US Narrow Money for the Twenty-First Century

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Abstract

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This study focuses on sweep programs in establishing conceptually appropriate and reliable measures of narrow money. We propose the aggregates $M1RS = M1 +$ holdings of funds swept in retail sweep programs, and $M1S = M1RS +$ holdings of funds swept in commercial demand deposit sweep programs. Based upon quarterly observations from 1959:1-2002:4, cointegration tests indicate the existence of long-run relationships between the velocity of $M1S$ and the corresponding opportunity cost of holding money, using either short-term or long-term interest rates. Tests find weaker evidence for $M1RS$, and little support for $MZM$.

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I. INTRODUCTION

Though money retains its fundamental role in a market economy, money measures have been noticeably de-emphasized within the conduct of US monetary policy. The FOMC stopped reporting annual growth objectives for monetary aggregates in 2000 (“Monetary Policy Report to the Congress,” *Federal Reserve Bulletin*, August 2000), although it states that the Fed believes that the money supply has value for gauging economic conditions.

However, a growing body of research calls for returning monetary aggregates to a more prominent role within monetary policy. Meltzer (1998) asserts that the view of persistent money growth as being the source of inflation is again widely accepted, perhaps more firmly held by some central bank governors now than at any time in the twentieth century. Nelson (2002) provides evidence that base money has a significant effect on output relative to potential in the US and UK, even after controlling for the short-term real interest rate. Nelson (2003) argues that money growth governs the mean and dynamics of inflation in present-day New Keynesian models. Leeper and Roush (2003) find evidence of an essential role for M2 within the transmission of monetary policy, even after controlling for the nominal interest rate.1

This paper focuses on the role of sweep programs in properly measuring narrow money. In a sweep program, banks move a portion of funds from customer demand deposits (DD) or other checkable deposits (OCD) into instruments with zero statutory reserve requirements. We examine the effects of two types of sweep programs in the US: retail sweep programs and commercial demand deposit sweep programs.

Narrow, transactions-based money historically has played a key role in the conduct of monetary policy. As Hafer and Wheelock (2001) explain, M1 served as the measure of money within the St. Louis model, although monetarists had long been divided over whether a narrow or
broad aggregate was the preferable target for monetary policy. The FOMC appeared to focus on M1 during the 1970s and early 1980s, publishing their target ranges for money growth in terms of M1. Hafer and Wheelock (2001), though, state that deviations in M1 velocity from its upward trend beginning in the early 1980s caused instability within the St. Louis model. Hoffman and Rache (1991) and Hoffman, Rasche, and Tieslau (1995) place dummy variables in their vector error correction mechanisms to capture observed shifts in M1 velocity.

What attention remains on the money supply seems to be focused on broad rather than narrow aggregates. But the broad aggregates have not escaped difficulties. Duca (2000) and Hafer and Wheelock (2001) document a deviation of M2 velocity from its long-run trend in the early 1990s, sometimes characterized as the “missing M2” episode. Duca and VanHoose (2004) state that one response was to replace M2 with MZM, consistent with the view that heightened substitution between small time deposits and mutual funds other than money market mutual funds (MMMF) largely accounted for the instability in M2 velocity. But as they go on to discuss, M2 and MZM velocity encountered problems in the early 2000s, plunging in ways not in line with opportunity cost variables. Duca and VanHoose (2004) state that broader aggregates may have become more vulnerable to portfolio substitution involving stock and mutual funds other than MMMF.

Narrow money has also been used extensively in examining money demand. A sizable body of research has emerged which empirically investigates the demand for M1, especially using cointegration techniques. Hoffman and Rasche (1991), Hoffman, Rasche, and Tieslau (1995), Dutkowsky and Atesoglu (2001), and Ball (2001) provide evidence of a stable long-run money demand equation using M1. Ball (2002) generates further support with M1, and
estabhishes a correspondence between the partial adjustment formulation and the vector error
correction model.

Yet research and policymaking using narrow money is currently being hampered by the
lack of an accurate measure of transactions-based money. Lucas (2000) finds that the
conventional M1 demand function breaks down in the 1990s, concluding that M1 has become
too narrow an aggregate for this period and beyond. Anderson (1997) argues that M1 has
become substantially distorted due to the emergence and growth of retail sweep programs.
Explicitly recognizing the impact of retail sweep programs on the demand for M1, Ball (2002)
ends his sample period in 1993.

Under retail sweep programs, banks move funds into money market deposit accounts
(MMDA), as part of savings accounts (Anderson 1997). Customers have unrestricted checking
privileges on both swept and unswept funds. VanHoose and Humphrey (2001) examine the
effect of retail sweeping on bank behavior and Federal Funds rate volatility. Dutkowsky and
Cynamon (2003) find that retail sweeps help explain systematic overprediction in post-sample
simulations of M1 demand. Under commercial DD sweep programs, as explained in Treasury
Strategies (2003), banks establish interest-bearing investment accounts that are linked to their
customers DD accounts. Then they sweep funds to or from the linked investment account as
needed, without customer intervention.

The amounts of funds in both types of sweep programs have become substantial. Based
upon data described in Anderson (1997), retail sweeps rose from $9.6 billion in October 1994 to
DD sweep programs grew from $15 billion in October 1991 to $323 billion in October 2002.
Reported OCD for October 1991 and October 2002 equal $324 billion and $274 billion, while
levels of reported DD for the same periods equal $283 billion and $300 billion. Since 2000, the data indicate that the amount of swept funds has exceeded the amount of reported DD plus OCD.

As discussed in Anderson (1997) and Dutkowsky and Cynamon (2003), retail sweep programs distort M1 as a measure of transactions money. Since the process is literally invisible to the account-holder (Anderson and Rasche 2001), retail sweeping does not change the amount of transactions deposits the customer perceives itself to own. But since swept funds are reported as part of MMDA, M1 underreports narrow money.

Commercial demand deposit sweep programs exacerbate this problem. The swept funds are reported in the linked investment accounts rather than DD. We argue, though, that the account holder most likely views the entire balance, swept and unswept, as the relevant transactions balance. Given the magnitude of funds in commercial DD sweeps, the additional distortion is substantial.

Therefore, a conceptually appropriate definition of narrow money needs to account for the transactions ability of funds in sweep programs. We offer simple-sum versions of two such aggregates, M1RS and M1S. We define M1RS as M1 + (swept funds from retail sweep programs). M1RS, or "M1 with retail sweep programs", comprises the set of assets with unrestricted transactions properties, based upon the minimum size of check or the maximum number of checks per month. We define M1S as M1 + (swept funds from retail sweep programs) + (swept funds from commercial DD sweep programs). M1S, or “M1 with sweep programs”, includes all assets that are directly linked to checkable deposits by means of sweeping.

We examine the performance of these proposed aggregates by conducting Johansen cointegration tests between the velocities of the different money measures and their respective
opportunity costs (interest rates of alternative assets minus own rates) using quarterly data for 1959:1-2002:4. The findings indicate a long-run relationship between the GDP velocity of M1S and its opportunity cost. This result holds for opportunity cost measures based upon short-term and long-term interest rates. Tests with M1RS show some support for a long-run relationship, primarily for opportunity cost measures based upon short-term interest rates. Overall, our results call attention to the importance of both types of sweep programs in forming conceptually appropriate and reliable measures of narrow money.

The paper proceeds as follows. Section 2 presents further information about retail and commercial DD sweep programs. Section 3 discusses data on sweep programs and their movement over time. Section 4 looks at the relationship between velocity and opportunity cost. Section 5 presents cointegration results. Section 6 concludes the paper.

II. SWEEP PROGRAMS

Under retail sweep programs, which originated in January 1994, banks move forecasted excess funds out of checkable deposits into MMDA. Anderson and Rasche (2001) state that retail sweep programs have reduced required reserves by an estimated $34.1 billion. Under commercial demand deposit sweep programs, banks establish an investment account linked to their customer’s commercial DD account. Based upon Treasury Strategies (2003), there are four types of linked investment accounts: Overnight Instruments, which include repurchase agreements (RP), commercial paper, Federal Funds, and master notes; Depository Instruments, which largely consist of MMDA; Offshore Instruments, such as Eurodollars; and Proprietary and Third-Party money market mutual funds (MMMF).

Writings on commercial DD sweep programs suggest that banks allow customers to write checks against their entire account balance (swept plus unswept funds). Treasury Strategies
(1998) states that a benefit to customers of sweep accounts is to be fully invested and yet have same day access to invested funds. Treasury Strategies (2003) lists liquidity as a customer incentive to hold sweep accounts.

Further evidence comes from online product descriptions from banks that offer commercial DD sweep accounts, based on respondents in Treasury Strategies 2002 survey (available from the authors upon request). DD Sweeps into Overnight and Offshore instruments, and even MMMF in some cases, are generally the last transaction of the business day, and are returned to DD as the first transaction of the next business day. For sweeping from MMMF, banks redeem just enough shares to cover planned disbursements. DD Sweeps into MMDA, which have a maximum number of allowable transfers per month, operate similarly to retail sweeps. The bank sweeps funds back into DD to pay checks and replenish the target balance. Banks reserve the last transfer of the month for sweeping the entire balance back to DD, if necessary.

III. THE GROWTH OF SWEEP PROGRAMS

Anderson (1997) provides a link to two monthly time series on retail sweep programs. The data consist of the amount of funds in newly initiated retail sweep programs, and the cumulative sum of funds in newly initiated programs. The latter measure, denoted as CSWEEP, serves as our measure of aggregate monthly holdings of swept funds in retail sweep programs.

The same series appears within data compiled by the Board of Governors of the Federal Reserve System, Division of Monetary Affairs. They use this measure to construct a series referred to as “Adjusted M1”, consisting of M1 plus swept funds in retail sweep programs. CSWEEP has roughly the same time series properties as the measure estimated by Dutkowsky and Cynamon (2003). Anderson and Rasche (2001) form an alternative measure, using panel
data from a sample of banks. Their measure is smaller than CSWEEP, but the two measures have a similar growth pattern over time.

Our series for swept funds within commercial DD sweep programs makes use of a dataset that we purchased from Treasury Strategies, Inc. They have conducted their Annual Commercial Banking Sweep Account Survey since 1991. The survey gathers data on October balances within each type of linked investment account. The data reflect commercial DD sweep programs only and not retail sweep programs.

Treasury Strategies (2003) characterize their data as expansive, following not only the growth and trends for the overall market, but for individual respondents over the past decade as well. They state that the survey data for 2002 represent 51% of the US total sweep assets, or 77% of the US sweep assets for banks with more than $25 billion in bank assets. Participants comprise 38% of total US commercial bank deposits. From their annual surveys, Treasury Strategies constructs a time series of estimated market totals of swept assets in US commercial demand deposit sweep accounts. They seek to establish and maintain consistent time series from the survey data.

The dataset from Treasury Strategies contains annual market totals of swept balances in October of each year from 1991-2002. The data also include annual series on the percentage allocation of DD sweeps into each of the four linked investment accounts. Treasury Strategies splits MMMF into those offered by the bank versus outside vendors, but we do not make this distinction. Over time the percentage of total funds swept into Overnight Instruments has declined from 57% in 1991 to 32% in 2002. The percentage in MMMF over the same period has risen from 23% to 44%. Depository Instruments have the smallest percentage allocation, less than 4% of the total over 1991-2002.
We begin our empirical investigation by examining the secular behavior of retail and DD sweep programs. To formalize, define assets 1-4 as Depository Instruments, MMMF, Overnight Instruments, and Offshore Instruments, let DDS\textsubscript{i} be nominal annual holdings of funds swept within commercial DD sweep programs into the \(i\)th asset at date \(t\), for \(i = 1,2,3,4\), DDS\textsubscript{t} be total swept funds in DD sweeps, RETS\textsubscript{t} be total swept funds from retail sweep programs, DD\textsubscript{t} be total unswept (or reported) demand deposits and OCD\textsubscript{t} be unswept other checkable deposits. From there, we compute the share of each swept asset relative to total transactions deposits, denoted by \(w_{it} = \frac{X_i}{DD_t + OCD_t + RETS_t + DDS_t}\), for \(X_i = DDS_{1t}, DDS_{2t}, DDS_{3t}, DDS_{4t}, DDS_t,\) and RETS\textsubscript{t}.

The time series behavior of these shares indicates that a logistic function provides a reasonable fit. The logistic equation captures the sharp rise of sweep programs and the subsequent leveling off as they become a mature product. We estimate the specification:

\[
\begin{align*}
    w_{it} &= \frac{\beta_{1i} \text{YEAR}_t}{1 + e^{-\beta_2 (\text{YEAR}_t - \beta_3)} + \epsilon_{it}}, \\
    \text{(1)}
\end{align*}
\]

where \(\text{YEAR}_t\) is the given year and \(\epsilon\) is a stationary residual.

A priori properties of sweep programs imply that all parameters in (1) have positive sign. The \(\beta_1\) coefficient measures the steady-state share of transactions balances swept into the given asset. The inflection point occurs at \(\text{YEAR} = \beta_3\), after which the function levels off asymptotically. The \(\beta_2\) parameter helps describe how quickly the equation converges to the long-run. At the inflection point, the slope equals \(\beta_1\beta_2\).
We estimate (1) by nonlinear least squares. Data for aggregate DD sweeps are the actual reported October data from the Treasury Strategies dataset. We compute the amount of swept funds in each type of linked investment account for October 1991-2002 by multiplying the percentage allocation to that asset by aggregate DD sweeps. Correspondingly, we use the October levels of CSWEEP for retail sweep holdings and October (seasonally adjusted) levels of DD and OCD. For the same reason, the variable YEAR is interpreted as October of that year. Estimates appear in Table 1.

The logistic specification gives plausible and significant estimates. The estimated long-run market shares for the linked investment accounts point to a dominant role for MMMF. The long-run share for Depository Instruments is the smallest. The estimated $\beta_3$ coefficients reveal different inflection points for the four instruments. Consistent with discussion in Treasury Strategies (2003), the estimates indicate that Overnight Instruments leveled off early, while MMMF have continued to gain in popularity.

The last two rows of Table 1 report logistic estimations of shares of aggregate DD sweeps and retail sweeps relative to total transactions deposits. The estimated model for retail sweep programs uses annual data for 1994-2002, corresponding to the period when retail sweeps have been in effect. While we clearly work with small samples here, our results only seek to describe the growth pattern of the different sweep programs over the past decade. In particular, these estimations are not used to generate the interpolated monthly time series for DD sweeps. Estimation of (1) with the sample ending at 2001 gives very similar results.

All the estimated models generate plausible and significant estimates. The $\beta_1$ coefficient for total DD sweeps indicates that in the steady-state, swept funds from these accounts will make
up over 25% of total transaction deposits. The findings reveal an even larger long-run share for retail sweeps, over 33%.

The estimated inflection points indicate that retail sweeps began to level off a bit earlier than DD sweeps, in the latter part of 1996. The model for retail sweeps, though, generates a noticeably higher estimated $\beta_2$ parameter than for DD sweeps. Given the relative magnitudes of the $\beta_1$ estimates, retail sweeps have a considerably steeper logistic function at the inflection point. This result reflects the sharp increase in retail sweeping during the mid-to-late 1990s.

The sum of the $\beta_1$ estimates for total retail and total DD sweeps indicates that in the long-run, swept funds will make up nearly 60% of total transactions deposits (swept plus unswept funds). This result indicates that the steady-state ratio of swept funds to unswept funds will be approximately 1.5.

IV. VELOCITY AND OPPORTUNITY COST

A long-run relationship between velocity and opportunity cost can be obtained from the conventional money demand specification:

\[ \log(M_t) - \log(P_t) = \alpha_Y \log(Y_t) - \alpha_R (R_t - r_M) + \mu_t, \]

where $M$ is the nominal money stock, $P$ is the price level, $Y$ is a scale variable, $R$ is an interest rate of an alternate asset to money, $r_M$ is the own rate of interest on money, and $\mu_t$ is a stationary residual. The behavioral parameters $\alpha_Y$ and $\alpha_R$ have positive signs.

The opportunity cost of holding money equals the difference between the two interest rates. Specifying a non-zero own rate of money is critical for broader aggregates, as argued by Carlson et al. (2000). As Duca and VanHoose (2004) discuss, the issue gains importance for
narrow measures as well, given the spread of interest-bearing transactions deposits resulting from the Depository Institutions Deregulation and Monetary Control Act (DIDMCA).

Equation (2) implies a pairwise relationship between velocity and opportunity cost if $\alpha_Y = 1$. Assuming unitary income elasticity, substituting this restriction into (2), and rearranging gives us

$$\log(V_t) = \alpha_0 + \alpha_R (R_t - r_{Mt}) + \mu_t,$$

where $V = PY/M$, $\alpha_0 = \alpha' Y$ and $\mu_t = \mu_t'$. The long-run relationship between the opportunity cost of holding money and velocity is given by the absolute interest rate semi-elasticity of money demand. Unitary income elasticity yields a parsimonious pairwise relationship between the logarithm of velocity and opportunity cost for a given money measure.2

The money demand literature provides models where this assumption holds, but others where it does not. For example, the classic Baumol-Tobin inventory-theoretic formulation implies an elasticity of 0.5. Some empirical studies, such as Ball (2001), find estimated income elasticities well-below unity, with the null hypothesis of $\alpha_Y = 0.5$ not rejected by the data.

On the other hand, some theoretical models produce money demand functions with unitary income elasticity. Lucas (2000) provides a Sidrauski model with homothetic preferences that yields a “money demand” relationship with this property. He also derives a unit income elastic money demand function in a form of the McCallum-Goodfriend model. Dutkowsky and Atesoglu (2001) provide a structural interpretation for this restriction within an addilog money-in-the-utility-function model.
In addition, the restriction of unitary income elasticity is important in some empirical money demand studies. Hoffman and Rasche (1991) find evidence consistent with this restriction using short-term and long-term interest rates. Hoffman, Rasche, and Tieslau (1995) characterize it as key to obtaining long-run money demand stability for the US, and rarely reject this restriction in the data. Lucas (2000) also makes this assumption, stating that estimates of the long-run income elasticity of money obtained from long US time series tend to be around unity.

V. EMPIRICAL RESULTS

The Data

The sample consists of quarterly data spanning 1959:1-2002:4. We perform tests for the different money stocks using GDP and consumption as scale variables. Data for nominal GDP, nominal consumption, and their respective price deflators are obtained from the FRED II database.

Monthly time series data on DD sweeps come from Jones, Dutkowsky, and Elger (2005), based upon their interpolations of the Treasury Strategies (2003) data. We use these series for aggregate DD sweeps and balances within each type of linked investment account. CSWEEP serves as the measure of swept funds in retail sweep programs. We use quarterly averages of the monthly time series for RETS and DDS. Quarterly averages of seasonally adjusted monthly data for M1, M2, M2M (M2 minus small time deposits), and MZM come from the FRED II database. The sweep-adjusted monetary aggregates are: \( M_{1RS} = M1 + RETS \) and \( M_{1S} = M1 + RETS + DDS \).

We perform cointegration tests with four different measures for the interest rate \( R \): 3 month Treasury Bills, 6 month Treasury Bills, 5 year Treasury Bonds, and 20 year AAA Corporate Bonds. This set of interest rates provides a reasonable representation of those used in
empirical money demand studies. We convert the discount rates for the two short-term bill rates to holding period yields.\(^3\) Own rates of interest for M2, MZM, and M2M come from FRED II. The Monetary Services Index (MSI) database (Anderson, Jones, and Nesmith 1997) provides the data that we use to calculate own rates of interest for the other monetary aggregates.

We set the interest rate on swept funds from retail sweep programs equal to the interest rate on OCD. Anderson and Rasche (2001) state that it seems unlikely that banks directly pass on earnings from retail sweep programs. For DD sweeps, we assume that all the interest earned on swept funds is passed on to the customers. Since Regulation Q prohibits banks from paying interest on DD, receiving interest would seem to be a primary incentive for customers to hold these accounts. With this assumption, funds in DD sweeps that are swept into a given asset earn the interest rate on that asset.\(^4\)

We set the interest rate of reported DD equal to zero. We use an interest rate on RP and Eurodollars for Overnight and Offshore instruments respectively and an interest rate on commercial MMDA for Depository Instruments. The variable \(r_M\) for M1, M1RS and M1S consists of a weighted average of the interest rates on the individual components, with weights being quantity shares for the given monetary aggregate.

Figures 1 and 2 offer a preliminary look at the pairwise velocity-opportunity cost relationship for narrow money. A discussion for the broader aggregates can be found in Carlson et al. (2000). Figure 1 displays the interest rate on 6 month Treasury Bills along with own rates of interest for M1, M1RS, and M1S for 1980:1-2002:4. The own rates deviate from one another in the 1990s, with M1S having the highest own rate.

Figure 1 depicts a decline in opportunity costs over time. The downward trend of the short-term interest rate in Figure 1 is opposite to its systematic upward movement in the 1960s
and 1970s (with own rates of narrow money equal to zero). Therefore, over the entire sample period of 1959:1-2002:4, a roughly inverse U-shaped pattern of opportunity cost emerges for all three narrow money measures. Opportunity costs reach a peak in the early 1980s, then steadily decrease, aside from some cyclical movement.5

Figure 2 graphs the logarithm of GDP velocity of M1, M1RS, and M1S for 1980:1-2002:4. Prior to sweeping, all three velocities are the same. In the early 1990s, velocity trends downward. Around 1994, though, the three velocities begin to deviate noticeably. M1 velocity rises sharply, and M1RS velocity remains roughly constant. But M1S velocity continues to decrease throughout the 1990s and into the post-2000 period.

Examining M1S velocity over the entire sample period reveals an inverse U-shaped pattern, consistent with co-movement with its opportunity cost. For the 1960s and 1970s, the velocity of M1 exhibits a discernable upward movement over time, before declining with a cyclical pattern in the 1980s (see Hafer and Wheelock 2001 for further discussion). But unlike the velocities of M1 and M1RS, M1S velocity continues to decline in the 1990s and into the twenty-first century.

Cointegration Results

To econometrically investigate the relationship between velocity and opportunity cost, we begin by testing for the restriction of unitary income elasticity in the long-run demand for money. This is done by estimating (2) using the Johansen cointegration procedure. With M1, M1RS, and M1S, the overall sample covers 1959:1-2002:4. The MZM estimations begin in 1974:1, since the FRED II does not report this series prior to then. Estimations for M2M and M2 begin in 1959:2, since the database does not contain an observation for the own rates of interest for 1959:1.
Since narrow money is at the heart of our investigation, we also perform estimations for two subsamples with M1, 1959:1-1980:4 and 1959:1-1990:4. In this way, we track more closely the M1 relationships as they have evolved over time. This approach corresponds to Hoffman, Rasche, and Tieslau (1995), although it is not as detailed as their year-by-year monitoring. Both subsamples end before the reporting of data on swept funds in retail and DD sweep programs.

Augmented Dickey-Fuller tests cannot reject the null hypothesis of a unit root for any of the variables in this study. We choose two lag lengths for the VECM within the Johansen test (k) – two and eight quarters. The lag length of two quarters describes rapid adjustment of money balances, consistent with Ball's (2002) partial adjustment framework. The choice also goes along with lag lengths used by Carlson et al. (2000) with monthly data. The eight lag specification corresponds to Ball (2001), based upon annual data and a longer sample relative to Carlson et al. (2000).

Tests for a long-run relationship use the Johansen Trace statistic, with the lag adjustment of Cheung and Lai (1993). All the estimated models specify a constant but not a trend term in the cointegrating equation. To conserve space, we report test statistics only for the null hypothesis that the rank equals zero. Statistics testing for higher ranks are insignificant at the 10% level, indicating the existence of at most one long-run relationship. The E-Views computer package performs the estimations.

Tests for unitary income elasticity can be summarized as follows. For M1S and MZM, in all cases the null hypothesis of unitary income elasticity cannot be rejected at the 10% level of significance. For M1RS and M1 in the 1959:1-1980:4 subsample, estimated coefficients tend to be close to unity, but tests in some cases reject the null hypothesis. For M1, M2, M2M, and for
M1 in the 1959:1-1990:4 period, tests reject the null hypothesis in all instances and the coefficients are considerably smaller than unity.\textsuperscript{6}

In general, the estimated income elasticities for M1 become progressively smaller as one extends the sample from 1980:4 to 1990:4 to 2002:4. Certainly sweep programs, at least to some extent, account for the suspected breakdown in the 1990s and into the twenty-first century. The behavior during the 1980s may reflect sharp short-run movements into M1 stemming from the invention and spread of NOW and Super NOW Accounts, as well as the phasing out of Regulation Q for bank deposits other than demand deposits, completed in 1986.

Based upon these results, we pursue pairwise velocity relationships for M1 with the 1959:1-1980:4 subsample, as well as for M1RS, M1S, and MZM. Table 2 reports the results. The findings for k = 2 provide evidence for cointegration with each interest rate measure for M1RS and M1S. The strongest support comes from estimations with the short-term rates. The results for the lag length of two indicate little evidence of cointegration for pre-1981 M1 and for MZM. For all the estimations, interest rate semi-elasticities have positive sign and plausible magnitudes.

When k = 8 the results provide evidence of a long-run relationship for M1 in the 1959:1-1980:4 subsample, and for M1RS and M1S with either short-term interest rate. The findings also indicate cointegration for pre-1981 M1 and the 5 year Treasury Bond rate. With the Corporate Bond Rate, cointegration occurs for M1RS and M1S. Tests in all cases for MZM cannot reject the null hypothesis of non-cointegration at any meaningful level of significance. Estimated coefficients for $\alpha_R$ are positive, generally significant, and have plausible magnitudes. For k = 8, pre-1981 M1 has the largest interest rate semi-elasticity of the estimations with narrow money and M1RS has the smallest.\textsuperscript{7}
The estimated interest rate semi-elasticities for M1S are surprisingly similar across the different interest rate measures. Duca and VanHoose (2004) discuss a movement in empirical research within money demand, from using short-term to long-term interest rates. The authors argue that one can justify using long-term rates if expectations of future short-term rates have a larger effect on money demand through affecting medium-run to long-run money management practices, than short-term rates have on money demand through substitution effects via short-duration financial substitutes. They contend that empirical evidence involving the degree of substitutability between M1 and M2 components is greatest for the non-M1, zero maturity components of M2 -- savings deposits and MMMF -- than for small time deposits. This property would imply that short-term rates measure the alternative to holding narrow money more accurately than long-term rates at the disaggregate level. Perhaps one reason for the robustness of our estimates across interest rates lies in the explicit attention to interest paid on transactions deposits in measuring opportunity cost. Duca and VanHoose (2004) point to this aspect as either ignored or not handled well by many studies of M1 demand.

The importance of DD sweeps is consistent with the findings of Jones, Dutkowsky, and Elger (2005). When they include retail sweeps but not DD sweeps within checkable deposits, they find that weak separability holds only for broader groupings of monetary assets. But when DD sweeps are also placed within checkable deposits, tests find weak separability for both narrow and broad groupings.

Our own examination of robustness reinforces the importance of including a measure of swept funds in commercial DD sweeps within the definition of narrow money. Estimations for the velocity of the aggregate M1S minus swept funds in MMMF against its opportunity cost generate nearly the same results as for M1S. We also investigated the aggregate M1RS +
Overnight DD sweeps, and the results are just a bit less supportive than for M1S. But estimations with the measure M1 + savings deposits, which absorbs retail sweeps but not DD sweeps, generate results similar to M2M.

VI. CONCLUSION

Sweep programs matter for the proper measurement of money. While retail sweep programs have received attention, our study emphasizes the role of commercial demand deposit sweep programs as well. Sweeps have altered the conceptually appropriate medium of exchange measure. The substantial growth of both types of sweep programs from the 1990s and into the twenty-first century exacerbates measurement problems with narrow money.

We propose two new measures of narrow money -- M1RS and M1S -- that have become economically meaningful in light of sweep programs. Our results provide evidence that a definition of transactions money that accounts for sweeps can generate reliable long-run relationships involving the velocity of money. These new measures can be used to extend the sizable body of research that has used M1.

The greater emphasis on M2, M2M and MZM by researchers and policymakers came about in part due to the distortion in M1. Our findings, however, indicate that the distinction between narrow money and broader measures is economically meaningful. In this way, they corroborate the benefits of working with a specialized medium of exchange measure.

Although our findings for M1S show promise, at least several caveats are in order. First, our study does not consider the substantial amount of currency outflows outside the US, which have impacted the money measures. Anderson and Rasche (2000), for example, estimate that by the 1990s, over 50% of US currency was being held abroad. Second, we are hampered by data problems in obtaining estimated time series on funds in retail and commercial DD sweep
programs. Given the compelling conceptual arguments for including sweep programs in the transactions measures of money, our study points to the need to collect more reliable data in this area.

Third, we have not addressed deeper issues involving money, including the potential for money supply to again play a greater role within monetary policy. Duca and VanHoose (2004) conclude that continuing doubts about the role of monetary aggregates in the transmission of monetary policy leaves the empirical -- as well as theoretical -- money demand literature in a somewhat unsettled state. They contend that it remains to be seen whether empirical advances in the money demand literature will have a practical impact on the conduct of monetary policy.

That said, it may be time to again consider narrow money. The favorable results for M1S and M1RS suggest that the significant short-run portfolio readjustments due to the DIDMCA and related legislation may have been resolved, and long-run stability can again be reflected in the data. Our study calls for M1S and M1RS to serve at least alongside existing money measures in gauging macroeconomic conditions.
REFERENCES


FOOTNOTES

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the Federal Reserve System, or any of the remaining parties.

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1. There is also a large body of related empirical research that supports the reliability of money
measures, particularly broader aggregates such as M2, based upon VAR estimates or
cointegration testing. See Duca and VanHoose (2004) for a detailed survey of work in these areas.

2. The benefits of being able to examine velocity in this way are reflected in time series graphs between these two variables found in the Federal Reserve Bank of St. Louis publication *Monetary Trends*, which displays these plots for M2 and MZM.

3. We performed some empirical investigation with the RETS and DDS series to see if we could find linkages between swept funds and short-term or long-term interest rates. We find no discernable evidence of any such relationships.

4. Reports by Treasury Strategies in the 1990s indicate that banks passed on roughly 80% of the earnings at the time. However, such data are not available after 1997.

5. See Ball (2002) for further discussion regarding the cyclical movement of short-term interest rates and the money supply during this period.

6. Overall, we do not find a great deal of evidence for cointegration in these estimated equations. The most supportive results are for M1, M1RS, and M1S with the Corporate Bond rate. For this interest rate and k = 8, tests reject the null hypothesis of non-cointegration for M1 with GDP as the scale variable, and M1RS and M1S with both GDP and consumption. The finding for M1 reinforces Ball's (2001) results with a Kalman-filtered Commercial Paper rate, while the evidence with M1RS corresponds to Dutkowsky and Cynamon (2003). The null hypothesis of non-cointegration cannot be rejected at the 10% level of significance for any of the estimations with M2 and M2M. The lack of evidence for the broader aggregates may stem in part from the relatively basic money demand specification. Duca (2000), for example, obtains considerably more supportive findings for M2 demand, within a model that considers bond mutual funds.
7. Results for consumption velocity are similar but provide somewhat weaker evidence of cointegration. For $k = 2$, we find evidence of cointegration for M1S with both short-term interest rates. For $k = 8$, cointegration occurs for M1S with all interest rates, and pre-1981 M1 for both short-term rates.

8. Part of the success of M1RS and M1S may be due to overestimation of swept funds in retail sweep programs, which may compensate somewhat for the loss in currency abroad. The variable CSWEEP measures the cumulative amount of funds in retail sweep programs since their inception. It does not consider any closing of retail sweep accounts since 1994. Anderson (1997) discusses other measurement issues, particularly in converting the Federal Reserve’s survey data into monthly averages.
FIGURE CAPTIONS

Figure 1. The 6 month Treasury Bill rate and own rates of interest for M1, M1RS, and M1S, 1980:1-2002:4.

Figure 2. The logarithms of GDP Velocity for M1, M1RS, and M1S, 1980:1-2002:4.
<table>
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<tr>
<th>Variable</th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
<th>$\beta_3$</th>
<th>$R^2$/SE</th>
<th>DW</th>
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<td>Depository Instruments</td>
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<td>(0.48)</td>
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<td>MMMF</td>
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<td>0.415</td>
<td>1999.18</td>
<td>0.99/0.005</td>
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<tr>
<td>(0.019)</td>
<td>(0.055)</td>
<td>(0.77)</td>
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<td>Overnight Instruments</td>
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<td>0.552</td>
<td>1994.87</td>
<td>0.98/0.004</td>
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<tr>
<td>(0.003)</td>
<td>(0.070)</td>
<td>(0.27)</td>
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<tr>
<td>Offshore Instruments</td>
<td>0.054</td>
<td>0.662</td>
<td>1996.28</td>
<td>0.99/0.002</td>
<td>1.56</td>
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<td>(0.002)</td>
<td>(0.069)</td>
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<td>0.468</td>
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<td>0.99/0.006</td>
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<td>(0.009)</td>
<td>(0.032)</td>
<td>(0.22)</td>
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<td>Total Retail Sweeps</td>
<td>0.339</td>
<td>1.131</td>
<td>1996.27</td>
<td>0.98/0.020</td>
<td>1.41</td>
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<td>(0.011)</td>
<td>(0.181)</td>
<td>(0.16)</td>
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Notes: Standard errors appear in parentheses.
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<th>Lag Length = 8</th>
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<td></td>
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<td>$\alpha_R$</td>
<td>(SE)</td>
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<td>M1†</td>
<td>0.047 (0.028)</td>
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<td>M1RS</td>
<td>0.067 (0.019)</td>
<td>18.41**</td>
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<td>M1S</td>
<td>0.076 (0.017)</td>
<td>20.54***</td>
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<td>MZM</td>
<td>0.143 (0.117)</td>
<td>7.06</td>
</tr>
<tr>
<td>6 Month Treasury Bill</td>
<td>M1†</td>
<td>0.051 (0.024)</td>
<td>5.89</td>
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<td>M1RS</td>
<td>0.063 (0.018)</td>
<td>18.14**</td>
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<td></td>
<td>M1S</td>
<td>0.072 (0.016)</td>
<td>20.65***</td>
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<td>MZM</td>
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<td>16.99**</td>
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<td>MZM</td>
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<td>6.22</td>
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<tr>
<td>20 Year AAA Corporate Bond</td>
<td>M1†</td>
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<td>8.20</td>
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<td>MZM</td>
<td>0.150 (0.074)</td>
<td>5.60</td>
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</tbody>
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