** (.0024)	-.0117** (.0024)	-.00976** (.00256)	-.00936** (.00255)
$(\Delta x_t - \Delta m_{t-1})$	.241** (.061)	.258** (.057)	.265** (.057)	.349** (.091)	.362** (.091)
$(\Delta x_{t-1} - \Delta m_{t-1})$	.175** (.063)	.211** (.057)	.204** (.058)	-.123 (.101)	-.146 (.100)
$(\Delta x_{t-2} - \Delta m_{t-1})$	.0909 (.0544)	.0993* (.0498)	.102* (.050)	.259** (.079)	.273** (.079)
DRTC×10^{-3}	-.315** (.079)	-.148 (.088)	---	-.132 (.090)	---
DISINTER	-.0207** (.0045)	-.00834 (.00454)	-.00536 (.00404)	-.00460 (.00436)	-.00225 (.00387)
γ	---	---	.0269 (.0254)	---	.0396 (.0309)

TABLE 9. Continued

$time^2 \times 10^{-5}$	---	-.283**	-.300**	-.376**	-.386**
		(.092)	(.098)	(.116)	(.115)
Δoc_{t-1}	---	-.00510	-.00493	-.00848**	-.00812*
		(.00298)	(.00301)	(.00322)	(.00322)
β	---	.278**	.246**	.374**	.328**
		(.060)	(.077)	(.072)	(.090)
SSE	.00180	.00137	.00140	.00142	.00143
RMSE	.00426	.00378	.00381	.00385	.00386
$\bar{R}^2$	.631	.709	.704	.699	.697
ME 90:Q1-92:Q4	.00047	.00001	.00012	.00007	.00002
RMSE 90:Q1-92:Q4	.00390	.00202	.00238	.00122	.00127

* Significant at 5% level
** Significant at 1% level
Standard errors appear in parentheses.

TABLE 10. Dufour Test of the Structural Stability of the Board's M2 Model

Sample Period: 1959:Q1-1992:Q4

Date	Coefficient	Stnd. Error
1990:Q1	-.0018	.0047
1990:Q2	-.0053	.0047
1990:Q3	-.0027	.0047
1990:Q4	-.0080	.0047
1991:Q1	-.0024	.0048
1991:Q2	-.0018	.0048
1991:Q3	-.0113*	.0048
1991:Q4	-.0085	.0048
1992:Q1	-.0079	.0050
1992:Q2	-.0164**	.0049
1992:Q3	-.0143**	.0051
1992:Q4	-.0101	.0053
F Test	$F_{12,109} = 1.961^{*}$	
Single Dummy 90:Q1-92:Q4	-.0065**	.0019

* Significant at 5% level
** Significant at 1% level

TABLE 11. Testing the Pre-1964 Structural Stability of Alternative Models

Sample Period: 1959:Q1-1989:Q4

Date	Board Coefficient	Board Stnd. Er.	Generalized Income Coefficient	Generalized Income Stnd. Er.	Generalized Consumption Coefficient	Generalized Consumption Stnd. Er.
59:Q4	-.0168**	(.0047)	-.0060	(.0051)	-.0073	(.0051)
60:Q1	-.0102*	(.0047)	.0000	(.0050)	-.0012	(.0051)
60:Q2	-.0160**	(.0049)	-.0078	(.0050)	-.0085	(.0051)
60:Q3	-.0112*	(.0051)	-.0049	(.0050)	-.0002	(.0053)
60:Q4	-.0158**	(.0050)	-.0094	(.0049)	-.0148**	(.0051)
61:Q1	-.0080	(.0048)	-.0007	(.0048)	-.0035	(.0051)
61:Q2	-.0081	(.0046)	-.0011	(.0046)	-.0067	(.0050)
61:Q3	-.0112*	(.0046)	-.0044	(.0046)	-.0068	(.0049)
61:Q4	-.0122*	(.0047)	-.0059	(.0047)	-.0075	(.0050)
62:Q1	-.0110*	(.0047)	-.0056	(.0047)	-.0021	(.0049)
62:Q2	-.0142**	(.0047)	-.0102*	(.0046)	-.0094*	(.0047)
62:Q3	-.0174**	(.0048)	-.0143**	(.0046)	-.0119*	(.0047)
62:Q4	-.0105*	(.0047)	-.0067	(.0048)	-.0043	(.0048)
63:Q1	-.0065	(.0046)	-.0039	(.0044)	-.0022	(.0046)
63:Q2	-.0048	(.0045)	-.0018	(.0043)	-.0026	(.0045)
63:Q3	-.0036	(.0044)	-.0014	(.0042)	-.0026	(.0044)
63:Q4	-.0008	(.0044)	.0018	(.0042)	.0030	(.0044)
F Test	$F_{17,92} = 2.071^*$		$F_{17,89} = 1.055$		$F_{17,89} = 1.098$	
Single Dummy 59:Q4-63:Q4	-.0083** (.0021)		-.0033 (.0023)		-.0037 (.0024)	

* Significant at 5% level
** Significant at 1% level
Standard errors appear in parentheses.

TABLE 12. Comparing the Past Performance of the Alternative Models: Forecast Encompassing from 1959:Q4-1963:Q4

Sample Period: 1959:Q1-1989:Q4

Independent Variable	Dependent Variable	T Statistic
$e_B - e_I$	e_B	2.148*
	e_I	-.889
$e_B - e_C$	e_B	2.395*
	e_C	-.703
$e_I - e_C$	e_I	1.367
	e_C	-.805

Notes:

$e_B \equiv$ residuals from Board model
$e_I \equiv$ residuals from generalized income-velocity model
$e_C \equiv$ residuals from generalized consumption-velocity model
* Significant at 5% level

TABLE A1. Does Adding Bond Funds to M2 Yield a More Explainable Aggregate?

Sample Period: 1964:Q1-1992:Q4

	Root-Mean-Squared Errors*	
	Complete Sample	1990:Q3-1992:Q4
Models Excluding RTC and Disintermediation Effects		
Board M2**	.0047	.0057
Board M2B**	.0045	.0056
Generalized Income-Velocity M2	.0036	.0026
Generalized Income-Velocity M2B	.0035	.0029
Generalized Consumption-Velocity M2	.0036	.0015
Generalized Consumption-Velocity M2B	.0036	.0018
Models Including RTC and Disintermediation Effects		
Board M2**	.0041	.0044
Board M2B**	.0040	.0040
Generalized Income-Velocity M2	.0035	.0022
Generalized Income-Velocity M2B	.0035	.0025
Generalized Consumption-Velocity M2	.0035	.0013
Generalized Consumption-Velocity M2B	.0035	.0016

Notes:

* Root-mean-squared errors are not corrected for degrees of freedom lost in estimating the models.

** As reported in Duca (forthcoming).

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