The Evolving Impact of Stock Market Shocks and Mortgage Activity on Broad Money Demand

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Abstract

Financial innovation amplifies shocks to the demand for broad money, such as M2. The targeting of monetary aggregates ended more than a decade ago largely due to money demand instability, often stemming from financial innovation. This study examines the effects of two recent financial innovations on demand for M2 that are driven by falling technology costs: buying and selling equity mutual funds and refinancing home mortgages. Gauging stock market effects is complicated both by opposing wealth and substitution effects and by measuring the sensitivity of M2 to shocks. To address these, we inter-act stock price changes with stock mutual fund loads, allowing M2's stock market sensitivity to depend on the costs of shifting between M2 and stock mutual funds. Stock fund loads are arguably the relevant asset transfer because of diversification needs and the concentration of M2 holdings among middle-income households. In theory, lower transaction costs should boost the stock sensitivity of money. Alternatively, loads may proxy for stock ownership rates, thereby tracking the increased stock market sensitivity of M2 balances among the middle class. In either case, flights from stocks into M2 entail inflows into money market mutual funds, consistent with the tendency for M2 and money funds to grow rapidly following recent stock price declines. Results imply that falling stock loads have boosted the negative correlation of M2 growth with equity shocks and accounting for loads is critical for identifying equity effects. Model fits in recent years are further improved when M2 is adjusted for mortgage refinancing volume, which has become more interest sensitive owing to improved financial technology that has reduced the cost of mortgage origination and rolling over mortgage-backed securities. Estimated effects are large, recently boosting M2 growth rates by as much as 2 to 4 percentage points owing to stock portfolio shifts, with refinancing effects boosting M2 growth by as much as 3 percentage points and lowering M2 growth by as much as 5 percentage points. Adjusted for these effects, M2 demand is much more stable. Whether it is sufficiently stable to be used for policy analysis remains to be seen. In any case, our analysis highlights the interaction between financial market structure and macro-economic relationships.

JEL Codes: E410, E500, G11; Key Words: stock market, earnings surprises, M2, mutual funds

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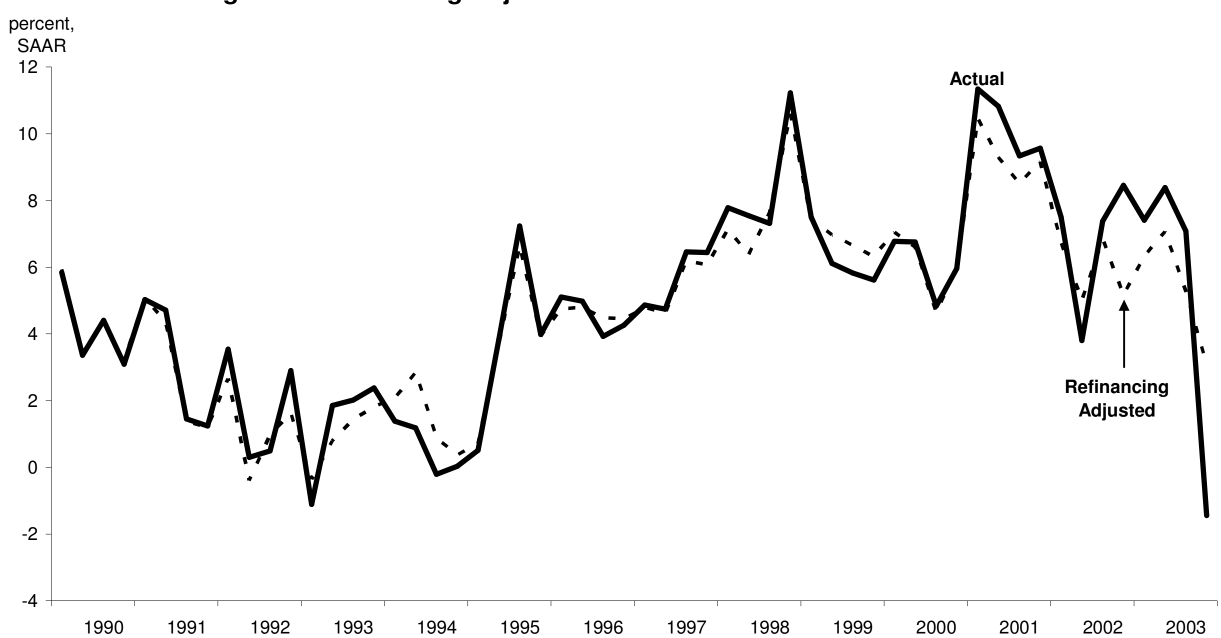
I. Introduction

In response to apparent instability in money demand during the early 1980s, economists and policymakers moved away from using monetary aggregates as policy guides, and, increasingly have viewed the stance of monetary policy based on a target for an overnight interest rate. This paradigm, however, is not without its problems. Time-varying term premia make it difficult to predict the relationship between overnight interest rates and the longer-term structure of interest rates. Furthermore, there is significant uncertainty and practical difficulties in identifying the Wicksellian neutral real rate (e.g., Clark and Kozicki, 2004), which may vary a good deal, as suggested by estimates from Laubach and Williams (2003). Both difficulties suggest that the federal funds rate, by itself, is not a sufficient statistic to measure the stance of monetary actions. While instability of money demand may arise from short-run asset disturbances which limit the information content of short-run money growth fluctuations, it is plausible that after adjusting money growth for large temporary shifts stemming from financial innovation, money growth rates may contain some information about long-run price pressures or nominal growth trends (for example, see McCallum (1997) and Nelson (2000)).[1]

Recent swings in broad money growth illustrate the difficulty of using monetary aggregates to measure the stance of policy. Some analysts have argued that very rapid M2 growth in the quarters after the 2001 terrorist attacks indicates an excessive easing by the FOMC. In 2002, there was concern that rapid M2 growth reflected an ill-advised accommodation of households temporarily fleeing equity into money market mutual funds (*Monetary Policy Report to the Congress*, 2002). During 2002 and 2003, large swings in mortgage refinancing activity made it difficult to interpret M2 growth (*Monetary Policy Report to the Congress*, 2004, pp. 23-

24). In Summer 2003, refinancing volumes set records—and M2 growth surged to a double-digit annual pace. Later, a collapse in refinancing activity (as mortgage rates rose) was accompanied by a sharp slowing in M2 growth which lasted until earlier mortgage-related surges unwound in early 2004. Indeed, as illustrated in Figure 1, M2 demand (and M2 growth) appears significantly more stable when M2 is adjusted for the enormous financial market churning from mortgage flows using the models of Duca (1991) and Anderson (1993).

Figure 1: Refinancing Adjusted M2 Growth Steadier In Recent Years



Sources: Federal Reserve and authors' calculations. Refinancing adjustments are based on approach number 1, which is later described.

This study has two purposes. First, we seek to better understand how innovations, particularly those affecting the liquidity of stock and housing wealth, have affected households' short-run portfolio demand for money. The innovations we examine are closely related to falling technology and transactions costs. Second, we seek to demonstrate that apparent instability in

[1] In its *Monetary Policy Report*, the Bank of England regularly seeks to separate "meaningful" movements in

money demand *can* be modeled. The improved money demand models may provide analysts and policymakers with better information about medium to long-run nominal variables based on broad money growth. Models of the role of money fall into three categories: multivariate empirical macro models with money (e.g., Carlson et.al., 2000; Anderson et al., 2002); computable general equilibrium models with money (McCallum, 2001; Dotsey and Hornstein, 2003); and single-equation money demand models. Our study is in this third category.

In recent years, a large literature has addressed the role of technology in reducing the costs of financial transactions and, in turn, of making portfolio adjustments (e.g., Carlson et al. (2000a, 2000b), Duca (2000), Orphanides and Porter (2000)). Textbooks often say that the essence of financial innovation is to increase the liquidity of relatively less-liquid financial (and some nonfinancial) assets. Financial engineering, in general, has the same motive: creating synthetic financial instruments that better match the needs and desires of both borrowers and lenders. By modifying the characteristics of assets, financial innovation and engineering change the substitution elasticities underlying money demand behavior, and cause "shifts" in the demand for money. Herein, we examine the money demand effects of changes in the costs of buying and selling mutual funds, and changes in the costs of refinancing residential mortgage debt.

Prior empirical evidence for significant stock market effects on money growth over reasonably long samples has been generally mixed, while evidence of substantial mortgage refinancing effects on money growth has been limited to M1. Based in part on theoretical results from Brunner and Meltzer's (1967) more general extension of the Baumol-Tobin model, this study empirically shows how changes in financial technology in the form of lower equity mutual fund costs may have altered the observed relationships between stock price changes and M2

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monetary aggregates from "noise" due to short-run financial market disturbances.

balances.[2] Furthermore, as in Duca (2003), this paper finds that stock market developments can, at times, have significant effects on money demand and money balances after accounting for the decline in mutual fund costs. Nevertheless, as sample periods are progressively extended into 2002 and 2003, even this approach still yields large residuals. But, by enhancing Anderson's (1993) improved techniques of estimating the refinancing effects on money, we are able to address this difficulty which likely stems from an increased interest rate sensitivity of refinancing activity. We thus find a well-behaved M2 demand relationship by accounting for the increased sensitivity of money balances to stock portfolio shifts and to mortgage refinancing effects, both of which stem from improvements in financial technology.

To establish these findings, Section 2 addresses the empirical difficulties with estimating stock wealth effects on money and theoretical reasons why lower stock transfer fees may induce more portfolio substitution between stocks and money. Section 3 then discusses how mortgage refinancing activity can substantially affect money balances and illustrates the increased interest sensitivity of refinancing activity. Section 4 lays out our empirical strategy for estimating stock wealth and mortgage effects, and presents the money demand specifications and variables used. Section 5 discusses our empirical results, which are more broadly interpreted in the conclusion.

II. Stock Wealth and Money Demand

A. Empirical Difficulties for Identifying Stock Wealth Effects on Money Demand

Attempts to analyze stock market effects on money have been hindered by three sources of difficulty. The first is that equity shocks could have positive wealth and negative substitution effects on money demand. The second concerns defining stock shocks. Hamburger (1966, 1977) found that money demand is negatively related to equity returns, as tracked by the dividend-price

[2] More generally, money demand models with costs of adjustment may be examined as inventory-theoretic models

ratio. But later Friedman (1988) found that this ratio is insignificant when wealth is included as a scale variable, and Allen and Connolly (1989) found it insignificant in a more standard money demand model. The mixed pattern of these results could reflect ambiguity about the net impact of positive scale (wealth) effects and negative substitution effects.

Another concern with the dividend-price ratio is that its link to stock returns has loosened over time due to changes in the equity premium (Blanchard (1993) and Siegel (1999)) and corporate efforts to reward investors with capital gains to avoid the double-taxation of dividends (Fama and French, 2001). Another approach, based on the random walk hypothesis, is to use stock price changes to gauge equity shocks (Dow and Elmendorf, 1998, and Carlson and Schwartz, 1999). However, it is unclear what horizon should be used to measure changes. Using VARs or other techniques to construct "stock surprises" raises concerns about whether such terms are too sensitive to model specification, especially given large shifts in the equity premium (see Blanchard (1981) and Siegel (1999, 2002)) and complications associated with learning.

To avoid such problems, Lange (2001) and Carpenter and Lange (2002) use revisions to future stock earnings from IBES's survey of analyst 12-month ahead S&P 500 earnings per share (EPS). Lange (2001) finds EPS revisions have significant and negative effects over 1995-2001, but not over longer periods.[3] Nevertheless, Duca (2003) found stock price changes were more significant in M2 models estimated over longer periods. Sample sensitivity also characterizes Dow and Elmendorf (1998) finding that stock price changes asymmetrically affect household money market mutual funds (MMMF) since the early 1990s, but not in earlier samples.[4]

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with adjustment costs (e.g., Cuthbertson, 1985, 1997).

[3] Carpenter and Lange (2002) found that EPS revisions and stock price volatility were significant in samples covering 1995:4-2002:2, but do not report results for longer samples.

[4] They found that positive and negative stock price changes boost MMMF growth, where the former is consistent with a positive wealth effect, and the latter, with a positive flight to quality effect outweighing a negative wealth

One explanation for sample sensitivity relates to the third major source of difficulty in identifying an effect of equity market shocks on M2. It is plausible that financial innovations have cut the cost of shifting in and out of stocks, thereby raising the size of negative equity substitution effects on M2. For three reasons, the relevant stock transfer cost for M2 is the load (proportional transfer fee) on equity mutual funds. First, middle-income families own the vast bulk of M2, whereas high-income families hold much smaller portfolio shares in M2 according to the Surveys of Consumer Finances (SCF's, see Kennickell, et al. 2000, pp. 10-11). Second, owing to limited assets and before the recent advent of exchange traded funds, the feasible way for a middle-income family to own a diversified stock portfolio was via mutual funds. Third, the relevant asset transfer cost for money is the proportional, not the fixed, cost of transfers, as Brunner and Meltzer (1967) show in their more general version of the Baumol-Tobin model.

Three other developments support the view that lower loads increased the stock market sensitivity of M2. First, much, if not most, of the 2001 surge in M2 growth reflects inflows into MMMFs and money market deposit accounts (MMDAs). Because mutual fund families make it easy to shift assets across their funds, substitution between M2 and equity assets likely disproportionately affected MMMFs. Similarly, bank holding companies offering MMDAs and asset management accounts have increased the ease of shifting between equity funds and MMDAs. Indeed, money fund, MMDA, and M2 inflows in 2001 were larger than interest rate spreads and other conventional money demand variables could explain based on past experience.

Second, the proportional cost of shifting between money market and equity mutual funds, the average load on equity funds has fallen since the early 1980s and is negatively correlated

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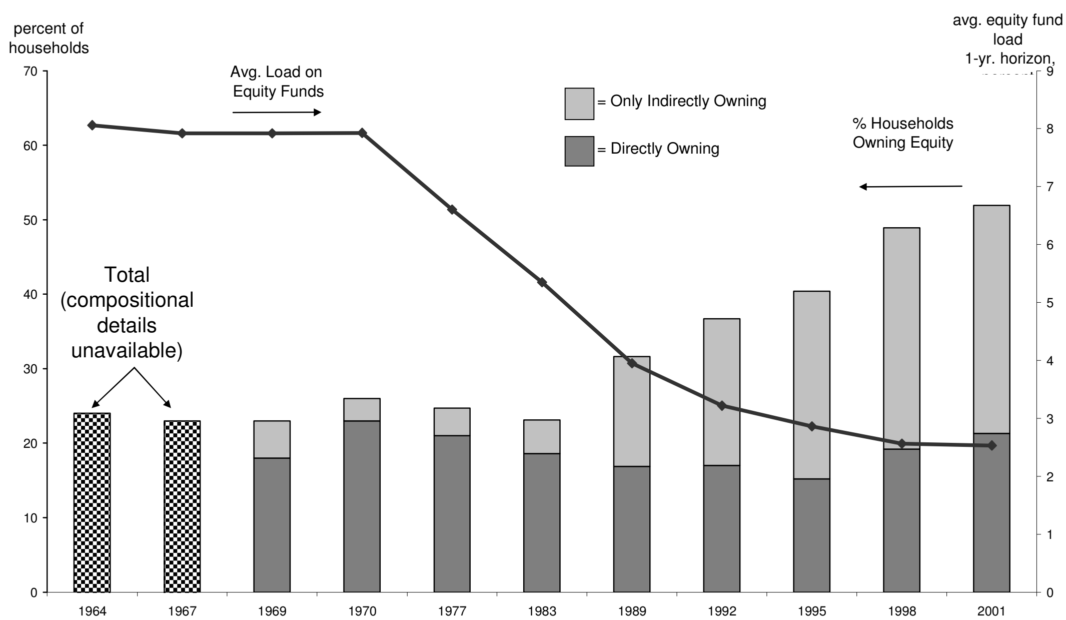
effect. Carlson and Schwartz (1999) obtain similar results for M2, but in contrast, find stock price changes were statistically significant over 1980-98. But, these variables are insignificant in the samples 1979-01 and 1979-02 with stock ownership rates from intermittent SCFs (Figure 2, see Duca 2005). These SCFs show that higher equity participation owed to greater mutual fund stock ownership. Third, SCFs reveal that stock ownership rates rose the most for middle-class families, whose median holdings of transaction accounts and certificates of deposits grew more slowly relative to total financial assets than for high-income families. Thus, cross-section data support the view that M2 balances are more susceptible to equity-related portfolio shifts owing to lower mutual fund loads.

Figure 2: Equity Fund Loads Fall and Stock Ownership Rates



The current study uses equity fund loads to track the changing equity sensitivity of M2. Separate variables for stock market shocks alone and interacted with equity fund loads are statistically significant in models of M2 growth. Furthermore, the presence of interactive stock market variables noticeably improves model fit, suggesting that as a result of lower asset transfer costs, negative substitution effects from equity markets have become relatively more important

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(which include the big price swings of recent years) using a Federal Reserve model similar to the ones used here than any positive scale or wealth effects. In addition, when these significant interactive variables are included, there is evidence that negative equity market shocks have increasingly affected M2 growth more than positive or symmetrically defined shocks. This result is consistent with a flight-to-quality effect on M2 growth, which is much less volatile in recent quarters when adjusted for estimated stock market effects.

B. Theoretical Background on Asset Transfer Costs and Stock Wealth Effects

Thus far, the literature on money demand lacks a fully integrated and detailed analysis of how changes in transaction costs would affect money holdings in a portfolio of several assets (bonds, money, and equity), where money demand could be affected by a flight to quality. Nevertheless, a number of relevant insights can be gleaned from several studies.

In particular, Brunner and Meltzer (1967) argue that the Baumol (1952) and Tobin (1956) models of money demand are special cases and that the standard implications from these models (that the income elasticity of money is one-half and only fixed transfer fees matter) do not hold under more general conditions. Brunner and Meltzer show that if agents face proportional as well as fixed asset transfer costs and receive asset income that they need to reinvest, then as labor income rises, velocity approaches a constant plus a term which is decreasing in the proportional cost of shifting between bonds and money. Consistent with their analysis, cointegration results from Duca (2000) indicated that the upward shift in M2's velocity in the early 1990s was in line with a downward shift in the average load on bond mutual funds, arguably the most feasible vehicle for middle-class households to own bonds. Nevertheless, the above theoretical study by Brunner and Meltzer and the empirical analysis of Duca do not address whether transfer costs affect the frequency and magnitude of portfolio shifts between equity and M2 balances.

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when the sensitivity of M2 to equity shocks can vary with stock fund loads or the MMMF share of M2.

Recent work by Liu and Loewenstein (2002) and Zakamouline (2002) analyzes the impact of transaction costs on when it is optimal for agents to realign their portfolios of risky and safe assets. (Though, of course, money is not riskless owing to variable inflation). In these models, transaction costs create a zone in which it is optimal not to trade, until the extent of portfolio misalignment is large enough to warrant incurring the transaction cost of realigning asset holdings. According to both models, as proportional transfer costs increase, the zone of no trading generally widens. Similar results arose in an earlier study by Davis and Norman (1990), who analyze households having utility functions characterized by hyperbolic absolute risk aversion, in a world with two assets, bank deposits yielding a fixed return, and stocks having variable returns of a known variation. As the proportional costs of transferring between bank deposits and equities falls, the narrower is the range of variation in stock prices in which households do not alter their portfolios (and consumption) in response to changing equity prices.

All three studies imply that a decrease in mutual fund loads increases the likelihood that households (for whom mutual funds are the relevant vehicle to own bonds and stocks) will realign their portfolios in response to a given change in opportunity costs. In particular, if downside equity risk rose, households would be more likely to shift from equity to MMMFS and MMDAs if the total cost of so doing—including stock mutual fund loads—were lower. Empirically, because most middle-class shareholders own equity via mutual funds and the vast bulk of M2 assets are held by middle-income families, this suggests that the sensitivity of broad money balances to stock market developments depends on the magnitude of equity fund loads.

In addition to directly affecting M2 growth by altering the costs of switching between M2 and equity assets, falling stock loads could plausibly boost stock ownership rates and via a participation channel, increase the sensitivity of M2 to stock market developments. As stressed by Heaton and Lucas (1999), high transfer costs for households whose utility functions exhibit habit formation can lead to a low stock ownership rate and a high equity premium, and a decline in asset transfer costs would induce greater stock ownership rates. Consistent with this implication, Duca (2005, forthcoming) showed that average equity fund loads and stock ownership rates from the irregular Surveys of Consumer Finances had a significant negative correlation very close to –1 for both overall and indirect (e.g., mutual fund) rates of equity participation. As a result, a variable inter-acting an equity shock variable with stock fund loads could be significant in M2 regressions because it tracks the share of households who own stocks. This plausible equity participation effect is analogous to the role of deposit participation in the models of Mulligan and Sala-i-Martin (1996, 2000), in which changes in the percent of households that own deposit accounts can affect the behavior of aggregate money holdings.

III. Mortgage Refinancing Effects

Mortgage activity affects money demand (see Duca (1990) and Anderson (1993)). Mortgage originations for home purchases and for refinancing mortgages increase liquid deposit balances. However, because of its volatility, refinancing is the more important for our analysis.

Funds involved in a mortgage refinance typically are parked in an escrow account during the three-day period when, under the Federal Reserve's Regulation Z, the household has the legal right to reverse a decision to refinance. In addition, households may convert equity to cash, and store the funds in a component of M2 until spent. Finally, and empirically most important, are the balances that mortgage servicers hold when households close the refinancing and remit the (unscheduled) principle to the servicer of the extinguished mortgage. If the mortgage has been securitized as part of a GNMA or FNMA mortgage-backed security (MBS) issue, the servicer may retain these funds in a liquid deposit for several weeks (governed by the terms of its servicing agreement with the GSE).[5] For Ginnie Mae and Fannie Mae MBS, as long as six weeks may pass between the date when the servicer receives the unscheduled principle payment and when it is remitted it to the GSE for transmission to the owner of the MBS.[6]

Swings in mortgage refinancing activity can significantly, if temporarily, distort money growth trends. Mortgage refinancing activity, once relatively rare, has become commonplace. Further, due both to more liberal fiduciary rules and the expanded use of deposit-sweep programs by commercial banks, their impact has expanded to include both demand deposits and certain deposits included in M2 but excluded from M1, such as MMDA.

Our estimates of the impact of mortgage refinancing on M2 are based Anderson's (1993) using data on MBS activity from the GSEs who issued and guaranteed the MBS.

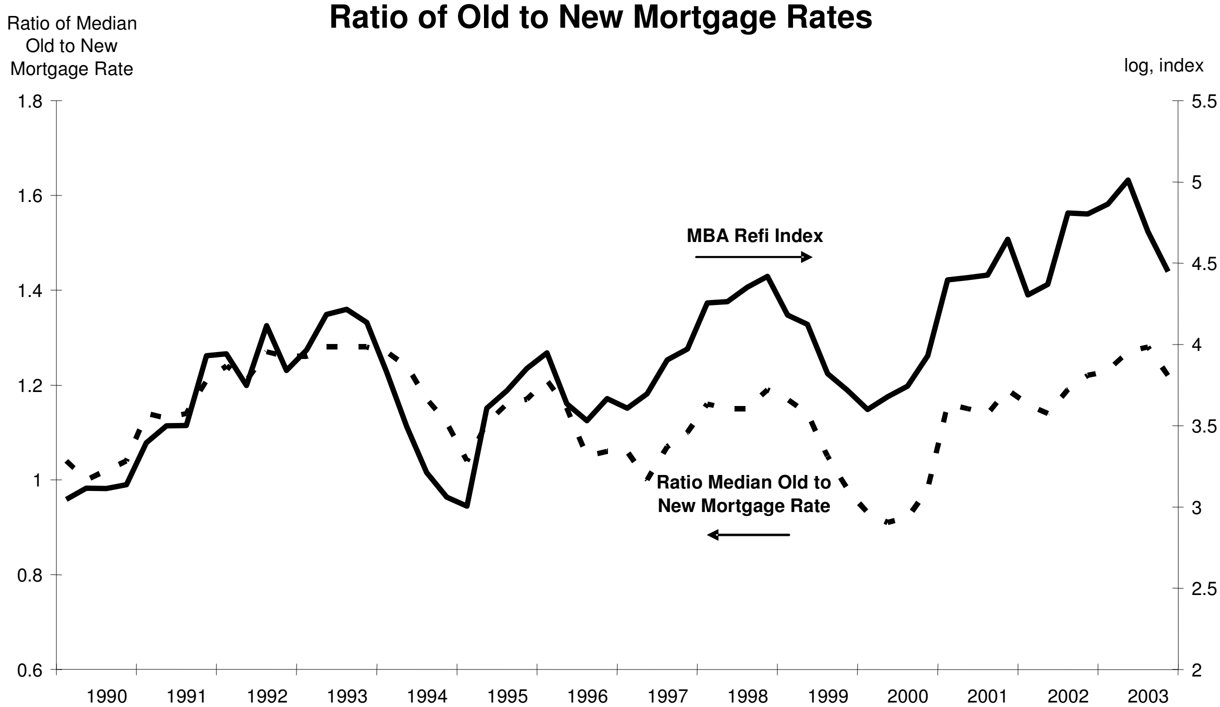
IV. Empirical Specifications and Data

In our empirical work, we follow a sequential strategy to assess the impact on a prototypical money demand equation of adding RHS explanatory variables to capture portfolio substitution into equity mutual funds and fillips in money demand due to mortgage activity. We begin with a "baseline" M2 specification that omits both stock and mortgage effects. Next, we add variables that capture the time-varying (due to falling transaction costs) impact of stock-related portfolio shifts based on Duca's (2005, forthcoming) data. Finally, we add variables to capture the time-varying effects (also, due to falling transaction costs) of mortgage refinancing.

[5] Three government sponsored enterprises (GSEs) are active in the mortgage business. The Federal National Mortgage Association (FNMA) often is referred to as Fannie Mae, the Government National Mortgage Association (GNMA) as Ginnie Mae, and the Federal Home Loan Mortgage Corporation as Freddie Mac.
[6] For Fannie Mae, the effect depends on the "program" under which the mortgages were sold to Fannie. Fannie's programs differ with respect to how long the servicer holds unscheduled principle payments before remitting them to Fannie. Anecdotal reports suggest that the servicer usually retained unscheduled payments before 1992 but since then, an increasing proportion of Fannie's purchases have been made under programs in which unscheduled payments are remitted promptly to Fannie. Viewing such data as proprietary, Fannie refused our request for the data.

This strategy is challenged by interactions among the variables. Technological change has reduced transaction costs, both of making portfolio shifts between M2 and equity funds and of refinancing home mortgages. As these activities have become more sensitive to interest rates differentials, their correlation with other RHS variables (controlling for the opportunity cost of M2) likely has changed. To the extent that the correlation has diminished through time, the degree of specification error committed by omitting mortgage activity (when it should properly be included) likely is higher in more recent periods than in earlier periods, when movements in the M2 opportunity cost variable would have better captured swings in mortgage activity. To address this issue, we also re-estimate both the baseline and equity-adjusted models using two M2 series that are directly adjusted for mortgage refinancing effects based on Anderson (1993).

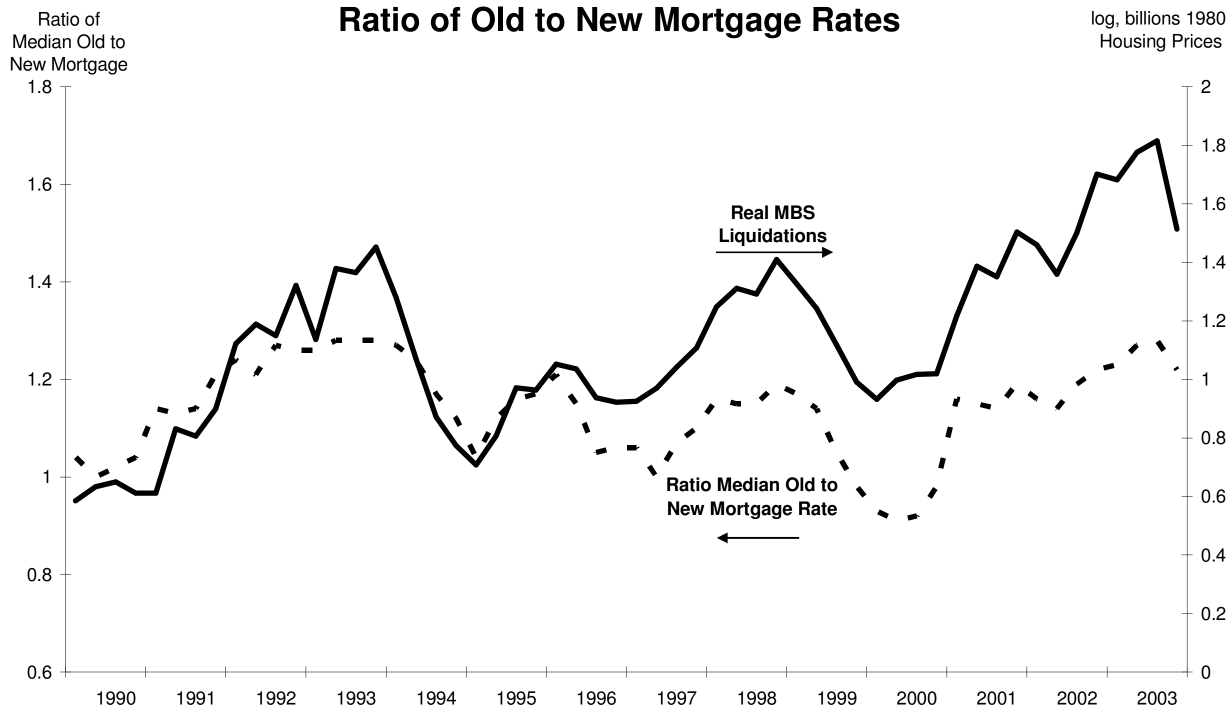
Figure 3: Mortgage Refinancing Applications More Sensitive to Ratio of Old to New Mortgage Rates



Sources: Mortgage Bankers Association, FHMLC, and authors' calculations.

Some readers have questioned our decision to measure mortgage refinancing effects via liquidations of MBS rather than by use of a direct index, such as the Mortgage Bankers Association (MBA) index. We have two reasons. First, including the MBA index as a RHS variable induces multicolinearity with M2 opportunity cost variables. Second, mortgage refinancing activity has become more sensitive to interest rates as fixed costs have fallen (e.g., see Bennett, Peach, and Peristiani, 2001). The volume of mortgage refinancing applications and of prepayments of mortgage-backed securities (MBSs) has become more sensitive, through time, to the ratio of the new and old mortgage rates (see Figures 3 and 4, respectively).

Figure 4: Mortgage-Backed Security Liquidations More Sensitive to Ratio of Old to New Mortgage Rates

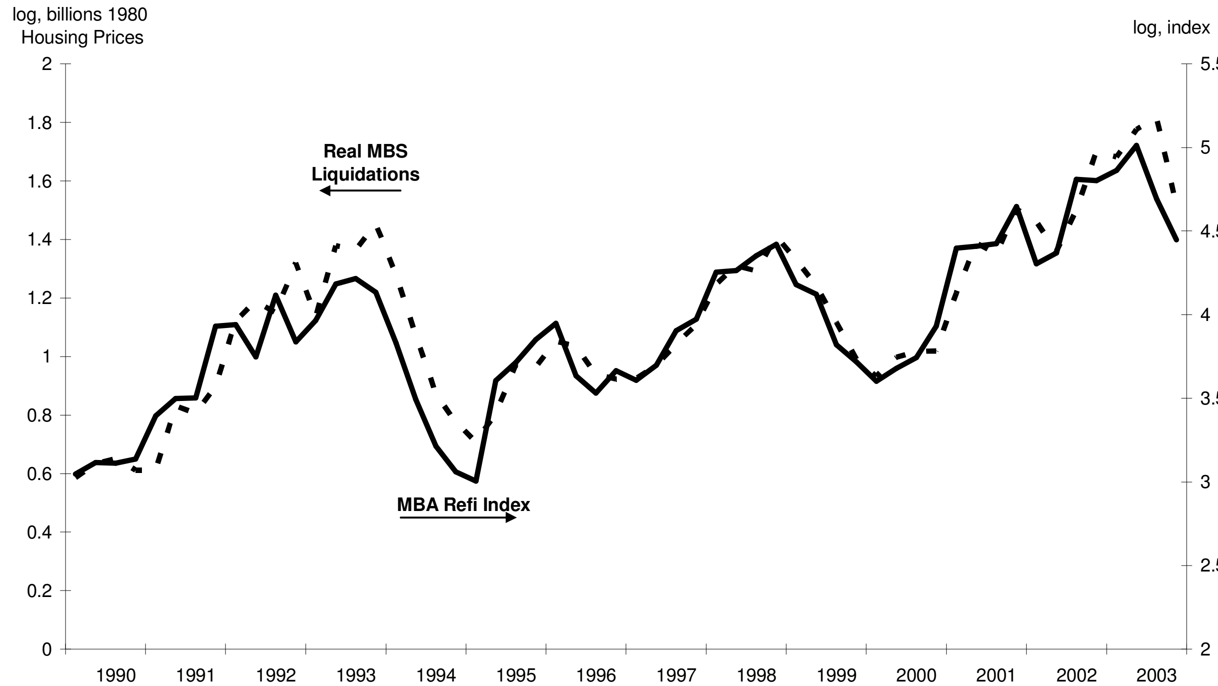


Sources: FNMA, GNMA, FHMLC, Office of Federal Housing Enterprise Oversight, and authors' calculations.

Because the MBA index begins in the early 1990s, it is inadequate to capture this time-varying effect. The MBS data, in contrast, allow us to estimate refinancing effects beginning in the early 1970s. The underlying estimates of MBS prepayment volume appears to be an accurate measure in that it closely tracks the MBA index of refinancing applications during their common sample period (see Figure 5).

A comparison of the estimated models allows us to assess how much of the recent swings in M2 growth are attributable to swings in equity portfolio and mortgage refinancing activity.

Figure 5: MBS Liquidations Move With Mortgage Refinancing Applications



Sources: Mortgage Bankers Association, FNMA, GNMA, FHMLC, Office of Federal Housing Enterprise Oversight, and authors' calculations.

A. Empirical Specifications and Conventional Money Demand Variables

Equity shocks are tested in a specification that builds upon a one-stage error-correction model developed at the Federal Reserve Board (Moore, Porter and Small, 1990) before the missing M2 period of the early 1990s:

$$\Delta\log(M2)_t = \alpha_0 + \alpha_1\log(M2)_{t-1} + \alpha_2\log(GDPAVG)_{t-1} + \alpha_3 TAYLOGZ_{t-1} + \alpha_4 TYME_t$$
$$+ \alpha_5\Delta\log(M2)_{t-1} + \alpha_6\Delta\log(PCE)_t + \alpha_7\Delta\log(PCE)_{t-1} + \alpha_8\Delta\log(PCE)_{t-2}$$
$$+ \alpha_9\Delta TAYLOGZ_t + \alpha_{10}DMMDA_t + \alpha_{11}DCREDCONTROL_t\,, \qquad (1)$$

where the lag of M2 and the two-quarter moving average of nominal GDP (GDPAVG) control for the impact of deviations of M2 from its equilibrium level reflected in GDPAVG), TYME is a time trend, TAYLOGZ is a Taylor-log approximation of the gap between the 3-month Treasury bill rate and the average return on M2, Δlog(PCE) lags control for short-run effects of consumer spending, DMMDA is a dummy for the introduction of MMDA accounts (=1 in 1983:q1) which temporarily boosted M2 growth, and DCREDCONTROL is a dummy (=1 in 1980:q2) for the credit control episode when money and credit temporarily plunged.[7] For consistency with the model's long-run assumptions about velocity, the sum of coefficients on lagged consumption (PCE) growth and minus the coefficient on lagged M2 growth is constrained to equal one. (See Small and Porter (1989) for details about many of these variables.) In the P-star model (Hallman, Porter, and Small, 1991) version of eq. (1), logs of M2 and nominal GDP are replaced with the gap between velocity and its long-run average. This model broke down in the early 1990s when the velocity of M2 jumped and then stayed within a high range through the late 1990s and 2000.[8]

There are at least two approaches to account for the missing M2. One, by Orphanides and Porter (1998) uses an algorithm to track shifts in equilibrium velocity, V2*. Rearranging the equation of exchange, the gap between the logs of actual (m2) and equilibrium M2 (m2*) can be expressed as the gap between the logs of equilibrium (v2*) and actual M2 velocity (v2). Using updated estimates of the statistical equilibrium velocity measure of Orphanides and Porter (2001), denoted as $v2^{*op}$, one can construct the following error-correction term for M2 growth:

$$EC = v2^{*op} - v2. \qquad (2)$$

A specification comparable to (1) replaces the long-run terms with EC from (2):

[7] See Moore, Porter and Small (1990).
[8] Initially, detecting a shift in velocity, even when suspected, was difficult; see Hallman and Anderson (1993). By 1996 or 1997, detecting the 1990-1991 shift was much easier.

$$\Delta\log(M2)_t = \alpha_0 + \alpha_1 EC_{t-1} + \alpha_2 TAYLOGZ_{t-1} + \alpha_3 TYME_t + \alpha_4 \Delta\log(M2)_{t-1}$$
$$+ \alpha_5 \Delta\log(PCE)_t + \alpha_6 \Delta\log(PCE)_{t-1} + \alpha_7 \Delta\log(PCE)_{t-2} + \alpha_8 \Delta TAYLOGZ_t$$
$$+ \alpha_9 DMMDA_t + \alpha_{10} DCREDCONTROL_t . \quad (3)$$

In another approach, Duca (2000) adds bond fund loads to M2 models to control for the velocity shift of the early 1990s, arguing that the cost of transferring between bonds and money fell in the early 1990s and induced households to hold less M2 and more bonds at each income level and gap between yields on Treasury bills and M2 assets. He found that the upward shift in M2's velocity was linked to a decline in the bond fund loads.[9] The general qualitative results regarding stock market shocks and mortgage refinancing effects were similar using the Orphanides-Porter and the Duca approaches. However, to keep the analysis of the results manageable and because model fits and behavior were better using the former approach, we only present results based the Orphanides and Porter specification given in equation (3). In addition, our focus is more on how the interplay between financial innovation and asset market churning affects short-run money balances than on how innovations may alter velocity in the long-run.

B. Stock Market Shock Variables

Stock market shocks are tracked using changes in stock prices and separating negative from positive changes in these variables. Prior studies use stock price changes to assess how equity shocks affect money balances. In the current study, the percent change in the S&P 500 (S&P) is used to track stock price changes, based on quarter-average levels of prices, consistent with the construction of other money variables. The S&P 500 appears more appropriate than the

[9] These empirical findings are consistent with the results of Carlson, et al. (2000) that M2's velocity is more stable excluding small time deposits, which plunged in the early 1990s. These findings provide indirect evidence that is consistent with the view that the falling costs of using bond mutual funds drove up the velocity of M2 in the early 1990s, an interpretation that Carlson, et al. (2002, pages 357 and 359) explicitly mention.

Dow Jones Industrial Average and Wilshire 5000. Relative to the S&P 500, the 30-stock Dow seems too narrow and the Wilshire 5000 appears not as well covered, especially in earlier years.

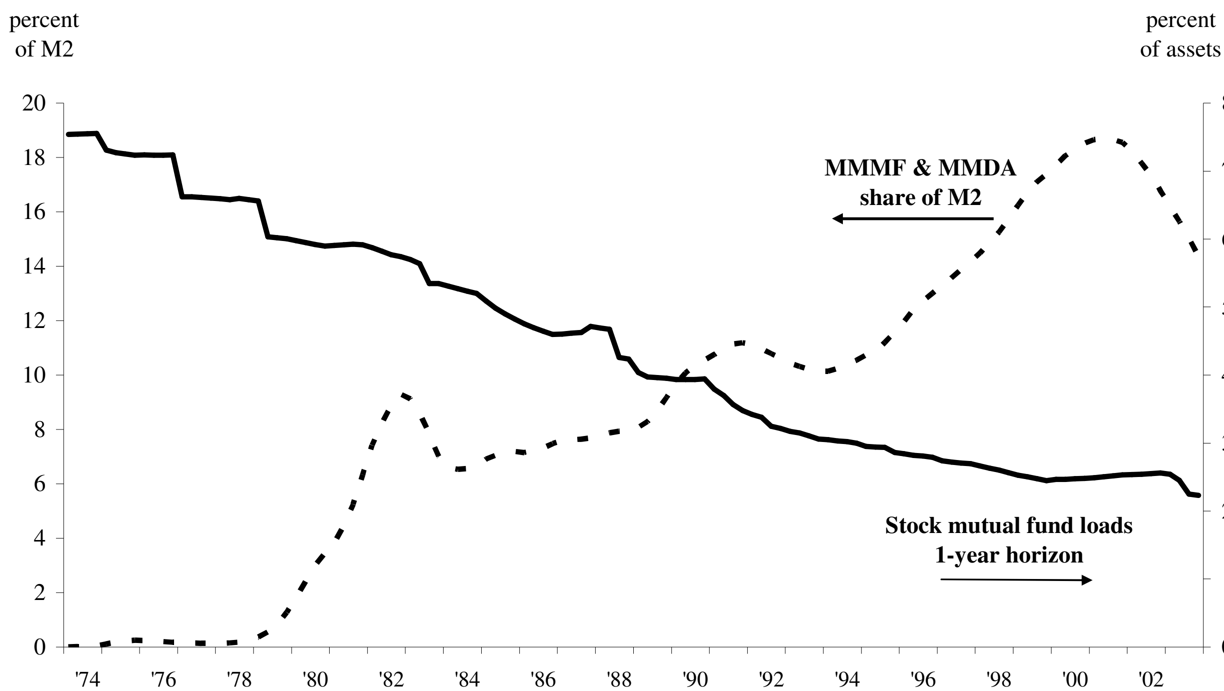
As in Dow and Elmendorf (1998) and Carlson and Schwartz (1999), asymmetric effects of stock market shocks were tested by separating stock price changes into positive (DSPPOS = S&P if >0; 0 otherwise) and negative (DSPNEG = |S&P| if <0; 0 otherwise) changes. Both of these studies found that positive and negative changes boosted M2 growth, where the former result is consistent with a positive wealth effect, while the latter is consistent with a positive flight to quality effect outweighing a negative wealth effect. However, the positive impact of rising stock prices may be an artifact of the end of an upward shift in M2 velocity (which brought the return of moderate M2 growth rates) and the strong bull market of the late-1990s.

In addition to testing these equity market shock variables in money specifications, the sensitivity of money to these shocks is allowed to vary over time according to either asset transfer costs or the relative importance of money market instruments in M2. The former are tracked using the average front-end load on equity mutual funds, as gauged by Duca's (2000, 2005) sample of large equity mutual funds. This series (SLOAD) uses a one-year horizon to blend both front-end and back-end proportional fees (see Appendix for details and Figure 6).

As an alternative to equity fund loads, the relative importance of money funds in M2 is used to track the evolving sensitivity of M2 holdings to stock market shocks. To avoid or limit simultaneity, the interactive terms multiply a particular stock shock variable with the one-quarter lag of the four-quarter moving average share of M2 that is in MMMFs and MMDAs (Figure 6). The latter are included in calculating the share because many banks make it easy for customers to shift from these accounts into stock mutual funds and because MMDAs are highly substitutable with money funds. (MMDAs were created in late 1982 to allow banks to offer a substitute for

MMMFs. MMMF levels declined when MMDAs were introduced.) In principle, equity market disturbances could affect M2 balances outside of money funds, a possibility not at odds with interacting stock market shock variables with stock fund loads. Nevertheless, if asset transfer costs affect the stock market sensitivity of M2, this plausibly entails portfolio shifts involving money fund balances. For this reason, examining the money-fund share interactive terms can serve as a robustness check on models using interactive stock fund load variables.

Figure 6: Stock Fund Loads and the Money Fund/MMDA Share of M2



V. Empirical Results

Given the large number of regressions and the need to make sense of the results, the findings are presented as follows. The first subsection discusses the sets of regressions that were run. Then, patterns related to model performance and to the importance of asset transfer costs are reviewed. Finally, results are reviewed concerning the issues of whether equity shocks are best measured with earnings expectations or stock price changes and whether equity shocks have asymmetric effects on M2.

A. Sets of Regressions

Nine sets of regressions are estimated. In the first, model 1 is the baseline model, and to this baseline model, model 2 adds the symmetric percent change in stock prices (DSP). To test for changes in the sensitivity of money holdings to stock market surprises, model 3 adds DSP and DSP interacted with stock mutual fund loads (DSP*SLOAD) to the baseline model. As an additional robustness check, model 4 instead adds DSP and DSP interacted with the 4-quarter moving average money market mutual fund share of M2 lagged one quarter (DSP*MFSHARE). In models 2-4, equity shocks are allowed to temporarily affect M2 growth, with the instantaneous effect reflected by the coefficient on the equity shock variables and the actual values of the variables. Any impact of an equity shock from quarter t on subsequent quarters depends on how quickly actual M2 balances error-correct toward their equilibrium level and the impact of time t money growth on M2 growth in time t+1. Thus, the specifications used to test for the impact of stock shocks implicitly assume that money balances mainly reflect a transactions demand for money, with only short-run effects from stock market shocks, whose impact on money balances wears off depending on the speed of error correction.

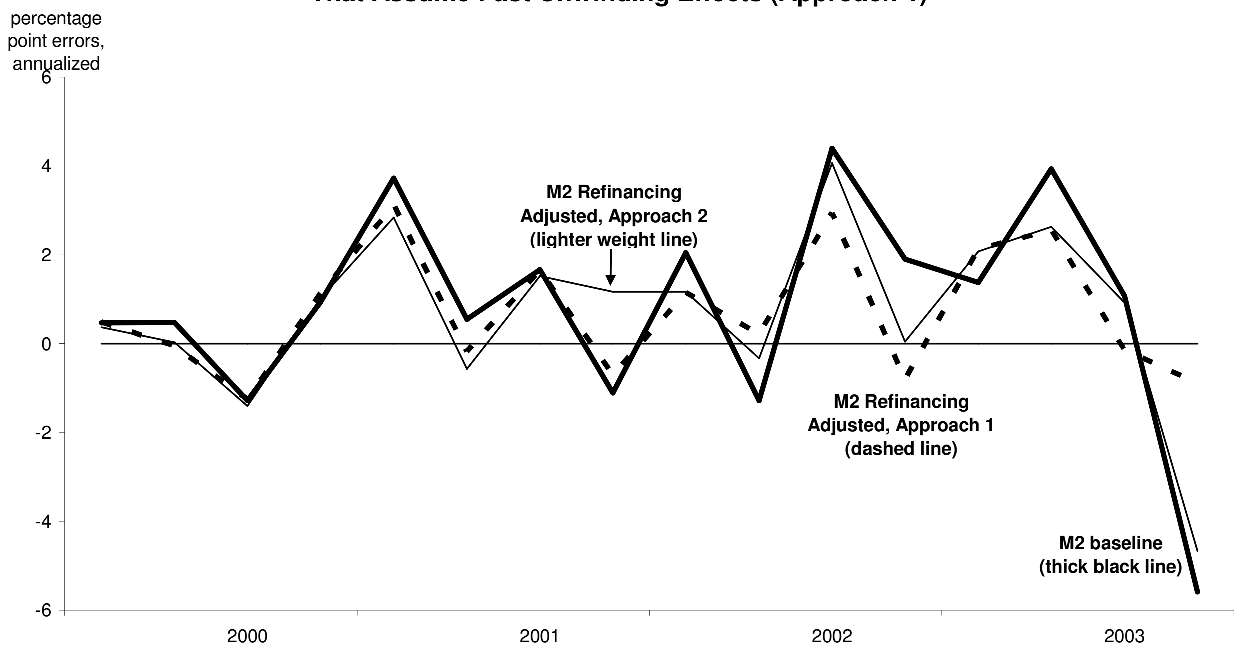
The second set of regressions mirrors the first set, except that negative and positive changes in stock prices (DSPNEG and DSPPOS) replace symmetrically defined price changes in models 2-4, with two correspondingly defined interaction terms (DSPNEGSLD and DSPPOSSLD) replacing the single interaction term in models 3 and 4. The third regression set follows the first except that it replaces the two symmetrically defined price change variables with DSPNEG and DSPNEG*SLOAD. All samples start in 1979:q2. The fourth, fifth, and sixth sets correspond to the first three sets of regressions except that all M2 terms use M2 balances adjusted for mortgage refinancing effects under the first adjustment approach. The seventh, eighth, and ninth sets correspond to the first three sets of regressions except that all M2 terms use M2 balances adjusted for mortgage refinancing effects under the second adjustment approach.

B. General Results: Why We Focus on Negative Changes to Stock Prices

In general, regressions favored including both a non-interactive and a interactive stock price term in the models, with the money fund-interactive share regressions yielding results consistent with those using stock fund loads. Accordingly, Table 1 summarizes results from estimating the baseline model using each of the three M2 series, with or without interactive and non-interactive stock terms. The lower half of the table lists the corrected R^2's from the baseline models in the first column, models with symmetric price change terms in the second column, models including separate negative and positive price change terms in the third column, and models with negative price change terms in the fourth column. Going down the first column in the lower half of the table reveals that fits from baseline specification jump when M2 is adjusted for refinancing effects, with a bigger improvement in fits over the actual M2 model yielded by refinancing adjustments done under approach 1 (0.06) than under approach 2 (0.03). The better performance obtained by using approach 1 is especially evident in Figure 7, which plots annualized residuals over 2000-2003 from estimating each M2 series with the baseline specification. Moving from left to right for each of the rows reveals that model fits jump less using symmetric price change variables (0.01 to 0.02) than for using asymmetric price changes (0.02 to 0.04) over the baseline specification, with little improved fit from having all four price change variables over the two negative stock price change terms.

The middle columns of the upper half of Table 1 reveal that positive price changes are insignificant, with negative terms at least marginally significant and having the anticipated sign. This result contrasts with the V-shaped findings of Carlson and Schwartz (1999) and Dow and Elmendorf (1998) that positive and negative stock price changes boost money growth. In models with only negative price terms (right-most columns), the statistical significance of the stock terms is greater than in corresponding models having symmetric price variables. Accordingly, we focus the rest of our analysis on models with or without negative price variables.

Figure 7: M2 Growth Residuals Lowered More by Refinancing Estimates That Assume Fast Unwinding Effects (Approach 1)



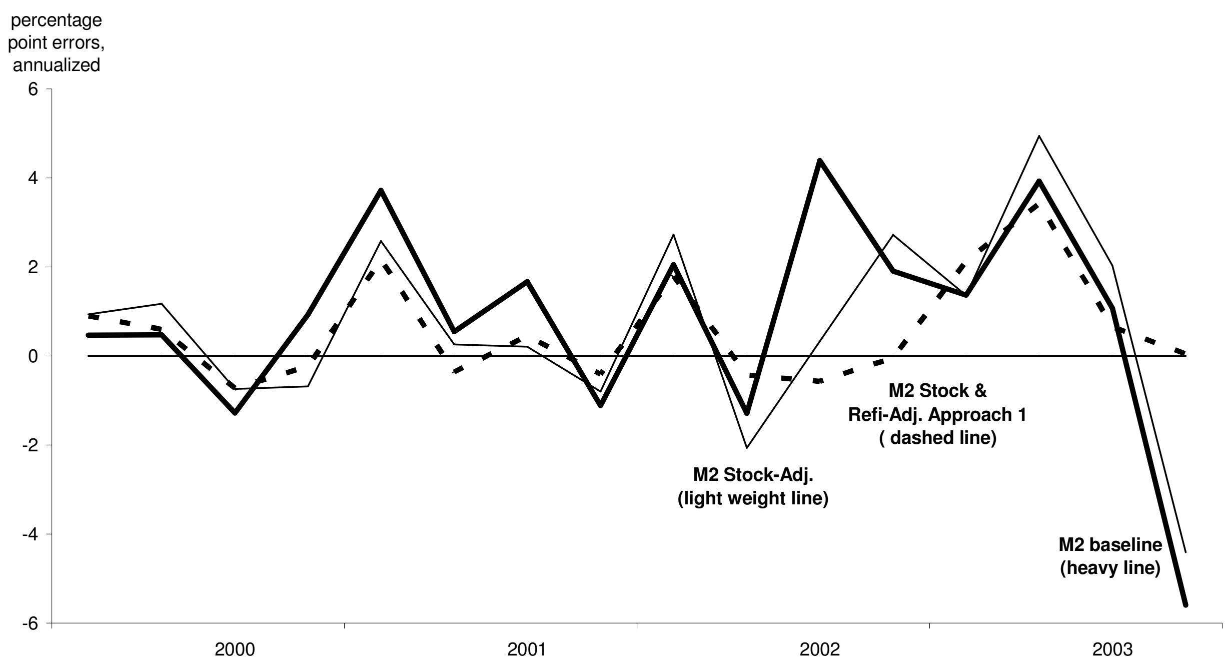
Sources: Federal Reserve and authors' calculations. Approach 1 assumes that refinancing effects unwind as fast as they accumulate, while Approach 2 assumes that refinancings boost M2 balances quickly, which then unwind according to the overall speed of error-correction for all balances.

C. General Results Without Controlling for Mortgage Refinancing Effects

Tables 2-4 which presents regressions including negative stock price terms of M2, M2 adjusted for refinancing under approach 1, and M2 adjusted for refinancing under approach 2, respectively. Several patterns emerge across the tables. First, in models using only non-interactive stock effects (model 2 in each case), negative equity shocks are statistically significant. Second, these non-interactive equity shocks become more statistically significant when the corresponding load-interactive variables are included (models 3 in each case). Third, load-interactive stock variables are at least marginally significant with the expected positive sign (model 3), implying equity price changes (Tables 2-4) have a smaller effect if asset transfer costs are higher. Fourth, the non-interactive and interactive negative stock price variables are jointly significant in every model according to F-test statistics. Fifth, in models including a variable inter-acting negative stock price changes with the money fund share of M2 (model 4), the non-interactive term is statistically insignificant, while the interactive term is significant and negative. The latter sign is as expected because a larger mutual fund share is associated with positive stock market developments having larger sized, negative substitution effects on money demand. This combination of signs implies that symmetric or negative stock market shocks have larger sized effects when the mutual fund share of M2, a proxy for the stock market sensitivity of M2, is higher. Sixth, although the positive sign on the non-interactive stock variables in model 4 of Tables 2-4 seems counterintuitive, the size of the negative coefficient on the interactive term is so large that the overall effect of medium- to large-sized equity market shocks is negative. The money fund approach yields (model 4) only slightly higher fits and t-statistics on stock shock variables than does the load approach (model 3), but this result might reflect simultaneity and does not provide an underlying economic rationale, in contrast to the load-interactive terms.

Seventh, model fits are highest when non-interactive and interactive DSPNEG variables are included using M2 adjusted for refinancings under approach 1 (see models 2 and 3 in Table 3). Also, model properties are notably better if non-interactive and interactive DSPNEG terms are included. Corrected R^2's are higher by roughly 0.02 and the EC coefficients gain significance and are larger in magnitude when interactive and non-interactive equity shock variables are included (models 3 and 4 in Tables 2-4).[10] Many of these patterns regarding the load-interactive terms are evident from comparing the baseline model (model 1) in Table 5 with models of each of the three M2 series that include non-interactive and load-interactive symmetric price changes (models 2-4). Nevertheless, model fits are higher using negative price changes. Comparing the heavy and light weight solid lines in Figure 8 reveals that model residuals are reduced from mid-2000 through 2001 by adding the negative stock price terms to the model of unadjusted M2. In this figure, the dashed line shows residuals from using refinancing-adjusted M2 (approach 1) in a model including both negative stock price change variables (the far-right model using refinancing-adjusted M2 under approach 1 in the upper-panel of Table 1). Comparing the

Figure 8: M2 Growth Residuals Lowered by Estimated Stock Portfolio Shifts From Mid-2000 to Late 2001 and by Refinancing Effects Since Mid-2002



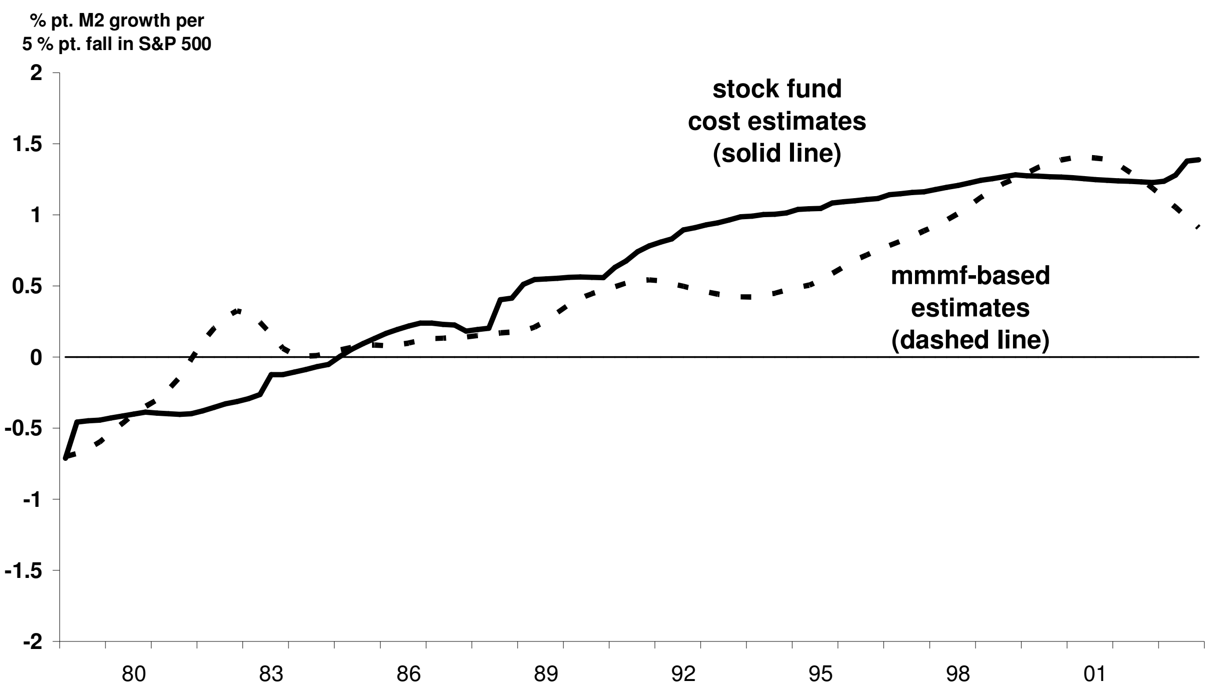
Sources: Federal Reserve and authors'

[10] A similar result arises in the bond fund load specifications (not shown), in that the t-statistics of coefficients on the

dashed and heavy-weight solid lines reveals that accounting for refinancing effects enhances model performance since mid-2002, a period when swings in mortgage refinancing activity were the most pronounced.

One possible reason why model performance is enhanced by including DSPNEG and DSPNEG*SLOAD is that short-run stock market effects on M2 have become large enough to create omitted variable bias. To assess this possibility, Figure 9 combines coefficient estimates from models 3 and 4 of Table 3 with actual equity loads to construct estimates of how much a 5 percentage point drop in the S&P 500 affects M2 growth. Reflecting the negative estimated coefficient on stock price changes interacted with stock fund loads (DPS*SLOAD) and declines in equity fund loads, the overall, estimated impact on M2 growth of a 5 point drop in stock prices

Figure 9: Effect of Negative Stock Price Changes on M2 Growth Using Stock Loads or the MMMF Share of M2 (refinancing-adjusted, approach 1, 79:4-03:4)

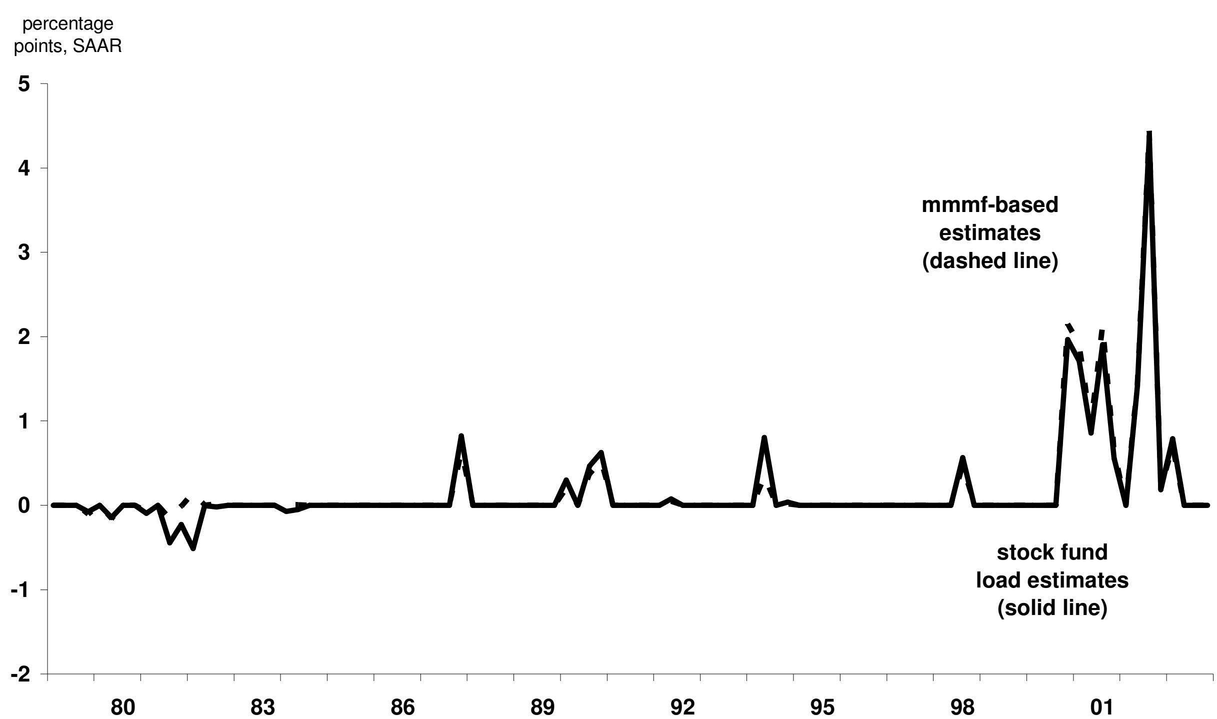


logs of velocity and bond fund loads were higher in models 3 and 4 than in models 1 and 2.

has become increasingly larger over time. The pattern of effects plotted in Figure 9 is consistent with the view that the negative substitution effects of equity shocks on M2 have grown relative to any positive wealth or scale effects. Wealth effects may have been somewhat more important than the negative substitution effects early in the sample, when the estimated net effect of a decline in stock prices on M2 was negative and when the average stock fund load was nearly three times as large as in recent years.

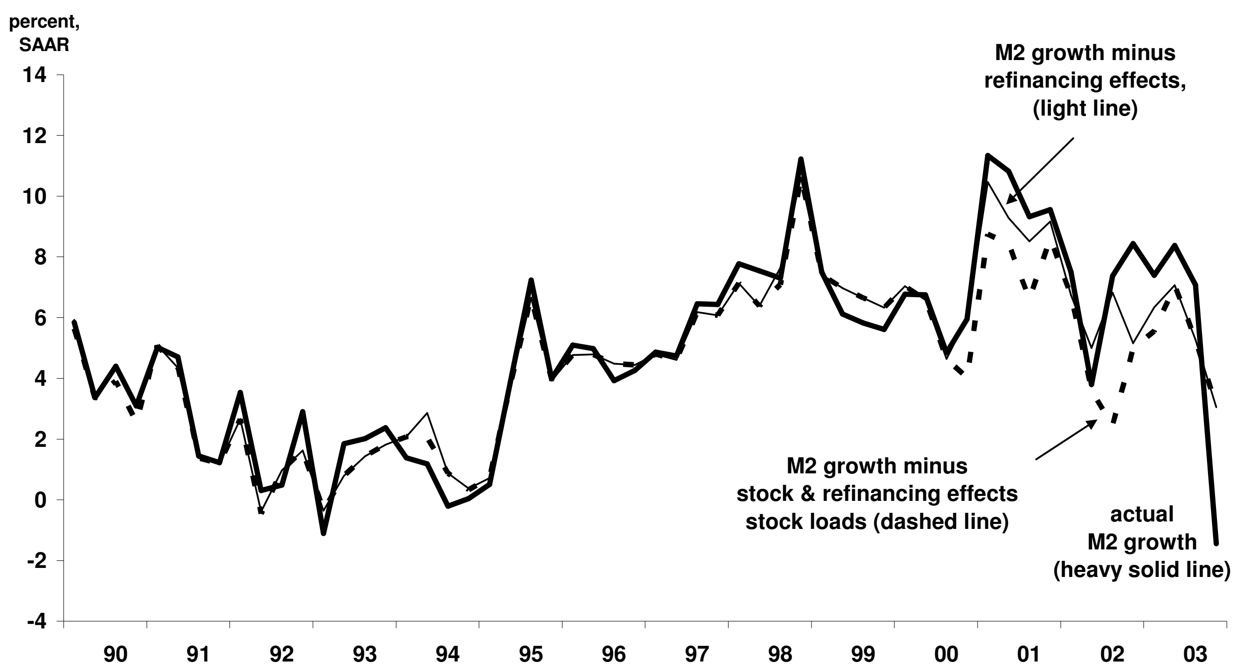
Based on these estimated evolving sensitivities and actual stock price changes, Figure 10 plots the estimated impact of stock price changes on annualized growth rates of M2 adjusted for refinancing effects under approach 1. As Figure 10 shows, stock price declines boosted refinancing-adjusted M2 growth rates by as much as 2 to 4 percentage points in much of 2001 and 2002. These effects are sizable enough to substantially affect recent refinancing-adjusted

Figure 10: Estimated Stock Price Change Effects on M2 Growth Rates (asymmetric price changes, refinancing-adjusted M2 under approach 1, 79:4-03:4)



M2 growth, as shown in Figure 11, which plots M2 growth with M2 growth adjusted for stock surprise effects using the load sensitivity specification containing negative stock price changes. This figure implies that many of the recent swings in M2 growth stem from refinancing effects and, to a lesser extent, from stock portfolio shifts. This finding is reflected in comparisons of the sums of squared errors from competing models over 2000:q1-2003:q4. The SSE from the baseline model of M2 ($6.22855*10^{-4}$, model 1, Table 2) falls by 61 percent when M2 is replaced with M2 adjusted for refinancing effects under approach 1 ($2.41796*10^{-4}$, model 1, Table 3) and by only an additional 12 percent ($1.707118*10^{-4}$, model 3, Table 3) when also including non-interactive and load-interactive negative stock price variables.

Figure 11: M2 Growth Adjusted for Stock Portfolio & Mortgage Refinancing Effects



VI. Conclusion

The impact of stock market shocks on monetary aggregates has been hard to analyze, partly because of difficulty in measuring what is a stock market shock and partly because of financial innovations that have affected the sensitivity of household money holdings to equity market shocks. This study attempts to address both of these difficulties and finds that support for the hypothesis that M2's sensitivity to stock market disturbances depends on accounting for asset transfer costs, which have fallen according to data on stock mutual fund loads. In addition, we find evidence that swings in mortgage refinancing activity have also had large effects on M2 that have more recently been larger than estimated stock portfolio effects.

With respect to whether equity shocks have asymmetric effects on money balances, findings indicate that negative changes in stock prices have larger sized effects on M2 than do positive price changes. Earlier, Dow and Elmendorf (1998) and Carlson and Schwartz (1999) found that both positive and negative stock price changes boost MMMF and M2 growth, respectively. Their findings could possibly reflect a positive wealth effect in the former case and a positive flight-to-quality effect that outweighs a negative wealth effect in the latter case. However, in the samples and specifications tested, these V-shaped results were not obtained. Furthermore, regardless of whether the sensitivity of M2 to equity shocks is allowed to depend on stock fund loads or the relative importance of money market mutual funds, positive stock price changes were always insignificant.

Results indicate that large declines in stock prices were associated with sizable inflows into M2, with annualized M2 growth being boosted by as much as 2 to 4 percentage points in some quarters of 2002. These findings, coupled with the large declines in mutual fund loads, imply that this broad monetary aggregate has become increasingly sensitive to portfolio substitution effects associated with financial market turbulence and that such substitution effects have become relatively more important than oppositely signed wealth or scale effects. Furthermore, results are consistent with the view that large declines in asset transfer costs can have important implications for household portfolio behavior.

But falling asset transfer costs alone cannot account for all of the recent swings in M2 growth. Record levels of refinancing activity (partly reflective of lower fixed costs and mortgage rate differential) and the surge in money balances that they can temporarily generate have been large enough to distort overall patterns of broad money growth—and to a greater extent than stock portfolio shifts in recent years with effects ranging from lowering annualize M2 growth by as much as 5 percentage points to boosting it by as much as 3 percentage points in some quarters. Together, greater refinancing and equity substitution effects can account for the large recent misses of traditional money demand models. In this sense, improved microeconomic financial efficiency in the form of lower mutual fund costs and mortgage refinancing costs is being manifested at the macro level in the form of money demand shocks. These effects are so sizable, that accounting for financial innovations is necessary if any useful information is to be gleaned from analyzing broad money growth.

While we have not as yet analyzed MZM, these conclusions are likely to hold for that aggregate as well, especially given that refinancing and stock portfolio activity are primarily affecting components of M2 that have zero maturity; namely money market mutual funds, MMDA's, and demand deposits. In future work, we also plan to analyze the impact of mortgage equity withdrawals on broad money balances because households may conceivably park proceeds in liquid accounts before using them for purchases of other goods or assets.

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Appendix A: Mutual Fund Data

Because data before the mid-1980s are sketchy and incomplete, mutual fund cots were based on a sample of large mutual funds. Funds were selected if their assets were at least $1 billion at year-end 1991 if the fund existed before the mid-1980s; were at least $2 billion at year-end 1994 if the fund's inception date occurred after 1983; were at least $5 billion at year-end 2003; or were at least $250 million at year-end 1975. The first criterion reflects whether a fund was sizable during early missing M2 period of the early 1990s. The second criterion reflects whether a growing but new fund was large near the end of the missing M2 period. The third criterion reflects whether a fund remained large following the stock market bust of the early 2000s. Given the stock and bond appreciation of the early 1990s, the hurdles for newer funds were higher for the 1994 and 2003 cutoff dates to keep data gathering costs from exploding. The fourth criterion avoids excluding funds that were relatively large in 1975 from distorting averages when fewer funds existed. Also excluded were funds that were closed-end, only open to employees of a specific firm, or institutional. One member, the Windsor Fund, became closed-end but was included because its open-end cousin (Windsor II) was started when it became closed-end, and both funds are large. 133 equity funds are in the sample (a list is available from the author) using data from the funds and various issues of Morningstar, IBC/Donoghue, and CDA/Wiesenberger (a, b).

Because only year-end asset data for many equity funds are available, quarterly asset weights are interpolated from a year-end data and quarterly inception dates of the funds. Using annual data for benchmark weights is common and is used in at least one of the conventional money variables (TAYLOGZ). Given the lack of large year-to-year changes in asset weights and the more important impact of load cuts in year-end to year-end changes in weighted-average loads, the series track quarterly load changes well. As discussed in Duca (2005, forthcoming), if expense ratios are added to SLOAD and if SLOAD were redefined using a 5-year horizon, the resulting overall mutual fund cost variable would behave very similarly with the annual, industry-side, overall equity fund cost estimates of Rea and Reid (1998, 1999).

Table 1: Estimates of Stock Market Surprise Effects on M2 Growth

Regressions Using Interactive and Non-Interactive Stock Market Variable (pairs of variables from separate regressions)

Stock Coefficients and T-Statistics

	Symmetric		Asymmetric Positive and Negative Shocks				Asymmetric Negative Shocks	
M2 Measure	***DSP***	***DSPSLD***	***DSPNEG***	***DSPNEGSLD***	***DSPPOS***	***DSPPOSSLD***	***DSPNEG***	***DSPNEGSLD***
M2	-0.0622* (-1.99)	0.0133+ (1.78)	-0.1480* (-2.39)	0.0284+ (1.86)	0.0169 (0.33)	-0.0007 (-0.07)	-0.1429* (-2.50)	0.0283+ (1.98)
M2 Refi-Adj. 1	-0.0544+ (-1.95)	0.0120+ (1.80)	-0.1272* (-2.33)	0.0238+ (1.77)	0.0151 (0.34)	0.0001 (0.01)	-0.1234** (-2.43)	0.0242+ (1.92)
M2 Refi-Adj. 2	-0.0647* (-2.26)	0.0138* (2.00)	-0.1454* (-2.55)	0.0278+ (1.98)	0.0093 (0.20)	0.0007 (0.07)	-0.1431** (-2.72)	0.0283* (2.16)

Corrected R^2

	Baseline (no shocks)	Symmetric	Asymmetric Positive and Negative Shocks	Asymmetric Negative Shocks
M2	0.6286	0.6371	0.6488	0.6533
M2 Refi-Adj. 1	0.6826	0.6892	0.7013	0.7030
M2 Refi-Adj. 2	0.6670	0.6790	0.6906	0.6946

Table 2: S&P 500 Price Effects in Velocity Shift Error-Correction Models of M2 Growth

Variable	Model 1	Model 2	Model 3	Model 4
constant	-0.0128**	-0.0131**	-0.0105*	-0.0103*
	(-2.75)	(-2.87)	(-2.24)	(-2.23)
EC_{t-1}	-0.0674*	-0.0800**	-0.0935**	-0.0941**
	(-2.35)	(-2.77)	(-3.21)	(-3.25)
$\log(OC)_{t-1}$	-0.0014	-0.0020	-0.0025	-0.0026
	(-0.88)	(-1.20)	(-1.54)	(-1.61)
$TYME_t$	0.0001**	0.0001**	0.0001*	0.0001*
	(2.82)	(2.96)	(2.49)	(2.49)
$\Delta\log(M2)_{t-1}$	0.6023**	0.6070**	0.6191**	0.6073**
	(8.15)	(8.35)	(8.63)	(8.54)
$\Delta\log(PCE)_t$	0.2707**	0.3025**	0.2865**	0.2875**
	(2.86)	(3.22)	(3.08)	(3.11)
$\Delta\log(PCE)_{t-1}$	0.0604	0.0485	0.0314	0.0424
	(0.69)	(0.56)	(0.37)	(0.50)
$\Delta\log(PCE)_{t-2}$	0.0666	0.0420	0.0630	0.0628
	(0.82)	(0.52)	(0.79)	(0.79)
$\Delta\log(OC)_t$	-0.0124**	-0.0121**	-0.0117**	-0.0118**
	(-4.60)	(-4.53)	(-4.47)	(-4.52)
$DMMDA_t$	0.0360**	0.0364**	0.0357**	0.0357**
	(6.74)	(6.94)	(6.91)	(6.94)
$DCREDCONTROL_t$	-0.0093*	-0.0086+	-0.0078+	-0.0079+
	(-2.11)	(-1.98)	(-1.82)	(-1.84)
$DSPNEG_t$		-0.0340*	-0.1429*	0.0458
		(-2.06)	(-2.50)	(1.15)
$DSPNEG*SLOAD_t$			0.0283+	
			(1.98)	
$DSPNEG*MFSHARE_t$				-0.6786*
				(-2.19)
R^2	.628	.642	.653	.656
L.M.(1)	0.238	2.152	1.540	1.580
Q(24)	15.18	14.18	15.67	15.46
F-Test 2 DSP terms			4.17*	4.61*

Sample: 79:2-2003:4. t-statistics in parentheses. **(*,+) significant at the 99% (95%, 90%) level.

Table 3: S&P 500 Price Effects in Velocity Shift Error-Correction Models of M2 Growth Adjusted for Mortgage Refinancing Effects Under Approach 1

Variable	Model 1	Model 2	Model 3	Model 4
constant	-0.0113**	-0.0116**	-0.0093*	-0.0092*
	(-2.80)	(-2.92)	(-2.28)	(-2.27)
EC_{t-1}	-0.0610*	-0.0731**	-0.0867**	-0.0871**
	(-2.30)	(-2.74)	(-3.18)	(-3.22)
$\log(OC)_{t-1}$	-0.0013	-0.0017	-0.0022	-0.0023
	(-0.87)	(-1.20)	(-1.56)	(-1.62)
$TYME_t$	0.0001**	0.0001**	0.0001*	0.0001*
	(2.85)	(2.98)	(2.48)	(2.48)
$\Delta\log(M2)_{t-1}$	0.6080**	0.6084**	0.6178**	0.6077**
	(8.94)	(9.11)	(9.37)	(9.27)
$\Delta\log(PCE)_t$	0.2107*	0.2412**	0.2287**	0.2298**
	(2.52)	(2.89)	(2.77)	(2.80)
$\Delta\log(PCE)_{t-1}$	0.1113	0.1022	0.0883	0.0975
	(1.46)	(1.36)	(1.19)	(1.32)
$\Delta\log(PCE)_{t-2}$	0.0700	0.0482	0.0653	0.0651
	(0.98)	(0.68)	(0.92)	(0.93)
$\Delta\log(OC)_t$	-0.0114**	-0.0112**	-0.0110**	-0.0110**
	(-4.84)	(-4.80)	(-4.78)	(-4.81)
$DMMDA_t$	0.0351**	0.0355**	0.0349**	0.0349**
	(7.49)	(7.70)	(7.69)	(7.71)
$DCREDCONTROL_t$	-0.0109*	-0.0103**	-0.0096*	-0.0097*
	(-2.83)	(-2.71)	(-2.56)	(-2.58)
$DSPNEG_t$		-0.0301*	-0.1234*	0.0371
		(-2.08)	(-2.43)	(1.06)
$DSPNEG*SLOAD_t$			0.0242^{+}	
			(1.92)	
$DSPNEG*MFSHARE_t$				-0.5746*
				(-2.08)
R^2	.683	.694	.703	.705
L.M.(1)	1.639	1.128	0.679	0.613
Q(24)	19.61	18.50	20.28	19.96
F-Test 2 DSP terms			4.05*	4.42*

Sample: 79:2-2003:4. t-statistics in parentheses. **(*,$^{+}$) significant at the 99% (95%, 90%) level.

Table 4: S&P 500 Price Effects in Velocity Shift Error-Correction Models of M2 Growth Adjusted for Mortgage Refinancing Effects Under Approach 2

Variable	Model 1	Model 2	Model 3	Model 4
constant	-0.0116**	-0.0118**	-0.0091*	-0.0090*
	(-2.73)	(-2.85)	(-2.13)	(-2.14)
EC_{t-1}	-0.0527*	-0.0646*	-0.0775**	-0.0777*
	(-2.07)	(-2.54)	(-3.02)	(-3.05)
$\log(OC)_{t-1}$	-0.0008	-0.0013	-0.0019	-0.0019
	(-0.56)	(-0.90)	(-1.27)	(-1.33)
$TYME_t$	0.0001**	0.0001**	0.0001*	0.0001*
	(2.72)	(2.84)	(2.25)	(2.27)
$\Delta\log(M2)_{t-1}$	0.6161**	0.6171**	0.6288**	0.6173**
	(8.74)	(8.96)	(9.28)	(9.17)
$\Delta\log(PCE)_t$	0.2445**	0.2787**	0.2630**	0.2644**
	(2.79)	(3.20)	(3.07)	(3.10)
$\Delta\log(PCE)_{t-1}$	0.0707	0.0601	0.0434	0.0543
	(0.88)	(0.76)	(0.56)	(0.70)
$\Delta\log(PCE)_{t-2}$	0.0687	0.0440	0.0648	0.0641
	(0.91)	(0.59)	(0.88)	(0.87)
$\Delta\log(OC)_t$	-0.0125**	-0.0121**	-0.0118**	-0.0119**
	(-5.01)	(-4.98)	(-4.95)	(-4.99)
$DMMDA_t$	0.0357**	0.0362**	0.0355**	0.0355**
	(7.23)	(7.48)	(7.48)	(7.51)
$DCREDCONTROL_t$	-0.0104*	-0.0097*	-0.0090*	-0.0090*
	(-2.55)	(-2.43)	(-2.28)	(-2.30)
$DSPNEG_t$		-0.0345*	-0.1431**	0.0424
		(-2.28)	(-2.73)	(1.16)
$DSPNEG*SLOAD_t$			0.0283*	
			(2.16)	
$DSPNEG*MFSHARE_t$				-0.6552*
				(-2.29)
R^2	.667	.682	.695	.697
L.M.(1)	1.920	1.457	0.818	0.758
Q(24)	15.36	14.63	15.98	15.70
F-Test 2 DSP terms			5.02**	5.35**

Sample: 79:2-2003:4. t-statistics in parentheses. $^{**}(^{*},^{+})$ significant at the 99% (95%, 90%) level.

Table 5: Symmetric S&P Price Effects in Velocity Shift Error-Correction Models of M2 Growth

Variable	M2	M2	Refi 1 Adj M2	Refi 2 Adj M2
constant	-0.0128**	-0.0158**	-0.0140**	-0.0145**
	(-2.75)	(-3.19)	(-3.24)	(-3.23)
EC_{t-1}	-0.0674*	-0.0890**	-0.0817**	-0.0732**
	(-2.35)	(-2.93)	(-2.87)	(-2.75)
$\log(OC)_{t-1}$	-0.0014	-0.0022	-0.0019	-0.0015
	(-0.88)	(-1.30)	(-1.30)	(-1.02)
$TYME_t$	0.0001**	0.0001**	0.0001**	0.0001**
	(2.82)	(3.38)	(3.40)	(3.38)
$\Delta\log(M2)_{t-1}$	0.6023**	0.6113**	0.6125**	0.6212**
	(8.15)	(8.31)	(9.06)	(8.94)
$\Delta\log(PCE)_t$	0.2707**	0.2692**	0.2085*	0.2460**
	(2.86)	(2.82)	(2.46)	(2.79)
$\Delta\log(PCE)_{t-1}$	0.0604	0.0364	0.0932	0.0469
	(0.69)	(0.41)	(1.21)	(0.58)
$\Delta\log(PCE)_{t-2}$	0.0666	0.0831	0.0858	0.0859
	(0.82)	(1.01)	(1.18)	(1.13)
$\Delta\log(OC)_t$	-0.0124**	-0.0118**	-0.0110**	-0.0119**
	(-4.60)	(-4.38)	(-4.67)	(-4.82)
$DMMDA_t$	0.0360**	0.0350**	0.0342**	0.0348**
	(6.74)	(6.52)	(7.24)	(7.04)
$DCREDCONTROL_t$	-0.0093*	-0.0072	-0.0091*	-0.0083*
	(-2.11)	(-1.59)	(-2.28)	(-2.00)
DSP_t		-0.0622*	-0.0544+	0.0647*
		(-1.99)	(-1.95)	(2.26)
$DSP*SLOAD_t$		0.0133+	0.0120+	0.0138
		(1.78)	(1.80)	(1.54)
R^2	.629	.637	.689	.679
L.M.(1)	2.384	1.972	1.289	1.550
Q(24)	15.18	16.03	20.85	16.51
F-Test 2 DSP terms		2.04	1.93	2.66+

Sample: 79:2-2003:4. t-statistics in parentheses. **(*,+) significant at the 99% (95%, 90%) level.