Effects of Movements in Equities Prices on M2 Demand

by John B. Carlson and Jeffrey C. Schwarz

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Introduction

In 1998, M2 and M3 increased 8½ percent and 11 percent, respectively. Over the past two years, these aggregates have grown at an average rate of around 7½ percent and 9 percent. But this rapid money growth has gone largely unnoticed in the financial press. It is widely understood that since 1993, the monetary aggregates have played a diminished role in the deliberation of monetary policy. At the same time, productivity increases have been surprisingly strong, especially over the past two years. This productivity "surprise" is often cited as the reason why rapid money growth has not translated into a rise in inflation.

What is less widely known is that since 1993, evidence has been building that M2 velocity is behaving more consistently with its historical experience. Though the evidence on the stability of M2 velocity is still too limited to provide a reliable basis for monetary targeting, there is good reason for concern about the risk of ignoring unusually strong money growth, especially if it persists. To determine this risk, it is constructive to assess the empirical relevance of factors identified as explanations for the unusual strength in money.

The February 1999 Humphrey–Hawkins report identifies several potential factors. First, heightened volatility in foreign financial markets has increased demand for safe and liquid assets—characteristics of several M2 components. Low long-term interest rates may also be a factor. Given the relatively flat yield curve, households give up little earnings when they hold savings in the form of short-term assets versus fixed-income securities. In addition, recent swings in stock prices may have led households to redirect savings flows. Such actions can lead to transitory increases in M2 as investors temporarily park funds in liquid assets while they determine those funds' ultimate destination. Preliminary research finds some evidence that money market mutual funds may be the liquid asset most often chosen as a "gateway" instrument.

In this article we assess the potential for such an explanation for the recent strength in M2. To do this, we extend a standard error-correction approach for M2 demand to include changes in stock prices as a transitory factor. Section I reviews previous research on the gateway factor. The framework for our analysis and the results are presented in sections II and III. We find that although stock price changes are statistically significant as an explanatory variable, they do not account for much of the recent strength in M2. Section IV offers a summary and conclusions.

I. Money Funds as a Gateway

Dow and Elmendorf (1998) estimate the effects of changes in stock prices on the demand for money market mutual funds, a component of the M2 measure of money. Their motivation follows from the observation that households have recently increased their wealth holdings in various investment vehicles such as stock and bond mutual funds and equities. Because money funds are often a temporary "parking lot" for funds used in financial transactions, they propose that the M2 component is affected most by the rapid rise in household holdings of bond and equity funds.

More precisely, Dow and Elmendorf identify two reasons that households own money funds. First, money funds offer a unique combination of low risk, market rate of return, and liquidity, and are thus likely to be included in any balanced portfolio. As with any asset, money-fund demand depends on expected rates of return on alternative assets, including stock and bond funds. When stock prices are expected to decline, for example, one would expect portfolio holders to shift wealth away from equities to other assets, including money funds. On the other hand, when stock prices are expected to rise, one would expect households to shift holdings from other assets to equities, the effects being symmetrical.[1]

Second, households use money funds as a gateway for performing other transactions. The gateway idea stems from the ease of using money funds as a safe, relatively liquid parking lot for wealth as it is rebalanced among other financial assets.[2] Since transaction volume tends to be high when stock prices vary substantially, Dow and Elmendorf hypothesize that both positive and negative changes in stock prices have a positive effect on holdings of money funds. However, in the latter case, if price movements (for example, short-term yield changes) are an effect of transitory demand, such an effect should be symmetrical. Hence, if the effect of volatility on money-fund demand dominates, the asymmetry should be evident. Moreover, Dow and Elmendorf suggest that the gateway effect should grow, since households would hold an increasing proportion of their wealth in bond and equity funds.

To investigate this hypothesis, Dow and Elmendorf propose a simple regression model of money-fund demand. Their basic specification regresses the percent change in money funds on the percent change in stock values, the rates of return on 3-month T-bill, 30-year Treasury, and money market deposit accounts, the percent changes in nominal disposable income, and both linear and quadratic trend variables. Stock price changes are separated into two variables, one including positive changes only (zero elsewhere), the other including negative changes only (zero elsewhere). Current values and four lagged values appear for stock price changes, while current and two lagged values appear for alternative yields. The Wilshire 5000 index is used as the measure of stock market value. All data are at monthly frequency.[3] The authors also consider specifications of both retail and institution-only measures of money funds.

Dow and Elmendorf find that a 1 percent increase in the Wilshire 5000 was followed by a ⅔ percent increase in retail money funds over a five-month span. A 1 percent decrease in the Wilshire 5000 was shown to be associated with a ⅓ percent to ⅔ percent increase in retail money funds over a five-month period (figure 1).[4] Note the asymmetry in the response of money funds to positive and negative changes in stock prices. In addition, the response occurs contemporaneously and over a period of four months; there is no evidence that this effect is offset in the months following.

■ **1** Dow and Elmendorf note that past returns are not necessarily a good measure of future performance. Indeed, if past changes are seen as independent of future changes, then one-time declines in equity prices would reduce the equity share of the portfolio, thereby inducing a rebalancing toward equities and away from other assets.

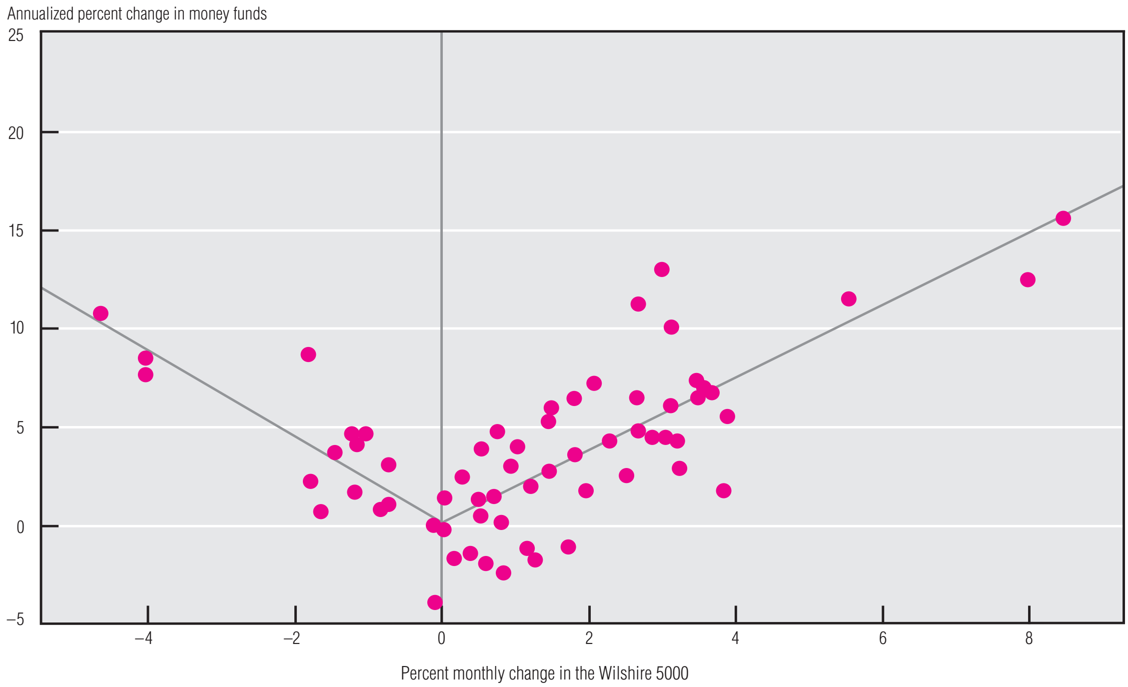
■ **2** Money market mutual funds are composed of short-term liquid securities (maturities generally less than 90 days) largely composed of Treasury bills and corporate paper.

■ **3** For the period from January 1992 to December 1998, Dow and Elmendorf focus on retail money funds, but also estimate the model using institutional money funds, money market deposit accounts (excluding the rate of return on money market deposit accounts as an independent variable in this case), and M2 less retail money funds. The model was also estimated for retail money funds using data for 1984–89.

■ **4** The range of response for retail money funds was dependent on the specification of the change in the stock index, particularly whether a month-average or month-end value was used. The larger magnitude shift in retail money funds was associated with the month-average specification.

FIGURE 1

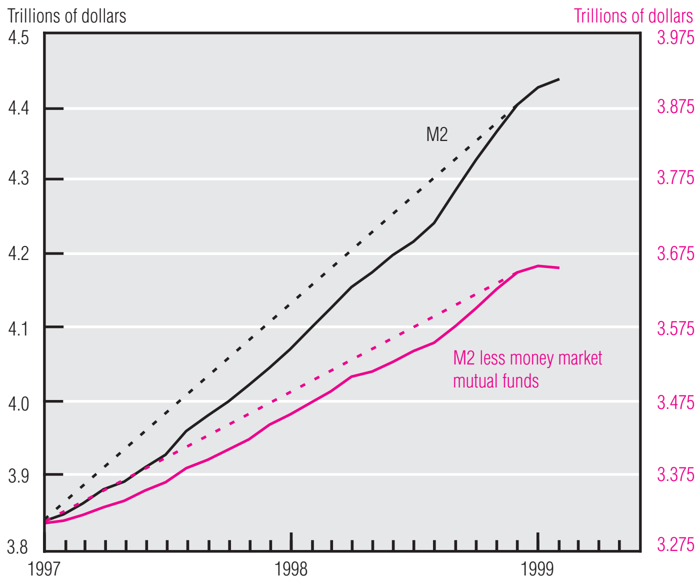
Equity Price Changes and Money-Fund Growth[a]



a. Money-fund growth rate in the corresponding and subsequent months after subtracting the estimated effects of other factors.
NOTE: Data are month averages January 1992 to August 1997.
SOURCE: Dow and Elmendorf (1998).

FIGURE 2

M2 and M2 Less Retail Money Funds



SOURCE: Board of Governors of the Federal Reserve System.

Dow and Elmendorf find that their estimates are robust for an alternative measure of stock prices, the S&P 500 index, but not for alternative components of money measures.[5] The estimated coefficients for the demand for institution-only money funds were of similar magnitude, but were not statistically significant. Dow and Elmendorf also examined similar specifications for money market deposit accounts and M2 less money funds, yielding no statistically significant coefficients for stock price movement. Findings for the 1984–89 period for retail money funds were similarly fruitless, indicating no significant relationship between stock price changes and money funds in this period.

Dow and Elmendorf conclude that for the mid-1990s, there has been a significant asymmetric relationship between changes in stock prices and the holding of retail money market

5 This conclusion should not be surprising, considering the high correlation between the two stock indexes. The correlation of the levels of the Wilshire 5000 and the S&P 500 from December 1979 to December 1998 is 0.999, and the correlation of their annualized month-to-month percent changes is 0.989.

mutual funds. They also conclude that this relationship did not exist during the latter part of the 1980s or for other measures of money, including M2 less money funds.

Although the data support Dow and Elmendorf's conclusions, it is not evident that their results extend to the M2 aggregate. M2 comprises several components that may be close substitutes for money funds. Thus, it is quite conceivable that an increase in money funds is, for example, offset by a decrease in money market deposit accounts.

Figure 2 suggests that Dow and Elmendorf's results also apply to M2. It illustrates that the non-money-fund component of M2 increased at an average rate of around 5 percent per year, as opposed to 6.5 percent for M2. The growth in the non-money-fund component is much more in line with historical experience. Thus, if money-fund strength derives from stock market price fluctuations, as hypothesized by Dow and Elmendorf, one would expect M2 growth to be strong given the recent large changes in stock prices. Further, if the recent swing in stock market prices is to explain the surge in M2 last year, then the change in stock market prices should enter significantly into specifications of M2 demand. Interestingly, Dow and Elmendorf do not examine this specification.

II. The Error-Correction Framework

To investigate the effect of stock prices on M2, we propose an error-correction specification based on a framework first proposed by Moore et al. (1990). This approach clearly distinguishes the long-run and short-run effects of the determinants of money demand. As in Moore et al., long-run money demand (often referred to as equilibrium money demand) is specified as

$$(1) \quad m_t = \alpha + y_t + \beta s_t + e_t ,$$

where m_t = log ($M2$), y_t = log (*nominal GDP*), and s = log (*opportunity cost*).[6] The term e_t represents the deviation of money from its long-run equilibrium value (derived from money balance to equilibrium levels). The unitary coefficient on nominal GDP implies that velocity varies directly with opportunity cost.[7]

The second aspect of the error-correction framework is a dynamic specification that describes the convergence process of M2 to its equilibrium. More precisely, this process specifies money growth as a function of the deviation of money from its long-run growth rate:

$$(2) \quad \Delta m_t = a + be_{t-1} + \sum_{i=1}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i}$$

$$+ \sum_{i=0}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t .$$

Changes in lagged values of log ($M2$) and current and lagged values of log (*opportunity cost*) and the scale variable (in our case, nominal GDP) also determine the adjustment to equilibrium—that is, the short-run path.

The general form allows for other variables, x_{ij}, to be included as transitory contributors (in log values) to the adjustment process, even though they may not affect the equilibrium value of money balances. These additional variables can be anything that may affect the rate of adjustment to equilibrium, such as personal consumption expenditures or movements in financial markets. The hypothesis proposed by Dow and Elmendorf suggests that stock price changes affect money balances in a transitory manner and, hence, are appropriately specified as log changes in equation (2), not as determinants of equilibrium demand. When the coefficient on the error-correction term is negative, convergence to equilibrium is assured.

When the long-run equilibrium equation, equation (1), is substituted into the short-run convergence equation, equation (2), the result is

$$(3) \quad \Delta m_t = a - b\alpha - b\beta s_{t-1} + b(m_{t-i} - y_{t-1})$$

$$+ \sum_{i=1}^{u} c_i \Delta m_{t-i} + \sum_{i=0}^{v} d_i \Delta s_{t-i}$$

$$+ \sum_{i=1}^{w} f_i \Delta y_{t-i} + \sum_{i=1}^{q} \sum_{j=0}^{n} g_{ij} \Delta x_{i,t-j} + \varepsilon_t .$$

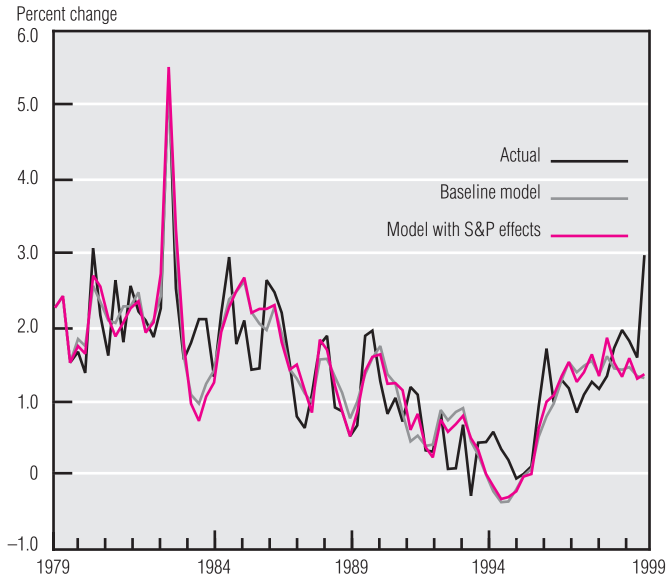
We estimate a version of equation (3).

6 Some economists argue that the appropriate scale variable in the long-run money demand function is wealth. For example, Sekine (1998) finds significant wealth effects in the demand for broad money in Japan. We examine the potential for wealth effects using alternative stock price measures as scale variables and find no significant effect.

7 Tests for the restriction that income elasticity equals one reveal that the restriction is supported by the data. For further results, see Carlson et al. (1999).

FIGURE 3

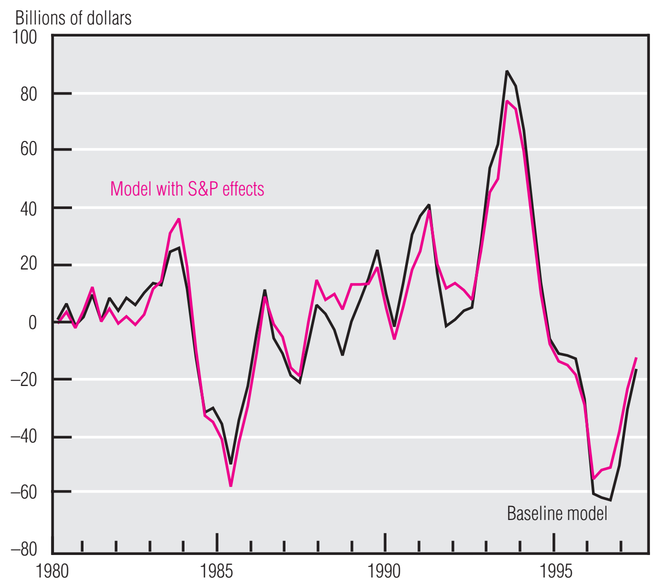
Effect of Stock Prices on M2 Demand, Actual versus Predicted



SOURCES: Board of Governors of the Federal Reserve System; and Federal Reserve Bank of Cleveland.

FIGURE 4

Estimation Errors (Predicted minus Actual)



SOURCE: Federal Reserve Bank of Cleveland.

III. Results

We estimate two specifications, one based on a streamlined version of Moore et al., the other including transitory variables to estimate the asymmetrical effect of changes in stock market values on M2 demand. The basic regression is

$$(4)\quad \Delta m_t = -0.077 - 0.009\, s_{t-1} - 0.184\,(m_{t-1} - y_{t-1})$$
$$\qquad\qquad (-7.08)\quad (-7.32)\qquad (-7.82)$$

$$+\,0.511\,\Delta m_{t-1} - 0.006\,\Delta s_t$$
$$(9.49)\qquad (-4.21)$$

$$+\,0.252\,\Delta c_t + 0.032\, d831_t - 0.028\, dum_t$$
$$(4.16)\qquad (7.33)\qquad (-7.77)$$

$$-\,0.0001\, t2_t + \varepsilon_t .$$
$$(-7.06)$$

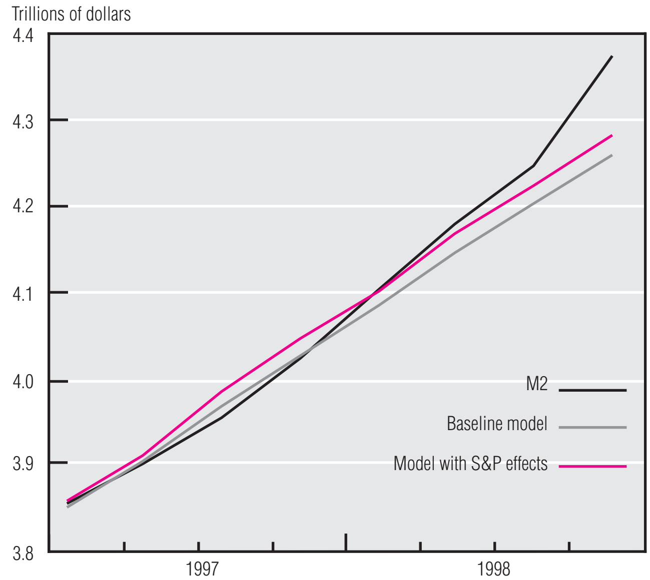
Adjusted $R^2 = 0.78$; estimation period = 1964:IQ to 1996:IVQ; *t*-statistics in parentheses (123 degrees of freedom) where s = log (*opportunity cost*), m = log (*M2*), y = log (*nominal GDP*), c = log (*personal consumption expenditures*), $d831$ is a qualitative variable that is equal to one in 1983:IQ and zero elsewhere,[8] *dum* is a dummy variable that introduces a linear shift from 1990:IQ to 1994:IQ,[9] and $t2$ is a modified

■ **8** Following Moore et al., we include this variable to account for a one-time shift in demand due to the deregulation of banking that took effect in 1983:IQ.

■ **9** This trend-shift variable is discussed in Carlson et al. (1999) to account for the unexplained shift in M2 velocity in the early 1990s. It was initially based on the observation of a persistent cumulative error in the standard model forecast in the early 1990s. By the end of 1993, the error had stabilized, suggesting that M2 velocity had stabilized around a higher level. This shift accords with findings of Whitesell (1997) and Orphanides and Porter (1998). Using annual data, Whitesell employs a procedure that allows him to identify both the timing and the magnitude of the velocity shift. Whitesell estimates that a sharp upward shift in long-run M2 velocity essentially begins in 1990 and is largely completed by 1994. Orphanides and Porter use a regression-tree approach to estimate structural changes in the M2 velocity opportunity-cost relationship. They conclude that the equilibrium of M2 velocity experienced an upward shift over a short period in the 1990s. Our shift variable is also similar to the interaction term that Mehra (1997) includes in his regression, *D*. His variable equals the spread between the 10-year Treasury and the own rate on M2 from 1989:IQ to 1996:IVQ and equals zero otherwise. Thus, his variable mimics a broken linear trend in 1980:IQ. The data are too limited in duration to discriminate between these approaches.

FIGURE 5

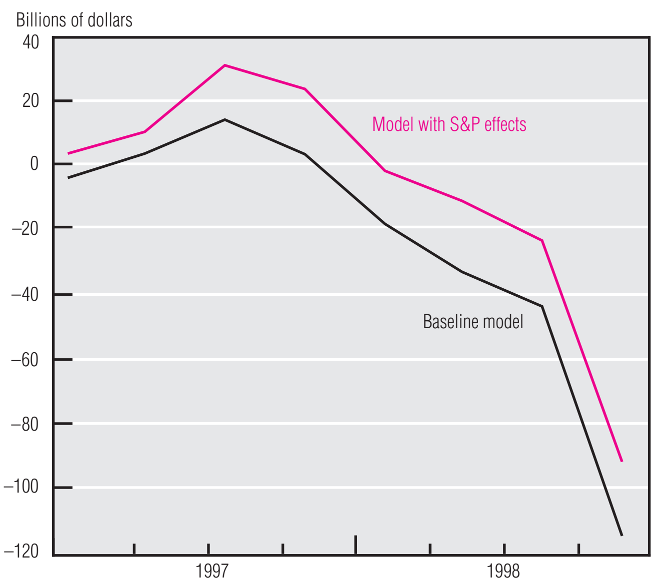
M2 Forecasts



a. Projections are based on actual post-sample values of GDP, personal consumption expenditures, and opportunity cost.
SOURCES: Board of Governors of the Federal Reserve System; and Federal Reserve Bank of Cleveland.

FIGURE 6

Out-of-Sample Estimation Errors



SOURCE: Federal Reserve Bank of Cleveland.

time trend which levels off at 1990:IQ.[10] All parameter estimates are significant at the 1 percent level or better. This regression will be referred to as the baseline.

The second regression, which will be referred to as including "S&P effects," is given by

$$(5)\quad \Delta m_t = \underset{(-7.05)}{-0.074} \underset{(-7.31)}{-0.009 s_{t-1}} \underset{(-7.63)}{-0.176\,(m_{t-1}-y_{t-1})}$$

$$\underset{(9.97)}{+0.521\,\Delta m_{t-1}} \underset{(-3.90)}{-0.005\,\Delta s_t}$$

$$\underset{(4.35)}{+0.255\,\Delta c_t} \underset{(7.21)}{+0.031\,d831_t} \underset{(-7.31)}{-0.026\,dum_t}$$

$$\underset{(-7.05)}{-0.0001\,t2_t} \underset{(3.02)}{+0.027\,stk\_pos_t}$$

$$\underset{(-3.02)}{-0.027\,stk\_neg_t} + \varepsilon_t .$$

Adjusted R^2 = 0.79; estimation period = 1964:IQ to 1996:IVQ; *t*-statistics in parentheses (121 degrees of freedom), where *stk_pos* and *stk_neg* are the positive and negative proportional changes in the S&P 500.[11] As in the baseline model, all parameter estimates are significant at the 1 percent level or better. A restriction that the coefficients on the change in stock-market variables must sum to zero was imposed. This restriction was introduced only after estimating the model with no restrictions, which showed that the two coefficients were of the expected signs and of similar magnitudes.[12] An F-test reveals that the restriction is supported by the data.[13] The restriction results in a slight increase in adjusted R^2 (from 0.78 to 0.79) and an improved forecast.

10 Moore et al. include a time trend to account for a modest upward drift in M2 velocity. When M2 was redefined in 1997, the drift was amplified (see Collins and Whitesell [1997]). We find, however, no evidence of an upward drift in the period since 1993.

11 The value of the S&P 500 at time *t* is defined as the average of the first month of the current quarter, *t*, and the last month of the previous quarter, *t*–1.

12 The coefficients for *stk_pos* and *stk_neg* without restriction were –0.024 and 0.037, respectively; the former was significant at the 5 percent level and the latter at the 1 percent level. All other variables in the unrestricted model were significant at the 1 percent level.

13 An F-test against the null hypothesis that the restriction is accurate—that is, the sum of the two coefficients is indeed zero—had a p-value of 0.464, indicating that the restriction is statistically valid.

Although the effect of stock prices on M2 demand is statistically significant, the improvement over the baseline model is only marginal. The addition of S&P movement terms increases the proportion of in-sample variation explained by slightly greater than 1 percent. This minor improvement is only slightly apparent in figure 3, which shows the in-sample predictions of the two models when estimation began in 1980:IQ.

Figure 4 illustrates the in-sample projection errors for the two regressions. The sum of the absolute value of errors for the model with S&P effects was about 97 percent of the sum for the baseline model (with the projections starting the estimation at 1980:IQ). Interestingly, the baseline model explains much of the M2 money growth for 1993–98; only after 1997 does the model go off track.

Figure 5 shows the out-of-sample forecasts of both regressions. Both models predict a similar path for M2, which is expected to exceed $4.6 billion by the end of 2000. The errors for the out-of-sample forecasts are shown in figure 6. The baseline model underperforms the model with S&P effects in 1998, while both models underpredict the level of M2. The out-of-sample sum of the absolute value of estimation errors for the S&P effects model was only 83 percent of the baseline model.

We also test whether the effect of stock prices is greater in the 1990s. Recall that Dow and Elmendorf found no significant asymmetrical effect of stock market movements on the demand for retail money funds in the latter part of the 1980s. We tested specifically whether there was a significant increase in the effect of stock market fluctuations on the demand for M2 in the 1992–97 period, the period for which Dow and Elmendorf found a significant effect for retail money funds. The regressions used to test this hypothesis were based on equations (4) and (5), with the addition of the interaction between both *stk_pos* and *stk_neg* and a dummy variable, *dum92.*[14] *Dum92* took the value of one from 1992:IQ through 1997:IVQ, the period of estimation used by Dow and Elmendorf, and zero elsewhere. The interaction terms were insignificant when added to both models.[15] Thus, unlike Dow and Elmendorf, we find that the gateway effect has not increased in recent years, but it is present in the data over the whole sample.

In the case of the baseline model, where the impact of movements in the stock market was considered only in the mid-1990s, there is no significant effect for M2. This is contrary to the findings of Dow and Elmendorf for retail money funds: the effect of the stock market fluctuations was significant only in the mid-1990s in their models. In the S&P effects model, the insignificance of the interaction terms leads us to conclude that there is no change in the effect of stock market fluctuations on the demand for M2 in the mid-1990s.

IV. Summary and Conclusions

Along at least one dimension, our results extend Dow and Elmendorf's hypothesis. We find that stock prices affect the demand for M2, not just its money-fund component. Thus, it appears that M2 serves as a gateway for redirecting funds in household portfolios. Although our statistical results are strong, the effect is not materially important for explaining recent fluctuations in M2, as it accounts for less than 13 percent of the out-of-sample errors in 1998.

Further, we find that the effect of stock prices on M2 is evident over the whole sample period, not just in the 1990s. In contrast, Dow and Elmendorf do not find statistically significant effects on money funds prior to 1990. This suggests that among M2 components, money funds are increasingly the instrument used as a gateway. Apparently, this purpose was served by alternative M2 components in earlier years.

We should note that our regressions are based on quarterly data, while Dow and Elmendorf examine a monthly specification. Their estimates, however, reveal that the effects of stock prices occur over a period of approximately four months, suggesting that the use of lower-frequency data sacrifices little empirically.

■ **14** Given the number of parameters we estimate, there were too few data points to break the sample in 1990.

■ **15** The models were estimated both from 1964:IQ to 1996:IVQ (our estimation period) and 1964:IQ to 1997:IVQ (to include all of Dow and Elmendorf's estimation period). The models were estimated both with and without a restriction that the coefficients on the interaction terms sum to zero. In each case, an F-test of the restrictions showed that the null hypothesis of coefficients which sum to zero could not be rejected, so only results for the restricted models are included. In all cases, the other coefficients estimated remained significant at the 1 percent level or better. The estimated coefficients follow (the format is as follows: positive coefficient [p-value] / negative coefficient [p-value]). Baseline model (restricted): through 1996:IVQ, 0.064 (0.060) / –0.064 (0.060); through 1997:IVQ, 0.023 (0.211) / –0.023 (0.211). Model with S&P effects (restricted): through 1996:IVQ, 0.041 (0.156) / –0.041 (0.156); through 1997:IVQ, –0.001 (0.482) / 0.001 (0.482).

Finally, if recent swings in stock prices do not account for much of the unexplained M2 growth, then what does? Volatility in foreign financial markets has subsided substantially, yet there is little evidence that M2 growth is being reversed. Further, recent strength in reported measures of output has led to an upward drift in long-term interest rates, which should unwind any yield-curve effect.

We emphasize that our baseline model has held up reasonably well since 1993. Except for the surge in the second half of 1998, M2 fluctuations have largely been explained by standard determinants of money demand. Notwithstanding the velocity shift in the early 1990s, M2 behavior has been much more in line with its historical experience, suggesting that underlying growth in nominal GDP is stronger than might be expected. Recent surprises in the strength of M2 have been matched with surprises in the strength of economic activity. Up to this point, however, rapid productivity growth has been a saving grace.

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