MZM: A Monetary Aggregate for the 1990s?

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Introduction

The Humphrey–Hawkins Act of 1978 requires the Federal Open Market Committee (FOMC) to specify annual growth ranges for money and credit early each year. These ranges are reconsidered at midyear, and preliminary ranges are specified for the upcoming calendar year. In the past, financial market participants paid close attention to the announcement of the monetary aggregate growth ranges in order to assess the intentions of the FOMC, the policymaking arm of the Federal Reserve System. Large deviations from range midpoints were often associated with policy actions designed to bring money growth back to its intended path.

In recent years, however, the reliability of various money measures as useful indicators on which to base policy has become seriously compromised. Consequently, the role of money in policy decisions has greatly diminished. In July 1993, Federal Reserve Chairman Alan Greenspan reported that "... at least for the time being, M2 has been downgraded as a reliable indicator of financial conditions in the economy, and no single variable has yet been identified to take its place."[1]

The breakdown of M2 as a monetary policy guide may sound familiar to those who have followed policy closely over the past two decades.[2] In the 1980s, the relationship between M1 and the economy became questionable.[3] As evidence grew that the aggregate had become an unreliable indicator, policymakers turned their attention to M2, which appeared to be immune to the effects that had undermined M1.

Recently, in response to the M2 breakdown, some analysts have been monitoring MZM, a measure of money that includes assets redeemable at par on demand. Interestingly, the relationship between MZM and economic activity appears to have stabilized in recent years, suggesting that the aggregate has a potential role

1 See *1993 Monetary Policy Objectives: Summary Report of the Federal Reserve Board*, July 20, 1993, p. 8.

2 For a complete analysis of the breakdown of M2, see Miyao (1996).

3 Although Hoffman and Rasche (1991) present evidence that M1 continued to have a stable long-run relationship with interest rates and income throughout this period, no short-run relationship was found to be sufficiently reliable for policy. Lucas (1994) also presents some evidence of a stable M1 demand relationship using annual data from 1900 to 1985.

BOX 1

Measures of Money

M1	=	Currency
	+	Demand deposits
	+	Other checkable deposits
	+	Traveler's checks
M2	=	M1
	+	Savings deposits (including MMDAs)
	+	Small time deposits
	+	Retail MMMFs
MZM	=	M2
	+	Institutional MMMFs
	–	Small time deposits
M3	=	M2
	+	Large time deposits
	+	Institutional MMMFs
	+	Eurodollars
	+	RPs

for policy. This article describes MZM, discusses its relationship with economic activity, and presents evidence that it has maintained a stable relationship with nominal GDP and interest rates. Some implications for MZM's usefulness as a policy guide are also briefly discussed.

I. What Is MZM?

Poole (1991) first coined the term MZM when he proposed a measure of money encompassing all of the monetary instruments with zero maturity. He based this distinction on Friedman and Schwartz's (1970) principle that money is a "temporary abode of purchasing power." Assets included in MZM are essentially redeemable at par on demand, comprising both instruments that are directly transferable to third parties and those that are not (see box 1). This concept excludes all securities, which are subject to risk of capital loss, and time deposits, which carry penalties for early withdrawal. Motley (1988) had earlier proposed such a measure, but called it nonterm M3.

On the spectrum of monetary aggregates, MZM is broader than M1 but essentially narrower than M2. Like M2, it encompasses M1, savings deposits (including money market deposit accounts [MMDAs]), and retail money market mutual funds (MMMFs). It does not, however, include small time deposits (such as retail certificates of deposit), which are in M2. On the other hand, MZM does cover institutional MMMFs, while M2 does not.[4] In sum, MZM includes all types of financial instruments that are, or can be easily converted into, transaction balances without penalty or risk of capital loss. The MZM measure that we use in this paper does not include overnight wholesale repurchase agreements (RPs) or overnight eurodollars, components of the originally proposed measure.[5]

II. Why MZM?

One of the basic motives for holding monetary assets is uncertainty. Inventory-theoretic models of money demand such as those of Baumol (1952), Tobin (1958), and Miller and Orr (1966) stress the uncertainties related to cash flow. Earlier, Keynes (1936) had noted the importance of uncertainty regarding future interest rates as a determinant of money balances. In proposing the nonterm distinction for a money measure, Motley states that "if there were no uncertainty about future rates of interest, the present and all future values of securities also would be known, and hence an investor would have no incentive to hold money." Holding money is thus a hedge against potential capital losses if an unanticipated need for liquidity occurs. The demand for money arises because wealth holders cannot anticipate their transaction needs in the face of uncertainty.

Motley also discusses the importance of transaction costs in exchanging non-money assets for money. These costs include not only brokerage fees, but also the implicit costs associated with inconvenience, sometimes called *shoe-leather* costs. Uncertainty about the future need for liquid funds thus creates incentives apart from interest rate uncertainty. The consequences of such behavior are captured in the inventory-theoretic models of money demand. Whether predicated on transaction costs or on interest rate uncertainty, money demand models generally indicate that the amount of money demanded varies directly with income and inversely with the opportunity cost of money.

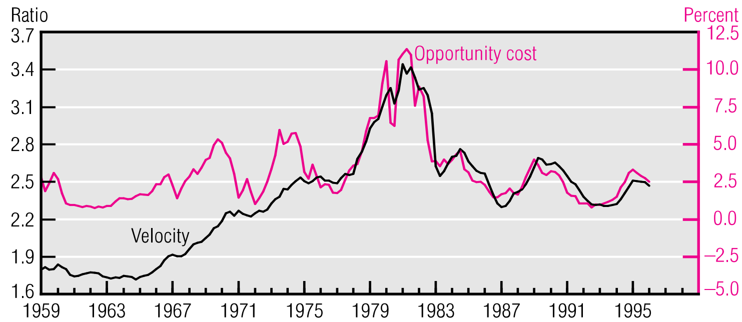
To link the MZM measure to its theoretical conception, Motley (1988, p. 39) argues that "each of the motives for holding wealth in the form of 'money' is more closely related to

4 Retail money funds are those with minimum initial investments under $50,000; institutional money funds have a required minimum initial investment of $50,000.

5 Technically, these are both term instruments, albeit of short duration. Whitesell and Collins (1996) find little evidence of substitution between these instruments and demand deposits in recent years. Data on overnight RPs and eurodollars are no longer available.

FIGURE 1

MZM Velocity and Opportunity Cost



SOURCES: Board of Governors of the Federal Reserve System; and U.S. Department of Commerce, Bureau of Economic Analysis.

BOX 2

Calculation of MZM's Rate of Return

$$RMZM = (1/MZM) \times [OCD \times ROCD + SAV \times RSAV + (RMF + IMF) \times RR\&IMF]$$

RMZM	=	Rate of return on MZM deposits
MZM	=	MZM
OCD	=	Other checkable deposits
ROCD	=	Rate of return on other checkable deposits
SAV	=	Savings deposits
RSAV	=	Rate of return on savings deposits
RMF	=	Retail MMMFs
IMF	=	Institutional MMMFs
RR&IMF	=	Rate of return on retail and institutional MMMFs

money's being a nonterm asset, that gives more or less immediate command over goods and services, than to its being the medium of exchange. All are motives for holding liquid assets in general, and not only assets that are a means of exchange." Thus, the zero-maturity criterion for selecting assets to be included in a measure of money has its basis in principle.

III. The Demand for MZM

Developing theoretical underpinnings for money demand is one thing; finding a stable empirical relationship is another. Estimated money demand relationships are notoriously unstable. The literature is replete with examples of estimated models that fail the test of time. Most fall victim to the effects of financial innovation, if not of regulation and deregulation. Financial innovation, for example, can lead to the development of new instruments like MMMFs, first introduced in the mid-1970s. Generally, such instruments are not included in the official money measures until an empirical basis becomes well established. MMMFs were first included in the 1980 redefinition of M2.

Structural change in the demand for an aggregate is usually evident in the time series of its velocity, especially in relation to interest rates. Figure 1 illustrates MZM velocity in relation to its opportunity cost (the difference between a market yield and the yield on MZM). In principle, MZM opportunity cost is a measure of the forgone income from holding MZM. It is calculated here as the difference between the three-month Treasury bill rate and the share-weighted average of yields paid on MZM components (see box 2).[6]

The movements in MZM velocity can be separated into two distinct periods. Prior to 1975, velocity seemed to trend continually upward with little regard for changes in the aggregate's opportunity cost. Since then, however, velocity appears to be relatively trendless in the long run, but varies systematically with changes in opportunity cost in the short run.

Poole argues that the upward trend in MZM velocity before 1975 is the likely result of financial regulations, especially Regulation Q, which placed ceilings on interest rates paid by depositories. We find this argument compelling. During periods of high and rising market interest rates, such ceilings create strong incentives for deposit holders to economize on their cash balances.[7]

Although interest rate ceilings were not totally eliminated until the early 1980s, they were often rendered ineffective by revisions of Regulation Q that started in the mid-1970s. For example, ceilings were sometimes raised once

6 Ideally, the opportunity cost measure would include all returns to holding deposits (such as gifts for opening an account and service credits) and subtract service charges. These data are not available, which may explain why some empirical specifications fail.

7 It is interesting to note that MZM velocity appears to ratchet up. When the aggregate's opportunity cost rises, its velocity also rises, but when opportunity cost falls, velocity does not. This is reminiscent of the experience of M1 in the 1970s. Porter, Simpson, and Mauskopf (1979) argue that this pattern reflected incentives for adopting cash management technology. Specifically, when interest rates breached old thresholds, balance holders adopted techniques that allowed them to economize on their M1 holdings. These techniques reduced the need to hold M1 even when interest rates fell.

they became effective. Moreover, depositories were periodically allowed to introduce new accounts whose interest rates were tied to those paid on U.S. Treasury bills. Finally, MMMFs, first introduced in 1973, provided balance holders with a zero-maturity instrument that effectively yielded a market rate. These instruments appeared to serve as a refuge from regulated yields. Because MMMFs attracted at least part of the depository outflows related to effective interest rate ceilings, such substitutions were internalized in the MZM aggregate.[8]

IV. An MZM Demand Specification

We consider a specification of MZM demand similar to that proposed by Moore, Porter, and Small (1990; hereafter MPS) for the M2 demand model. They apply methods developed by Engle and Granger (1987) that distinguish long-run and short-run determinants. Our long-run relation follows the form

$$(1) \quad M_t = AY_t S_t^{\gamma},$$

where M is the measure of money, A is the scale parameter, Y is nominal GDP, and S is equal to one plus the opportunity cost of money.[9] Note the implicit constraint that the elasticity of M with respect to Y is equal to one.[10] The parameter γ is the elasticity of opportunity cost. An implication of all money demand theories, of course, is that the sign of γ is negative.

Equation (1) can be rewritten as

$$(2) \quad Y_t/M_t = V_t = A^{-1}S_t^{-\gamma},$$

where V is the income velocity of money. Thus, the long-run relation embeds the simple relationship between MZM velocity and opportunity cost evident in figure 1.

Because the model is estimated in log form, we rewrite the long-run relations as

$$(1') \quad m_t = \alpha + y_t + \gamma s_t + e_t \text{, or}$$

$$(2') \quad v_t = -\alpha - \gamma s_t - e_t,$$

where lower-case variables denote the natural log. The variable e is introduced to account for any potential deviation between the actual level and long-run equilibrium.

Estimation of (1′) or (2′) requires careful analysis. It is widely known that most aggregate economic time series are nonstationary in levels. In such variables, there is no tendency to systematically return to a unique level or trend over time. Moreover, when these variables exhibit drift, standard regression analysis can yield spurious relationships. Table 1 presents evidence that natural logarithms of MZM velocity and opportunity cost are nonstationary both in the whole sample period and after 1974.

Methods developed by Engle and Granger (1987) and Johansen (1988) allow us to examine whether equilibrium relationships exist between two or more nonstationary variables. Such variables are said to be cointegrated if some linear combination of them is stationary. Thus, cointegration implies a long-run relationship between variables, and we can obtain estimated long-run elasticities from the cointegrating vector. However, cointegration between two or more variables requires that each be stationary in a differenced form. The evidence presented in table 1 tends to confirm that the first differences of MZM velocity and opportunity cost are stationary.[11]

To test if MZM velocity and opportunity cost are cointegrated, we estimate a chi-squared statistic proposed by Johansen (1988).[12] Specifically, this approach tests the hypothesis that there are, *at most, r* cointegrating vectors. The results presented in table 2 are mixed. These tests fail to reject the hypothesis that there is no cointegrating vector involving MZM velocity and opportunity cost over the whole sample. Since 1974, however, evidence supports the hypothesis that there is one cointegrating vector. Thus, a stable equilibrium relationship linking MZM velocity and opportunity cost appears to have

■ 8 The existence of reserve requirements has given banks an incentive to "sweep" transaction balances into nonreservable and usually nonmaturing assets like MMDAs. Thus, this form of regulation avoidance is also internalized in the zero-maturity measure.

■ 9 The units are not in percentage terms. Hence, a 3 percent rate for opportunity cost would appear as 1.03. We found that this specification is more robust than the simple log of opportunity cost. Since the model is estimated in log form, this variable approximates a semilog form for opportunity cost. MPS include the log of opportunity cost in their model, but use a linear approximation when the value is small.

■ 10 Although the Baumol (1952) model of money demand indicates an income elasticity of 0.5, it assumes that money bears no interest. MZM largely comprises interest-bearing components.

■ 11 Unlike the whole-period findings, these test results are not uniformly concordant. The augmented Dickey–Fuller test for stationarity in the first difference of MZM is not significant at the 10 percent level, but the Phillips–Perron test is significant at the 5 percent level.

■ 12 For any n variables there may be n cointegrating vectors. We are concerned here with finding one cointegrating vector for two variables.

TABLE 1

Stationarity Test Results

Sample: 1961:IQ to 1994:IVQ

Variable		Test Statistics v_t	s_t	m_t	Critical Value 10%	5%
Lag truncation:		(8)	(11)	(11)		
Constant, no trend						
Dickey–Fuller	t_α	−1.92	−2.13	0.59	−2.58	−2.89
Phillips–Perron	t_α	−1.72	−2.52	0.34	−2.58	−2.89
	z_α	−3.77	−11.9	0.17	−11.1	−13.8
Constant, trend						
Dickey–Fuller	t_α	−1.28	−2.04	−1.86	−3.15	−3.45
Phillips–Perron	t_α	−1.26	−2.47	−1.84	−3.15	−3.45
	z_α	−3.62	−11.7	−5.96	−17.6	−20.8

Variable (1st diff.)		Δv_t	Δs_t	Δm_t	10%	5%
Lag truncation:		(8)	(11)	(11)		
Constant, no trend						
Dickey–Fuller	t_α	−3.34	−3.64	−3.31	−2.58	−2.89
Phillips–Perron	t_α	−7.15	−9.90	−6.73	−2.58	−2.89
	z_α	−76.9	−101.7	−68.8	−11.1	−13.8
Constant, trend						
Dickey–Fuller	t_α	−3.68	−3.66	−3.38	−3.15	−3.45
Phillips–Perron	t_α	−7.11	−9.86	−6.68	−3.15	−3.45
	z_α	−75.1	−100.7	−68.1	−17.6	−20.8

Sample: 1975:IQ to 1994:IVQ

Variable		Test Statistics v_t	s_t	m_t	Critical Value 10%	5%
Lag truncation:		(8)	(7)	(1)		
Constant, no trend						
Dickey–Fuller	t_α	−1.54	−1.80	−0.93	−2.59	−2.91
Phillips–Perron	t_α	−1.65	−2.18	−1.04	−2.59	−2.91
	z_α	−5.59	−6.91	−0.55	−10.9	−13.6
Constant, trend						
Dickey–Fuller	t_α	−2.54	−2.69	−1.81	−3.16	−3.46
Phillips–Perron	t_α	−2.09	−2.18	−1.23	−3.16	−3.46
	z_α	−7.58	−8.95	−4.10	−17.2	−20.4

Variable (1st diff.)		Δv_t	Δs_t	Δm_t	10%	5%
Lag truncation:		(8)	(11)	(11)		
Constant, no trend						
Dickey–Fuller	t_α	−2.69	−2.66	−2.46	−2.59	−2.91
Phillips–Perron	t_α	−5.28	−7.93	−5.37	−2.59	−2.91
	z_α	−41.5	−67.4	−42.7	−10.9	−13.6
Constant, trend						
Dickey–Fuller	t_α	−2.68	−2.69	−2.47	−3.16	−3.46
Phillips–Perron	t_α	−5.27	−7.93	−5.37	−3.16	−3.46
	z_α	−41.9	−67.0	−43.2	−17.2	−20.4

NOTE: Regressions are of the form $\Delta y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 t + \sum_{j=1}^{n} \gamma j \Delta y_{t-j} + \varepsilon_t$, except when the trend is omitted. The test statistics are for H_0: $\alpha_1 = 0$. Thus, when the test statistic exceeds the critical value, we cannot reject the hypothesis that the series is nonstationary. Lag length is determined by the highest significant lag order from the autocorrelation or partial autocorrelation function. Critical values are interpolated from tables 4.1 and 4.2 in Banerjee et al. (1993).

SOURCE: Authors' calculations.

TABLE 2

Cointegration Test Results

	Johansen Trace Test Statistics	
5% Critical Values Trace Test	17.84	8.08
	$r = 0$	$r = 1$
1961:IQ–1994:IVQ	13.88	2.92
1975:IQ–1994:IVQ	20.62	5.14

NOTE: If the test statistic is greater than the critical value, we can reject the hypothesis that there are, at most, r cointegrating vectors. The results are based on four lag specifications.

SOURCE: Authors' calculations.

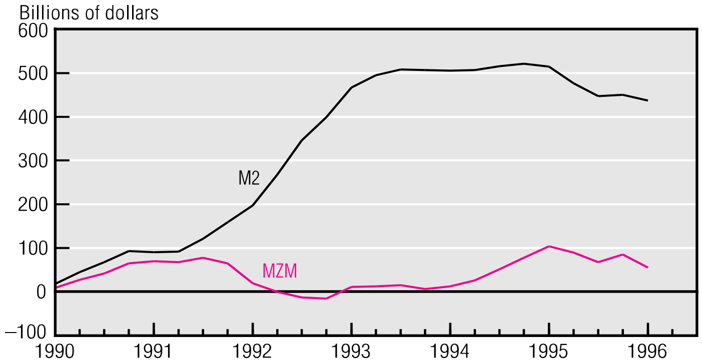
emerged beginning in 1975. It is important to note that this latter period includes extensive deregulation of depositories, an acceleration in financial innovation, a substantial disinflation, and three relatively unique business cycles.

V. An Error-Correction Specification

One implication of the cointegration test results is that e_t in equations (1′) and (2′) has been stationary since 1974. Stationarity in e_t allows us to obtain consistent estimates of the parameters of the long-run relationship over the latter period. One estimation procedure is to embed e_{t-1} in a short-run relation that describes the adjustment path to equilibrium. This relation is commonly called the error-correction process. We propose a streamlined version of the MPS specification:

FIGURE 2

MZM and M2 Prediction Errors



SOURCES: Board of Governors of the Federal Reserve System; and authors' calculations.

BOX 3

Regression Results

$$\Delta m_t = -0.095 - 0.132\,(m_{t-1} - y_{t-1}) - 0.572\, s_{t-1} + 0.248\,\Delta m_{t-1}$$
$$\quad (2.97)\quad (3.35)\qquad\qquad (3.26)\qquad (5.55)$$

$$-0.438\,\Delta s_t - 0.742\,\Delta s_{t-1} - 0.114 D831_t + \varepsilon_t$$
$$(3.60)\qquad (4.70)\qquad (10.51)$$

NOTE: Adj. R^2 = 0.83, SSE = 0.0098, Box–Ljung statistic Q(12) = 18.35, $F_{1,72}$ = 3.20 (test on restriction: $m_t - y_t = 0$), and estimation period = 1975:IQ to 1994:IVQ.
SOURCE: Authors' calculations.

$$(3)\qquad \Delta m_t = \beta_0 + \beta_1 e_{t-1} + \beta_2 \Delta m_{t-1} + \beta_{30}\Delta s_t + \beta_{31}\Delta s_{t-1} + \beta_4 D831 + \varepsilon_t,$$

where Δ denotes the first difference of a variable, e_{t-1} is the deviation of money from its long-run equilibrium value in the prior period, ε is white noise, and *D831* is a qualitative variable that equals zero in all quarters except 1983:IQ, when it equals one. We include the final variable to account for transitory effects related to the introduction of MMDAs.

Solving for e_t in (1′) and substituting into (3) yields a form that allows the parameters to be estimated jointly:

$$(3')\qquad \Delta m_t = \beta_0 - \beta_1\alpha + \beta_1(m_{t-1} - y_{t-1}) - \beta_1\gamma s_{t-1} + \beta_2\Delta m_{t-1} + \beta_{30}\Delta s_t + \beta_{31}\Delta s_{t-1} + \beta_4 D831 + \varepsilon_t.$$

From this form, the long-run opportunity cost elasticity, γ, can be easily recovered. Equation (3′) is estimated using ordinary least squares, with the results presented in box 3.

It is most interesting to note that the long-run opportunity cost elasticity of MZM is –4.33, an unusually high estimate. A one-percentage-point increase in MZM opportunity cost from its current level would reduce equilibrium MZM demanded by more than 4 percent. This indicates that the lion's share of MZM variation (and the variation in its velocity) reflects a systematic effect due to interest rates. To verify that the velocity specification is appropriate, we test the restriction that the income elasticity equals one. This test fails to reject a unitary income elasticity at the 5 percent significance level. In sum, MZM demand since 1974 is relatively well explained by the few variables included in our framework.

VI. MZM in the 1990s

It is widely held that the demise of M2 as a reliable policy guide resulted largely from the proliferation of mutual funds in capital market instruments, particularly bond funds (see Duca [1995], Darin and Hetzel [1994], Collins and Edwards [1994], and Orphanides, Reid, and Small [1994]). This view is summarized succinctly by Darin and Hetzel (p. 39): "In the early 1990s, the combination of 1) low rates of return on bank deposits relative to capital market instruments and 2) the decreased cost of operating bond and stock mutual funds diminished the public's demand for saving in the form of bank deposits." The historical relationship between M2 and economic activity broke down as depositors redirected these savings flows from bank deposits to stock and bond mutual funds. This unraveling is evident in the cumulative out-of-sample projection errors of a version of the MPS model specification (see figure 2).

To investigate the robustness of the MZM specification during the proliferation of bond and equity funds, we estimate the model through 1989 and use out-of-sample simulations to 1996:IQ.[13] This simulation reveals no significant cumulative error. Indeed, more than five years after the sample period, MZM is essentially

13 Because we are examining only the robustness of parameters, we use actual values for exogenous variables. However, the simulation is dynamic. Hence, values of MZM are model projections during the simulation period.

on track. It appears that the rapid growth of mutual funds came largely at the expense of small time deposits, and that the zero-maturity distinction is an important and durable dividing line for aggregating monetary assets.

MZM also fares well when compared to the narrower aggregates. One factor that has recently been depressing growth in the narrow aggregates is the widespread emergence of sweep accounts. Banks are initiating these programs to economize on their reserves, which earn no return. These arrangements "sweep" excess household checkable deposits, which are reservable, into MMDAs (also of zero maturity), which are not reservable, thereby reducing a bank's required reserves. Over the past few months, depository institutions have stepped up their efforts to initiate sweep programs, leading to sharp declines in checkable deposits and total reserves and thereby depressing both M1 and the monetary base. Because there is little or no reason to believe that the development of sweep accounts has had any measurable impact on aggregate economic activity, the related weakness in the narrow money measures is misleading. Since MZM includes MMDAs, the effects of the sweep program are internalized. Thus, MZM's relationship to economic activity is unaffected.

VII. MZM as a Policy Guide

The estimated interest sensitivity of MZM demand has implications for the aggregate's usefulness as a policy guide. For example, normal interest rate fluctuations over a business cycle may imply relatively sharp movements in the level of MZM demanded. When choosing monetary targets, policymakers typically attempt to project changes in money growth due to demand and set target ranges to accommodate such growth. Because interest rate changes are largely induced by unforeseen circumstances, it would be difficult, if not impossible, to anticipate the appropriate growth rate for MZM in the year ahead. Thus, the aggregate does not seem well suited to being a monetary target, particularly when real shocks to the economy result in desired changes in equilibrium interest rates.

Nevertheless, policymakers may find it useful to monitor MZM. Specifically, MZM could play an important *complementary* role in assessing the indicator properties of the other monetary aggregates, especially M2. Because MZM was immune to the effects of mutual fund development while M2 was not, we can reasonably infer that M2 weakness was largely a portfolio phenomenon—reflecting the substitution of mutual funds for time deposits—and not a signal of inherent weakness in the economy. Monitoring MZM thus allows us to gain some insight into potential problems associated with M2. Moreover, given the widespread implementation of sweep accounts, narrower aggregates such as M1 have become less reliable.

VIII. Conclusion

Deregulation and financial innovation have wreaked havoc on the relationship of traditionally defined money measures with economic activity and interest rates. Surprisingly, perhaps, we have found that an alternative measure of money, MZM, has endured these events quite well. Over the last 20 years, the aggregate has exhibited a stable relationship with nominal GDP and with its own opportunity cost.

Our estimated model of MZM demand is based on the framework proposed by MPS to estimate M2 demand. Out-of-sample predictions in the 1990s reveal that the MZM demand relationship is immune to innovations in the mutual fund industry that led to the demise of M2. In addition, because MZM includes MMDAs, it has not been affected by the advent of sweep accounts, which continue to confound the interpretation of narrower money measures such as M1 and the monetary base.

The relative stability of MZM demand tends to confirm Motley's (1988) and Poole's (1991) conjecture that zero maturity is an important theoretical distinction for determining which assets should be included in a measure of money. Interestingly, Poole invoked the "temporary abode of purchasing power" principle advocated by Milton Friedman, while Motley drew on the notion of "liquidity preference" proposed by Keynes. Nonetheless, both argue that zero-maturity instruments tend to be better insulated from the effects of deregulation and financial innovation.

We find that MZM demand is quite sensitive to changes in opportunity cost. This complicates MZM's usefulness for policy purposes because policymakers may choose to accommodate such changes in demand. The upshot is that MZM is not particularly well suited to being an intermediate target. Nevertheless, it could play a complementary role in monitoring the other monetary aggregates.

Finally, we would like to acknowledge our own reservations about making too much out of empirical relationships estimated over spans of 20 years or less. Clearly, experience has shown that many macroeconomic relationships hold up well for such periods, only to break down miserably once they are taken seriously. What is different about our model of MZM demand is that it has endured a period of tumultuous change that laid waste to most other measures of the money supply.

References

Banerjee, A., et al. *Cointegration, Error-Correction, and the Econometric Analysis of Nonstationary Data.* New York: Oxford University Press, 1993.

Baumol, W.J. "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics,* vol. 66 (November 1952), pp. 545–56.

Collins, S., and C.L. Edwards. "An Alternative Monetary Aggregate: M2 Plus Household Holdings of Bond and Equity Mutual Funds," Federal Reserve Bank of St. Louis, *Review,* vol. 76 (November/December 1994), pp. 7–30.

Darin, R., and R.L. Hetzel. "A Shift-Adjusted M2 Indicator for Monetary Policy," Federal Reserve Bank of Richmond, *Economic Quarterly,* vol. 80, no. 3 (Summer 1994), pp. 25–47.

Duca, J.V. "Should Bond Funds Be Added to M2?" *Journal of Banking and Finance,* vol. 19, no. 1 (April 1995), pp. 131–52.

Engle, R.F., and C.W.J. Granger. "Cointegration and Error Correction: Representation, Estimation, and Testing," *Econometrica,* vol. 55, no. 2 (March 1987), pp. 251–76.

Friedman, M., and A. Schwartz. *Monetary Statistics of the United States: Estimates, Sources, and Methods.* New York: National Bureau of Economic Research, 1970.

Hoffman, D.L., and R.H. Rasche. "Long-run Income and Interest Elasticities of Money Demand in the United States," *Review of Economics and Statistics,* vol. 73, no. 4 (November 1991), pp. 665–74.

Johansen, S. "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control,* vol. 12, nos. 2/3 (June/September 1988), pp. 213–54.

Keynes, J.M. *The General Theory of Employment, Interest, and Money.* New York: Harcourt, Brace, and World, 1936.

Lucas, R.E., Jr. "On the Welfare Cost of Inflation," Center for Economic Policy Research, Publication No. 394, February 1994.

Miller, M.H., and D. Orr. "A Model of the Demand for Money by Firms," *Quarterly Journal of Economics,* vol. 80 (August 1966), pp. 413–35.

Miyao, R. "Does a Cointegrating M2 Demand Relation Really Exist in the United States?" *Journal of Money, Credit, and Banking,* vol. 28, no. 3 (August 1996), pp. 365–80.

Moore, G.R., R.D. Porter, and D.H. Small. "Modeling the Disaggregated Demands for M2 and M1: The U.S. Experience in the 1980s," in P. Hooper et al., eds., *Financial Sectors in Open Economies: Empirical Analysis and Policy Issues.* Washington, D.C.: Board of Governors of the Federal Reserve System, 1990, pp. 21–105.

Motley, B. "Should M2 Be Redefined?" Federal Reserve Bank of San Francisco, *Economic Review,* Winter 1988, pp. 33–51.

Orphanides, A., B. Reid, and D.H. Small. "The Empirical Properties of a Monetary Aggregate that Adds Bond and Stock Funds to M2," Federal Reserve Bank of St. Louis, *Review,* vol. 76, no. 6 (November/December 1994), pp. 31–51.

Poole, W. Statement before the Subcommittee on Domestic Monetary Policy of the Committee on Banking, Finance, and Urban Affairs, U.S. House of Representatives, November 6, 1991.

Porter, R.D., T.D. Simpson, and E. Mauskopf. "Financial Innovation and the Monetary Aggregates," *Brookings Papers on Economic Activity,* vol. 1, no. 79 (1979), pp. 213–29.

Tobin, J. "Liquidity Preference as a Behavior Towards Risk," *Review of Economic Studies,* vol. 25 (1958), pp. 65–6.

Whitesell, W.C., and S. Collins. "A Minor Redefinition of M2," Board of Governors of the Federal Reserve System, *Finance and Economics Discussion Series,* No. 96-7, February 1996.