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Deposit Rate Deregulation and the Demand for Transactions Media

Michael C. Keeley and Gary C. Zimmerman*

The deregulation of deposit rates on personal checking accounts has caused a large portion of the M1 monetary aggregate to become interest-bearing and has raised the question of whether the demand for M1 might also have been affected. This article compares the behavior of deregulated components of M1 with that of the regulated components prior to deregulation. We find that the short-run open-market interest rate elasticities of demand for the noninterest-bearing components prior to deregulation are considerably lower than the elasticities of the deregulated interest-bearing deposits. Deposit rate deregulation, therefore, appears to have made the demand for M1 much more sensitive to interest rate changes.

Many analysts argue that the traditional relationship between M1 and the economy no longer holds. As supporting evidence, they cite the apparent contradiction between M1's historically high annual growth rate of approximately 11 percent between September 1984 and September 1985 and the lack of a resurgence of high inflation that would normally be associated with such rapid money growth. Some have attributed this changed behavior to the elimination of deposit rate ceilings, claiming that the elimination has altered the relationship between the demand for M1 and interest rates, income, or both. In this article, we examine the behavior of each of the components of M1 to see whether deregulation can explain M1's recent unusual behavior.

Deposit rates on personal checking accounts have been deregulated very rapidly during the past few years through the authorization of NOW (Negotiable Order of Withdrawal) accounts nationwide on December 31, 1980 and Super NOW accounts on January 5, 1983. While the NOW account was restricted to pay a maximum of 5¼ percent interest, the Super NOW was totally free of interest rate ceilings. When introduced, the Super NOW had a $2500 minimum balance requirement, but the requirement was reduced to $1000 on January 1, 1985 and dropped entirely on January 1, 1986, thus eliminating the regulatory distinction between NOW and Super NOW accounts.

Personal interest-bearing checking accounts now are free of all regulatory deposit rate or minimum balance restrictions, although individual institutions are free to impose their own minimum balance requirements.[1] Businesses, however, are still limited to holding noninterest-bearing demand deposits.

This deregulation of personal checking accounts raises a number of questions about how the monetary aggregates will behave because balances in the new accounts are counted in the checkable deposit component of M1 — the narrowly defined monetary

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aggregate.[2] Some have suggested that these accounts may have attracted funds from savings-type balances that were previously counted only in the broader monetary aggregates, such as M2 or M3.[3] If true, shifts into the new accounts may have altered the behavior of M1 and changed the relationships between M1 and the economy.

Even if such portfolio shifts did not occur, deposit rate deregulation has the potential to change the income and interest rate elasticities of the demand for checkable deposits and, perhaps, even of currency. This also would change the behavior of the monetary aggregates and prevent them from providing the signals for monetary policy they have in the past.

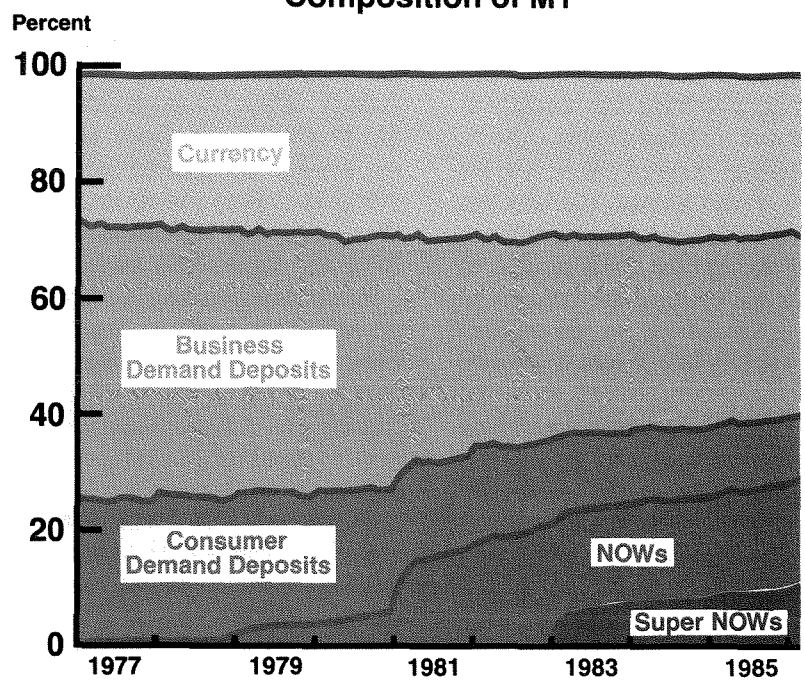
In this paper, we explore these issues. Section I provides a brief sketch of the deregulation of checkable deposits and the impact of those changes on the composition of the monetary aggregates. In Section II, we outline a microeconomic model of the demand for various transactions media and discuss the likely impact of deregulation on that demand. Section III presents our empirical evidence. Finally, Section IV contains a summary and conclusions.

I. The Changing Composition of the Monetary Aggregates

Over the last decade, the composition of M1 has undergone a major shift (See Chart 1). The shift began with the gradual adoption of NOW accounts, which were first available on an experimental basis in New England. NOWs and a number of like accounts — ATS at banks and share drafts at credit unions that will hereafter be referred to as NOWs — raised the explicit interest paid on transaction balances from zero to a maximum of 5¼ percent.[4]

Following their authorization nationwide on December 31, 1980 for banks and thrifts, NOWs grew very rapidly. As Chart 2 shows, even after the initial large shift into NOWs was completed in 1981, interest-bearing checking accounts continued to grow more rapidly than M1's other components. At the beginning of 1980, only 5 percent of households had interest-bearing checking accounts; by 1985, over 35 percent had them. As of mid-1986,

Chart 1
Composition of M1



interest-bearing checking account deposits amounted to $200 billion; and they comprised over 30 percent of M1, and over 70 percent of personal transaction deposits.

Sources of Interest-Bearing Checkable Deposits

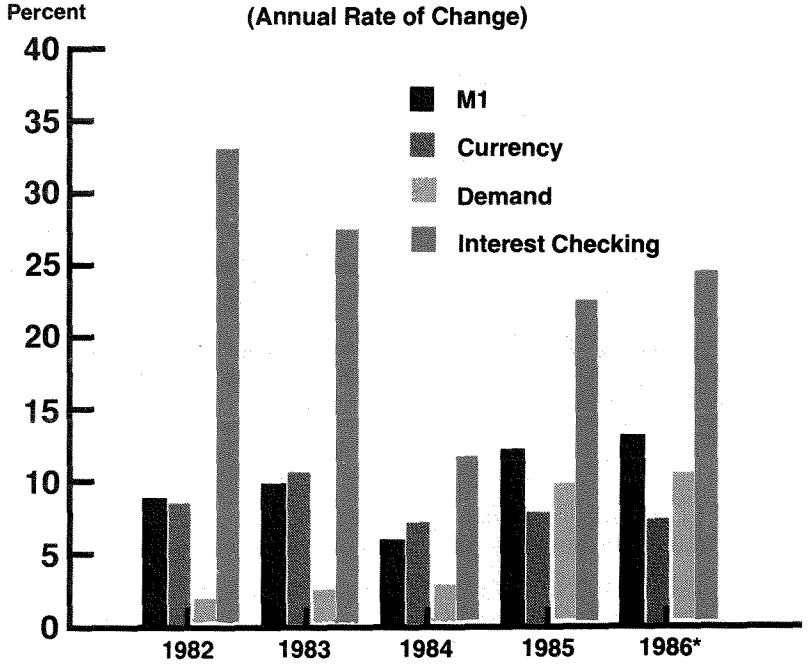
The source of funds moved to interest bearing-checkable deposit balances included in M1 may be an indicator of how M1 will behave. If NOW accounts attracted balances from savings or time accounts, those balances may behave more like savings balances than transaction balances and impart a savings quality to M1. One piece of evidence suggesting that NOWs and Super NOWs may have attracted a sizable portion of funds from non-transaction balances is that the average balances in these transaction accounts are substantially higher (at approximately $5,000 and $13,000, respectively) than the average balance (of approximately $1,500) in personal checking accounts prior to the nationwide authorization of NOWs.[5]

During the introductory NOW period, surveys and studies suggested that about 25 percent of the new money shifted into NOWs came from non-transaction sources.[6] These funds, generally believed to have been shifted from savings accounts and time certificates, may be more interest-sensitive than demand deposits, and therefore may have made M1 more interest-sensitive.

However, there undoubtedly also was a major shift of demand deposits into NOWs during the introductory period. Chart 3 shows, for example, a sharp drop in demand deposits coinciding with the initial sharp increase in NOW balances in early 1981. Our statistical estimates of that shift are consistent with the earlier estimates — they show that about 71 cents of each dollar moved into NOWs came from demand deposits.[7]

NOWs, while apparently more attractive than demand deposits for many consumers, were only partially deregulated (since they had a ceiling rate of 5¼ percent) in contrast to the Super NOW, which offered depositors a full transaction account free of

Chart 2
Growth Rates of M1 and its Components
(Annual Rate of Change)

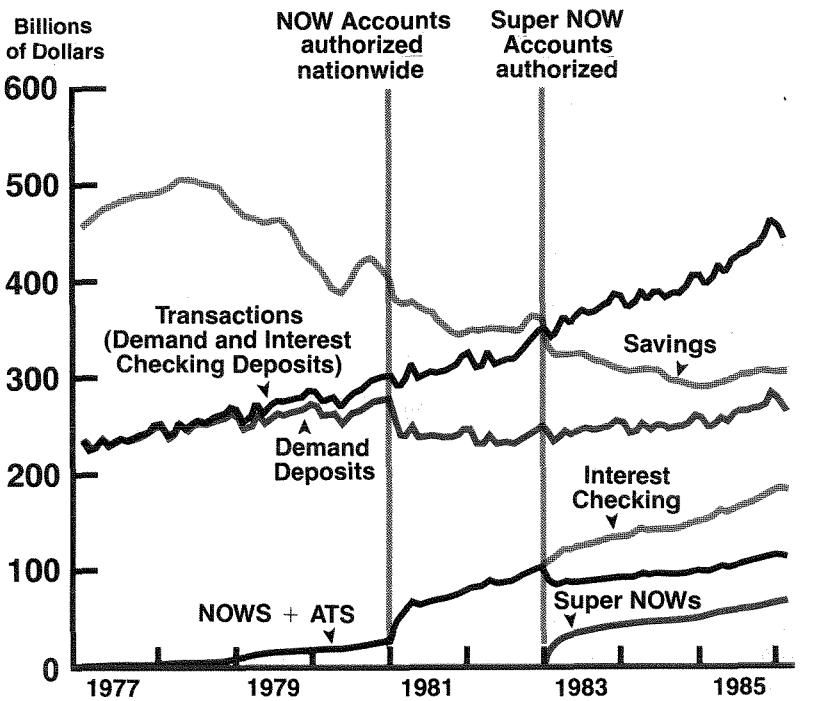


(*Preliminary estimates using first 6 months of 1986)

any interest ceilings. Thus, one might expect many customers to prefer the Super NOW over the NOW. In fact, the Super NOW was very popular and caused a dramatic shift in the composition of M1. By year-end 1985, Super NOWs represented over 10 percent of M1. Chart 3 also suggests that a majority of Super NOW deposits came from NOW accounts[8], although other explanations are possible. The growth in Super NOWs for example, is not inconsistent with a significant inflow from such nontransaction sources as passbook savings or time accounts.

In sum, deregulation has dramatically changed the composition of M1 by making a large portion of it interest-bearing. A future sharp increase in interest rates could well induce flows from the remaining noninterest-bearing demand deposits still held by households into interest-bearing accounts. To understand better the impact of these actual and potential changes, we present the theoretical effects of deregulation and empirical estimates of their magnitude in the following sections.

Chart 3
Transaction and Savings Deposits Over Time



II. Theoretical Framework

The effects of removing interest rate ceilings on deposit accounts depend on how easy it was for depository institutions to circumvent the ceilings through nonprice competition in the first place. A profit-maximizing depository institution would expend resources (both interest and noninterest) on attracting and holding various kinds of deposits to equate the marginal costs of different types of deposits, including transaction deposits. However, depositors' returns need not be equal to the marginal costs of attracting deposits if nonpriced services are not perfect substitutes for cash interest payments.

At one extreme, some economists (for example, Klein, 1974) have argued that ceilings can be circumvented costlessly through nonprice competition. If this were correct, deposit rate deregulation would have no effects. At the other extreme, much of the traditional money demand literature (see Judd and Scadding, 1982, for a review) assumes that the ceilings were perfectly enforced so that deposits for which the payment of interest is prohibited earn no return, even in terms of nonpriced services.

An intermediate position is that binding deposit rate ceilings drive a wedge between depositories' marginal costs of deposits and depositors' marginal returns because of the inefficiencies of nonprice competition (see Keeley and Zimmerman, 1985). That is, in general, depositors value the implicit payments (of nonprice competition) at less than their cost because people generally prefer cash to payments in kind. In other words, barter is less efficient than monetary exchange.

The view that nonprice competition is inefficient implies that removing a deposit rate ceiling would increase the return depositors receive without affecting depositories' marginal costs. Such an increase in depositors' returns should lead to a one-time increase in the quantity of deposits in the affected account. In addition, as we discuss in more detail later, the increase in the level of depositors' returns may affect the interest elasticities of demand for deposits as well.

There is strong evidence supporting the view that nonprice competition is inefficient: NOW accounts succeeded in attracting large quantities of deposits previously held in demand deposits (as well as funds from other accounts), and Super NOW accounts attracted funds from NOWs. These large shifts would not have occurred if depositories had been able to circumvent the ceilings costlessly. Thus, in the aggregate, depositors' returns on Super NOW accounts likely exceeded returns on NOWs, and the returns on NOWs likely exceeded the returns on demand deposits.[9]

The other, more commonly discussed (Santomero and Siegel, 1985), effect of deposit rate deregulation is that deregulation may make deposit rates vary more closely with open market interest rates.[10] This effect is presumably due to the higher cost of varying implicit rather than explicit interest payments, at least in the short-run. However, as Flannery (1982) has argued, explicit retail deposit rates (adjusted for reserve requirements) are not expected to vary one-for-one with open market rates because there are adjustment costs to changing them too. Thus, the importance of this effect is an empirical question.

Although the most important type of deregulation of transaction accounts was the raising and then removing of the deposit ceilings on them, ceilings on term accounts and limited transactions accounts such as the money market deposit account (MMDA) also have been removed. Thus, rates on these other accounts also may vary more than before. Since the other accounts may be substitutes for transaction accounts to a certain degree, the increased variation in term accounts' interest rates also may affect the demand for transaction accounts and currency.

Interest and Income Elasticities

In sum, deposit rate deregulation may have increased the return and/or the covariation of deposit rates with respect to open market rates. Below, we analyze these potential effects on the sensitivity of the demand for transaction deposits to changes in income or open market interest rates. We begin by discussing the implications of a simple inventory model of money demand, and then consider a more general model of asset demand.

An Inventory Model

Much of the literature on deregulation's effects

has used the simple inventory model of money demand.[11] This model, developed by Baumol (1952), assumes that persons minimize the inventory costs of holding transaction balances by holding most of their financial wealth in one asset, such as a bond. This model implies that the demand for real transaction balances D can be written as [12]:

$$\ln D = \alpha + \beta_1 \ln Y - \beta_2 \ln(r - r_d) \qquad (1)$$

where D = real transaction balances
Y = real income
r = open-market interest rate
r_d = rate on deposits
α = a parameter that depends on the transactions costs of selling bonds (assumed to be constant)
β_1 = elasticity of demand with respect to income
β_2 = elasticity of demand with respect to the opportunity cost of holding deposits.

Differentiating lnD with respect to lnr gives:

$$\frac{d\ln D}{d\ln r} = \eta_r^D = -\beta_2 \left(\frac{r}{r - r_d}\right)\left(1 - \frac{\delta r_d}{\delta r}\right) \qquad (2)$$

This equation shows that the elasticity of D with respect to the market rate r, η_r^D, depends on two factors with opposite effects: how close r_d is to r and the covariation of r_d with respect to r. The closer the level of the rate on deposits to the open market rate (that is, the closer r_d is to r), the greater the elasticity; but the greater the covariation of r_d with respect to r, the lower the elasticity.

This model can be used to analyze how the interest elasticities of various transaction media, which are deregulated to different degrees with regard to interest payments, might compare with one another. The most highly regulated transaction medium in a sense is currency, on which the own rate is zero. This model predicts, therefore, that the interest elasticity of currency should be $-\beta_2$.

As mentioned previously, checkable deposits were subject to varying degrees of regulation regarding the payment of interest, with demand deposits being the most highly regulated, Super NOWs the least regulated, and ordinary NOWs at an intermediate stage. If nonprice competition were inefficient, then these varying degrees of regulation would translate into own rates of interest (implicit plus explicit) on transaction media with the following ranking:

$$0 = r_{\text{currency}} < r_{\text{demand deposits}} < r_{\text{NOWs}} < r_{\text{Super NOWs}} \qquad (3)$$

If the own rate of interest on each of these accounts does not vary with open market rates, then equation 2 implies that Super NOWs should be the most interest-elastic (in absolute value) and currency the least, with demand deposits and NOWs in between:

$$\eta_{\text{currency}} < \eta_{\text{demand deposits}} < \eta_{\text{NOWs}} < \eta_{\text{Super NOWs}} \qquad (4)$$

This ranking would still hold even if the covariation of r_d with r, were not zero (which it is not for the Super NOW, for example), as long as it is small compared to the differences in the levels of r_d due to the inefficiencies of nonprice competition. This result, however, is due to the logarithmic form of the demand function, which in turn comes from the inventory-cost minimizing basis of the model. A more general asset demand function would not necessarily reproduce this implication about the ranking of elasticities.

The Short-Run Versus Long Run

Although the covariation of deposit rates with open-market rates may be low in the short-run, especially for implicit interest payments, in the long-run, it is likely that competitive forces would push (implicit plus explicit) deposit rates towards open market rates until they equalled the open market rate times one minus the reserve requirement. Thus, even though the ranking in equation 4 might hold in the short-run, it would seem much less likely to hold in the long-run because in the long-run, r_d would adjust fully to changes in r.

Thus, deregulation may have substantial effects on the short-run interest elasticities yet not affect long-run elasticities. In the empirical analysis, the model we employ allows for differences between long-run and short-run elasticities.

A Generalized Asset Demand Model

The simple inventory model has been criticized on a number of grounds. For one, if reserve requirements were eliminated and deposit rates equalled

open market rates, the model would collapse. A more general model, similar to that discussed in Santomero and Siegal (1985), which does not suffer from this drawback, views the demand for (real) transaction balances as a generalized asset demand that depends on the own rate of return, rates of return on substitute assets (including the open market instrument), and income or wealth:

$$D = f(r_d, r_{s1}, r_{s2}, \ldots, r_{sn}, r, Y) \qquad (5)$$

where r_{si} is the rate of return on a substitute asset i, and Y is real income (or wealth). Taking the derivative of equation 5 with respect to the open market rate r gives:

$$\frac{dD}{dr} = \frac{\delta D}{\delta r_d}\frac{\delta r_d}{\delta r} + \frac{\delta D}{\delta r_{s1}}\frac{\delta r_{s1}}{\delta r} + \cdots + \frac{\delta D}{\delta r_{sn}}\frac{\delta r_{sn}}{\delta r} + \frac{\delta D}{\delta r}. \qquad (6)$$

This formulation has several implications about the effects of deposit rate deregulation — both deregulation of own rates and rates on substitute bank deposits — on the sensitivity of transactions media to the open market rate, r. First, deregulation of the own rate may increase $\delta r_d/\delta r$. This alone would lessen the interest-sensitivity (in absolute terms) of checkable deposits. Second, deregulation of substitute deposits would likely increase $\delta r_{si}/\delta r$, and thus increase the sensitivity of D with respect to r (holding constant the own rate).

Third, by eliminating the inefficiency of nonprice competition, deregulation would increase the level of r_d and thus the partial derivatives in equation 6 would be evaluated at a higher level of r_d. Such an increase in the level of r_d would cause portfolio shifts into transaction deposits, but without a knowledge of the specific functional form of equation 5, it is not possible to judge what the effect would be on interest and income elasticities.

It appears that, in general, theory cannot predict the net effect of deregulation on the interest-sensitivity of checkable deposits with one exception. The deregulation of checkable deposit rates as well as the deregulation of other deposit rates should increase the interest-sensitivity of the demand for currency (since $r_d = 0$), assuming that deposits are substitutes for currency and that rates on checkable and other deposits would vary more closely with open market rates after deregulation.

Income Elasticity

Deregulation may also have altered the income elasticity of demand for currency and bank transaction deposits. The simple inventory model implies that the income elasticity of the demand for all types of transaction media, including fully deregulated accounts, would be unaffected by deregulation (and equal to β_1) as long as $r_d < r$. In contrast, the more general model of asset demand suggests that, as r_d approaches r with deregulation, more and more investment funds may be held in bank transaction deposits because there are costs to holding multiple investments or switching funds from the open-market instrument into bank deposits. If so, the income elasticities of deregulated accounts may differ from those of regulated accounts if the income elasticity of demand for investment balances differs from that for transaction balances.

III. Empirical Results

The traditional approach to studying the effects of deposit rate deregulation on the behavior of transactions media has been to try to determine if the behavior of an aggregate, such as M1 or M2, changed with deregulation (see, for example, Judd, 1983 and Judd and Motley, 1984). This paper takes a different approach, and tries to determine how deregulation might have affected the behavior of each *component* of the M1 monetary aggregate.

Our approach has several potential advantages. First, it may be better able to determine whether deregulation had an effect. Deregulation of personal checkable deposit accounts has been phased in gradually along with deregulation of noncheckable deposits and limited checking accounts and reductions in reserve requirements. Thus, it may be difficult to detect an abrupt change resulting from deregulation by examining an aggregate's behavior

at any one time even though a deregulated account may behave much differently from a regulated one.

Second, our approach may yield more information about deregulation's effects. In particular, only an analysis of the behavior of the components of M1 can test the ranking of short-run interest elasticities of demand implied by the inventory model of money demand. The model implies, under certain assumptions, that the most deregulated media would be the most interest-elastic. Our analysis allows us to test this hypothesis directly by comparing the elasticities of currency, demand deposits, NOW, and Super NOW accounts. By analyzing only the behavior of an aggregate, one cannot compare the demand elasticities of different transactions media that have been deregulated to varying degrees.

Finally, our approach may yield more insight into the future behavior of transactions deposits. Since the final step of deregulation was completed just this year, the behavior of the Super NOW account — a prototype of a fully deregulated account — may give a better indication of the future behavior of transactions deposits than the past behavior of an aggregate dominated by regulated and partially deregulated deposit accounts.

Below, we present estimates of the interest and income elasticities of various transactions media: currency, demand deposits, NOWs, and Super NOWs. We also present estimates for money market deposit accounts (MMDAs) for purposes of comparison. However, before presenting estimates of income and interest elasticities of demand, we present some evidence on how the own interest rates on two deregulated accounts — MMDAs and Super NOWs — have behaved to shed light on the hypothesis that deregulation will increase the covariation of deposit rates with respect to the open market rate.

Covariation of Deposit Rates with Open-Market Rates

The hypothesis that deposit rate deregulation will increase the covariation of deposit rates with respect to open-market rates cannot easily be tested directly because there were no direct measures of (implicit) deposit rates prior to deregulation. However, an extreme version of this hypothesis — that deregulated deposit rates will equal the open-market rate times one minus the reserve requirement — can be tested. An alternative hypothesis suggested by Flannery (1982) is that deposit rates respond sluggishly

TABLE 1

Interest Rate Regressions

Linear Model: $r_{d_t} = a + \beta i_{T\text{-bill}_t} + \epsilon_t$

	a	β	R^2	Period
MMDA	.014***	.72***	.90	83.03-86.02
	(.0036)	(.041)		
Super NOW	.032***	.39***	.82	83.04-86.02
	(.0030)	(.030)		

Adjustment Model: $r_{d_t} = a + (1-\lambda) r_{d\ t-1} + \lambda\beta i_{T\text{-bill}\ t} + \epsilon_t$

	a	1-λ	λβ	β	R^2	Period
MMDA	−.000020	.66***	.30***	.88	.99	83.03-86.02
	(.0013)	(.035)	(.025)			
Super NOW	.0025	.82***	.11***	.61	.98	83.04-86.02
	(.0018)	(.043)	(.018)			

***Significantly different from zero at the 1 percent level.

Monthly data. Standard errors in parentheses.

with respect to open-market rates because of adjustment costs. Tests of these hypotheses for Super NOWs and MMDAs are presented in Table 1, which contains regressions of MMDA and Super NOW rates on the three-month T-bill rate using monthly data.[13]

The hypothesis that deposit rates should equal the reserve-adjusted open market rate implies that, in a linear regression of a deregulated deposit rate on the open-market rate (which we measure as the continuous-time, annualized 3-month T-bill effective yield), the constant term should be zero and the slope equal to one minus the reserve requirement. Estimates of the first set of regressions reject this hypothesis. They both show positive and statistically significant constant terms and slopes of less than one minus the reserve requirement (the reserve requirements are zero for personal and .03 for nonpersonal MMDAs, and .12 for Super NOWs).[14]

One interpretation of the type of deposit rate behavior implied by these results is that there are adjustment costs involved in varying the rate on deposits. In the long-run, bank deposits would be priced competitively (after adjusting for reserve requirements), but in the short-run, the rate on deposits would vary less than one-for-one with open-market rates.

To test directly for sluggish adjustment of deposit rates, we estimated a standard "adjustment" model in which a fraction of the difference, λ, between the actual deposit rate and the equilibrium deposit rate is assumed to be eliminated in each period. The second set of regressions in Table 1 contain estimates of this model. For the MMDA, the estimated adjustment coefficient λ is about one-third and the long-run effect of an increase in the T-bill rate on the deposit rate is somewhat less than unity (.88). A one percentage point increase in the bill rate leads to only a .30 point increase in the MMDA rate in one month.

Super NOW rates behave even more sluggishly, with an adjustment coefficient of .18 and a one-month response of only .11 percentage point to a 1 point increase in the T-bill rate. Part of this greater sluggishness may be due to the much higher reserve requirements on Super NOWs, but the large differences cannot be explained by reserve requirements alone. The explanation may lie in the greater costs involved in opening Super NOW accounts, which increase the associated adjustment costs. Another reason may be that tax incentives make implicit interest a larger part of the return from holding Super NOWs.

In sum, deposit rates on retail deposit accounts do not move one-for-one with open-market rates, at least in the short-run. Even the MMDA, which is not subject to a reserve requirement (on personal accounts), responds sluggishly in the short-run to changes in open-market rates. The Super NOW exhibits even more sluggish behavior. It seems likely that (before deregulation) implicit rates on checking deposits behaved at least as sluggishly and perhaps even more so than Super NOW rates.

While not definitive evidence, the sluggish behavior of the Super NOW rate suggests that the main effect of deposit rate deregulation will be to increase the short-run variation in the relative opportunity cost of transaction deposits. If the elasticity of demand for transaction deposits with respect to that cost were constant, the increased relative variation would imply an increase in the responsiveness of the transactions deposits to changes in the open-market rate.

Effects of Deregulation on Interest and Income Elasticities

Perhaps the most direct way to determine the effect of deposit rate deregulation on the interest and income elasticities of demand for checkable deposits is to compare the elasticities of demand of fully and partially deregulated deposit accounts with each other and with transactions media prohibited from paying interest. Below, we present such comparisons.

Estimates of interest and income elasticities of specific transactions media were obtained from the following partial-adjustment form of the real money demand function that has been widely used in past studies:

$$\begin{aligned} \ln(D_{it}) = {} & \alpha + (1 - \lambda)\ln(D_{it-1}) \\ & + \lambda\beta_1 \ln(r) + \lambda\beta_2 \ln(Y) \\ & + \beta_3 T_1 + \ldots + \beta_{13} T_{11} \\ & + \beta_{14}\,\text{Trend} \end{aligned} \qquad (7)$$

where:

D_{it} = real deposits at time t of type i
r = the nominal open-market interest rate
Y = real income
$T_1, \ldots, T_{11}$ = monthly seasonal dummies
Trend = a linear time trend variable

Monthly data (not seasonally adjusted) from different subperiods within the time frame of January 1959 through February 1986 were used to estimate the parameters of equation 7. The CPI-UXL series, which uses the rental equivalence method of computing housing costs, was used to deflate all nominal variables. (This measure avoids the built-in correlation between interest rates and housing cost, and hence the price level, in the older CPI-U series which included the mortgage costs of housing. See Huizinga and Mishkin, 1985.) The nominal open-market interest rate is the 3-month T-bill rate (converted to a continuous-time yield from the bank-discount basis), and real income is personal income.

In Table 2, estimated interest and income elasticities are presented for three at least partially deregulated deposit accounts: the Super NOW, NOW, and MMDA, and are compared with estimated interest and income elasticities for demand deposits and currency held by the public both prior to and after deregulation.

Estimates for the NOW account are presented separately for the periods before and after the Super NOW was introduced because of a possible change in its interest elasticity. It appears that Super NOWs were successful in attracting substantial deposits

TABLE 2

Interest and Income Elasticities of Deregulated Accounts Compared to Regulated Accounts

	$\lambda\eta_i$	$\lambda\eta_y$	η_i	$(1-\lambda)$	Period
MMDA	−.15***	−.096	−.45	.67***	83.04-86.02
	(.026)	(.29)		(.046)	
Super NOW	−.090***	.26	−.38	.76***	83.04-86.02
	(.020)	(.24)		(.042)	
Now	−.12***	.90	−.29	.58	81.04-82.12
Pre-Super NOW	(.041)	(.88)		(.30)	
Now	−.045***	.057	−.56	.92***	83.04-86.02
Post-Super NOW	(.019)	(.20)		(.051)	
Demand Deposits	−.017***	.20***	−.19	.91***	59.01-80.10
Pre-NOW	(.0023)	(.036)		(.019)	
Currency *(Held by Public)*	−.0050***	.047***	−.10	.95***	59.01-80.10
Pre-NOW	(.00094)	(.0115)		(.016)	
Demand Deposits	−.044***	.31**	−.44	.90***	81.04-86.02
Post-NOW	(.010)	(.11)		(.041)	
Currency *(Held by Public)*	−.0090*	−.028	−.45	.98***	81.04-86.02
Post-NOW	(.0047)	(.043)		(.050)	
Demand Deposits	−.064***	.32	−.28	.77***	83.04-86.02
Post-Super NOW	(.019)	(.20)		(.075)	
Currency *(Held by Public)*	−.0073	−.0019	−.10	.93***	83.04-86.02
Post-Super NOW	(.0095)	(.099)		(.16)	

***Significant at the 1% level.
**Significant at the 5% level.
*Significant at the 10% level.

Standard errors in parentheses.

from NOWs. Since the most interest-sensitive funds in NOWs likely shifted into Super NOWs, NOWs might have become less interest-elastic after Super NOWs became available.

Finally, the first three months after an account was introduced were excluded from the sample periods to allow for portfolio adjustment not related to the explanatory variables. For similar reasons, the two months prior to the introduction of NOWs were excluded from the sample used to estimate the models for demand deposits and currency.[15]

The estimated short-run (one-month) interest elasticities presented in the first column of Table 2 are relatively high for both Super NOW accounts and NOW accounts prior to the introduction of Super NOWs, averaging around −.10. This compares to the interest elasticities of demand deposits and currency of −.017 and −.005, respectively. In fact, the estimated short-run interest elasticity of the Super NOW is closer to the elasticity of the MMDA — an account used primarily for savings, not transactions — than the elasticity of either demand deposits or currency prior to deregulation. The NOW account appears to have become less interest-elastic after the introduction of Super NOWs, but it still is much higher than the short-run interest elasticity of demand deposits or currency prior to deregulation.

The results for demand deposits during the post-deregulation period suggest that their short-run interest elasticity increased over time. For example, the estimated short-run interest elasticity was −.044 during the 1981.04-1986.02 post-NOW period and −.064 during the 1983.04-1986.02 post-Super NOW period, compared to an estimated elasticity of only −.017 during the 1959.01-1980.10 pre-NOW period. Nevertheless, these higher elasticities are still far below those of Super NOWs and even conventional NOWs during the pre-Super NOW period.

The estimated short-run interest elasticities of demand for currency for all periods are considerably lower (in absolute value) than the elasticities of Super NOWs, NOWs or demand deposits as theory predicts. However, there is some indication that the interest elasticity of currency may be higher in the post-NOW period.

For the Super NOW and NOW, the estimated long-run elasticities appear to be larger than that of demand deposits prior to the introduction of NOWs. In addition, the speed of adjustment, λ, for the Super NOW is much greater than that for either demand deposits or currency. The holding of more savings-type funds in these accounts could account for this faster adjustment if savings balances react more quickly than transaction balances to changes in interest rates. The rapid speed of adjustment for the MMDA, which presumably consists mostly of savings balances, provides supporting evidence. In addition, the point estimate of λ for NOWs prior to the introduction of Super NOWs (although not statistically significant) also is higher than those of demand deposits or currency.

The results on income elasticities are less clear-cut than those on interest elasticities. Although the point estimates of the income elasticities of Super NOW and NOW accounts are generally larger than those of either currency or demand deposits, their standard errors also are large and none of the estimates is statistically significant. As a result, it is not possible to determine whether these accounts are more income-elastic than currency or demand deposits. The estimated income elasticity for the MMDA also is not statistically significant, possibly because its balances are of a longer term investment nature and therefore do not respond to monthly fluctuations in income.

Interpretation of Results

The results on the demand for various transactions media suggest that deregulation has increased the absolute value of the media's short-run interest elasticities. One interpretation of these results is that they confirm the hypothesis of the traditional inventory model that a higher level of rates on deregulated accounts in conjunction with relatively little own rate variation causes the demand for deregulated accounts to be more interest elastic, at least in the short-run. This interpretation is consistent with both the lower interest elasticity of demand for currency (whose own rate is zero) compared to that for demand deposits (whose implicit rate is greater than zero), and the higher elasticity of Super NOW accounts compared to that of demand deposits.

These results are also consistent with the notion that lifting the ceilings on consumer checkable accounts has reduced the inefficiencies of nonprice

competition and thus increased the effective rate depositors receive.

An alternative explanation might be that Super NOWs and NOWs contain more savings-type balances than do demand deposits, and that savings balances are more sensitive at the margin to interest rate changes.

The interest elasticity results are consistent with our finding that the own rates on Super NOWs do not vary closely with open market rates in the short-run. As a result, a change in market rates causes a larger *percentage* change in the opportunity cost of holding Super NOWs. Since the inventory model of money demand implies that the elasticity of demand with respect to the opportunity cost is constant, greater variability in the opportunity cost of deregulated accounts would explain why those accounts apparently have higher interest-sensitivities with respect to market rates.

One Additional Test

One additional test of this hypothesis is to estimate the interest-sensitivity of the demand for a deregulated account with respect to its opportunity cost rather than the open market rate. If the hypothesis were correct, the short-run interest elasticity of demand with respect to the opportunity cost for a deregulated account should be much closer to that of a regulated account with respect to the open market rate.

This type of test can be carried out best for the Super NOW since it is the only checkable deposit entirely free from interest ceilings and for which data are available on its own rate. However, as discussed previously, it is likely that Super NOWs do pay some implicit interest. Using its explicit rate as a measure of the total rate therefore probably biases the measured opportunity cost upward, and thus the estimated interest-sensitivity.

The results of estimating the model described by equation 7 for Super NOWs, but using the log of the *difference* between the open-market rate (the three-month Treasury bill rate) and the Super NOW rate are as follows. As expected, the estimated short-run elasticity with respect to the opportunity cost is much lower (in absolute value) than the elasticity

TABLE 3

Interest and Income Elasticities of M1 before and after the Nationwide Introduction of NOWs

Separate Models

	$\lambda\eta_i$	$\lambda\eta_y$	η_i	$(1-\lambda)$	Period
M1 Before NOWs	−.012***	.19***	−.09	.86***	59.01-80.10
	(.0016)	(.033)		(.026)	
M1 After NOWs	−.041***	.19***	−.82	.95***	81.04-86.02
	(.0079)	(.77)		(.044)	

Fully Interactive Model

(Tests of the statistical significance of the difference between periods 59.01-80.10, 81.04-86.02)

	$\lambda\eta_i$	$\Delta^a\lambda\eta_i$	$\lambda\eta_y$	$\Delta^a\lambda\eta_y$	$(1-\lambda)$	$\Delta^a(1-\lambda)$
M1 Pooled Data	−.012***	−.028***	.19***	.0007	.86***	.087
	(.0016)	(.0086)	(.033)	(.089)	(.025)	(.053)

[a] The symbol Δ is used to denote the change in the parameter during the 81.04-86.02 period.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Standard errors in parentheses.

with respect to the open market rate as reported in Table 2. (−.026 versus −.090). The estimated short-run elasticity with respect to the opportunity cost is close to the elasticity of demand deposits with respect to the market rate in the pre-NOW period (−.017). Thus, this result also is consistent with the prediction of the traditional inventory demand model that deregulation will increase the short-run elasticity with respect to the open-market rate if the own rate does not vary strongly with the open-market rate.

Effects on M1

One implication of these results is that the deregulation of rates should have increased the interest-sensitivity of an aggregate such as M1, which includes NOW and Super NOW accounts. The interest elasticity of an aggregate such as M1 is a weighted sum of the interest elasticities of the aggregates' components — the weights being each component's share of the aggregate. Below, we test the hypothesis by comparing the short-run interest elasticity of M1 before and after the introduction of NOWs. The results of this test are presented in Table 3.

To determine whether the short-run interest elasticity of demand for M1 increased after NOWs were introduced nationwide in January 1981, we estimated the basic model described by equation 7 separately for the two periods 1959.01 - 1980.10 and 1981.04 - 1986.02. The first three months of 1981 were excluded because NOW accounts were in an adjustment phase then, and possibly attracted funds not previously held in checkable deposit accounts. The last two months of 1980 were excluded because many banks promoted the new accounts by offering high rates on retail RPs at the time.

TABLE 4

Interest and Income Elasticities of Demand Deposits and Publicly-Held Currency Before and After the Introduction of Nationwide NOWs

Separate Models

	$\lambda\eta_i$	$\lambda\eta_y$	η_i	(1-λ)	Period
Demand Deposits Before NOWs	−.017*** (.0022)	.20*** (.036)	−.19	.91*** (.019)	59.01-80.10
Demand Deposits After NOWs	−.044*** (.010)	.31*** (.12)	−.44	.90*** (.041)	81.04-86.02
Currency Before NOWs	−.0050*** (.00094)	.047*** (.011)	−.10	.95*** (.016)	59.01-80.10
Currency After NOWs	−.0090*** (.0047)	−.027 (.043)	−.45	.98*** (.050)	81.04-86.02

Fully Interactive Model

	$\lambda\eta_i$	$\Delta\lambda\eta_i$	$\lambda\eta_y$	$\Delta\lambda\eta_y$	(1-λ)	Δ(1-λ)	Period
Demand Deposits	−.017*** (.0022)	−.028*** (.011)	.19*** (.035)	.12 (.13)	.92 (.018)	−.016 (.047)	59.01-80.10 81.04-86.02
Currency	−.0050*** (.00092)	−.0040 (.0056)	.047*** (.011)	−.074 (.052)	.95 (.016)	.026 (.060)	59.01-80.10 81.04-86.02

***Significant at the 1% level
**Significant at the 5% level
*Significant at the 10% level

Standard errors in parentheses.

The results indicate that the short-run interest-sensitivity of M1 apparently more than tripled (in absolute value) from −.012 to −.041. To test whether this increase was statistically significant, the data from the two periods were pooled and a fully interactive version of equation 7 was estimated on the pooled sample, allowing each parameter to take on different values in the two periods. In the bottom part of Table 3, T-tests are presented of whether the key parameters in the post-NOW period are statistically significantly different from those in the pre-NOW period. The tests show that the increase in interest elasticity was statistically significant at the 1 percent level, whereas neither income elasticity nor the adjustment parameter changed by a statistically significant amount. Thus, the results provide very strong evidence that the short-run interest elasticity of M1 in the period after NOWs were authorized nationwide was higher (in absolute value) than before. This result is consistent with the much higher interest elasticities of Super NOWs and NOWs, but does not prove that their introduction was the sole cause of the increase in interest-sensitivity of M1.

Another possible cause of M1's increased interest-sensitivity is an increase in the interest-sensitivity of the other components of M1 as well, perhaps due to the deregulation of noncheckable accounts, such as the money market certificate, and limited checking accounts, such as the MMDA. To test this hypothesis, we estimated the model described by equation 7 for demand deposits and currency before and after the nationwide introduction of NOWs. The results are reported in Table 4. The point estimates of the interest elasticities of demand deposits and currency are higher (in absolute value) in the post-NOW period. However, only the increase in the demand deposit interest elasticity is statistically significant.

The increase in the estimated interest-elasticity for demand deposits may be due to a switch by consumers into NOWs and Super NOWs that left businesses holding an increased portion of demand deposits. It also might be due to deregulation of other accounts that are substitutes for demand deposits. Whatever the reason, the increase in the interest elasticity of demand deposits is part of the explanation for the increased interest elasticity of M1. (It is also possible that currency contributed to the increase, but we cannot determine statistically whether it did.)[16] Also, Super NOWs and/or NOWs contributed to the increase since the elasticity of M1 in the post-Super NOW period exceeds the elasticities of either currency or demand deposits.

Because of an increase in the short-run interest elasticity of each of the components of the M1 monetary aggregate after deregulation, M1 is now more interest-sensitive — about 4 times more sensitive according to our findings. Thus, M1 should show wider variations in response to exogenous interest-rate changes now than before deregulation.

IV. Summary and Conclusions

Deposit rate deregulation has caused a major change in the composition of M1. As of mid-1986, 30 percent of M1 consisted of interest-bearing checking accounts. This changed composition of M1 and the associated rapid growth of its interest-paying components has raised the question of whether deposit rate deregulation has also changed the demand for M1.

The empirical results presented in this paper suggest that the short-run elasticity of demand for M1 with respect to the open market rate has been affected, but that there were no statistically significant changes in other parameters of the demand function. Specifically, our results suggest that the short-run interest elasticities of demand for NOW and Super NOW deposits exceed those of either demand deposits or publicly held currency prior to the nationwide authorization of NOW accounts.

One explanation for these higher interest elasticities is that deposit rate deregulation has increased the total (implicit plus explicit) returns to depositors by lessening the inefficiencies of non-price competition while not increasing, at least by much, the short-run covariation of total deposit returns with respect to the open market rate. The combination of these two factors, in turn, has led to increased variation in the relative opportunity cost of NOW and Super NOW deposits. Assuming the elasticity of demand with respect to the opportunity cost is constant implies that the short-run interest

elasticity of these accounts with respect to the open-market rate has increased.

An additional factor accounting for the increase in the short-run interest-sensitivity of M1 is the apparent coincident increase in the interest-sensitivity of demand deposits with the nationwide introduction of NOW accounts. Also, there appears to be an increase in the short-run interest elasticity of currency associated with the introduction of money market certificates — an important first step in the deregulation of deposit rates on nontransaction accounts.

Not only has deposit rate deregulation apparently changed the short-run behavior of the M1 monetary aggregate, it is also likely to make the composition of M1 more variable than before. This is because the demand for the interest-bearing components of M1 appears to be much more interest-elastic than the noninterest-bearing components, at least in the short-run. Moreover, deposit rate deregulation has apparently indirectly increased the short-run interest elasticity of demand for the noninterest-bearing components.

These changes in demand raise questions for monetary policy under virtually any view of what money is and how money is related to other aspects of the economy. For one, they suggest that the traditional relationships between M1 and the economy have changed. For another, they raise an even more basic question of whether an aggregate comprised of both interest-bearing and noninterest-bearing components with different interest elasticities and changing relative prices is useful as a guide to monetary policy.

FOOTNOTES

1. While deregulation has made interest-bearing checking accounts available to all consumers, the prohibition against the payment of interest on traditional noninterest-bearing demand deposits remains. Hence, consumers have the option of either interest-bearing NOW or Super NOW accounts, or noninterest-bearing checking accounts, which typically have both lower minimum balance requirements and lower fees.

2. M1 ($639.9 billion as of December 1985, not seasonally adjusted) is defined to include only financial assets that are used as media of exchange. It includes publicly held currency ($173.1 billion), travelers checks ($5.5 billion), net demand deposits at banks ($281.3 billion), and other checkable deposits consisting of NOWs, Automatic Transfer Service (ATS) accounts, credit union share drafts and demand deposits at thrifts ($115.8 billion), and Super NOWs ($64.2 billion).

3. The broader monetary aggregate, M2, includes both transaction balances reported in M1, and savings-type balances, such as MMDAs, savings deposits, small time certificates, general purpose money market mutual fund shares, and other short-term financial assets. M3 is an even broader aggregate. In addition to M2, it includes large-denomination time deposits, term RPs and Eurodollars, and institution-only money market funds. Because both M2 and M3 contain both savings and transaction balances, they are much less likely to be affected by portfolio shifts between transaction and savings balances than M1 which contains only transaction balances.

4. Ceilings for banks and savings and loans were 5¼ percent, while during some periods, credit union share drafts were allowed to pay higher rates.

5. Data on NOW and Super NOW balances are from the Federal Reserve Board's "Quarterly Survey of Number of Selected Deposit Accounts" for November 1985. Personal checking account average balances for 1980 are from the Functional Cost Analysis, published by the Federal Reserve Banks. Average account balances in NOWs and Super NOWs are well above typical minimum balance requirements for free NOW and Super NOW accounts which averaged $1073 and $3300 respectively, as reported in Sheshunoff and Company's study entitled "Pricing Bank Services and Loans," 1985.

6. See *Federal Reserve Bulletin,* July 1981, page 542.

7. The statistical estimates are from a statistical model in which the change in demand deposits was regressed on the change in NOW deposits and changes in interest rates, a time trend, seasonal factors, and a dummy variable for the period covered by the special credit restraint program in 1980. The model was estimated for the period from February 1959 through June 1981 to include the first six-month adjustment period following the nationwide introduction of NOW accounts. A $1.00 increase in NOWs (including ATS accounts) was estimated to result in a statistically significant $.71 decline in demand deposits.

8. We were unable to obtain a statistically significant estimate of the shift from NOWs into Super NOWs.

9. There are reasons that not all (personal) transaction deposits shifted into Super NOWs even though their total returns likely exceeded those on other transaction deposits. For one thing, implicit interest is nontaxable, explicit interest is taxable and transactions fees are not deductible. Thus, some depositors with high transactions needs, small average balances, or high tax rates might prefer to receive nontaxable implicit interest through "free" transaction deposits that earn no explicit interest rather than receive taxable interest and pay (nondeductible) transaction fees.

Similarly, many depositories continue to require minimum balances in Super NOW accounts as a method of compensation for the transaction services they provide rather than

charge fees directly. This is sensible even though such balances incur the implicit reserve tax because this tax is still far lower than the typical personal marginal income tax rate.

10. In addition, the gradual reduction in reserve requirements that has been occurring may increase the absolute (but not relative) variation of interest payments on transaction deposit accounts with open-market rates. The ratio of required reserves to checkable deposits has declined from over 22 percent in the early 1940s to about 10 percent now; there was a 40 percent decline in the time since the Monetary Control Act of 1980 was passed. As reserve requirements decline, we expect that the absolute variation in interest rates on reservable deposits accounts with respect to open-market rates will increase. This increased variation, in turn, may affect the degree to which persons substitute among different accounts and among deposit and nondeposit investments depending on whether demand depends on the absolute or relative variation in rates.

11. See, for example, the discussion in Simpson (1984).

12. The simple model derived by Baumol implies income and interest elasticities should be one-half. However, a more general formulation is silent on the magnitude of these parameters.

13. All interest rates are continuous time annual yields, and thus have the same dimension.

14. To determine whether our use of the T-bill rate as a measure of the open-market rate was appropriate, we regressed the T-bill rate on the Federal Funds and 1-month CD rates (two other open-market rates). The results are as follows:

	α	β	R^2	Period
Federal Funds	−.0068 (.0048)	1.08*** (.056)	.92	83.03-86.02
1-Month CD:	−.0033 (.0036)	1.05*** (.041)	.95	83.03-86.02

***Significant at the 1% level

These regressions have zero intercepts and unitary slopes, as expected, and confirm that the T-bill rate is a good measure of an open-market rate.

15. The model described by equation 7 in Table 2 was also estimated in first difference form as a check on the robustness of the estimates (see Plosser and Schwert, 1977 and 1978, and Plosser, Schwert and White, 1982). Also, the model was estimated excluding the first six months after the account was offered to allow for a longer adjustment not related to the explanatory variables. The results, however, are relatively robust with respect to these two changes.

16. It is possible that the interest elasticity of the demand for currency increased when nontransactions accounts were deregulated. If so, the test reported in Table 4 has little power because the wrong breakpoint was used. Using June 1978 as the breakpoint — the date the 6-month money market certificate was authorized and the date many argue was the first important step in deregulating the interest rates on noncheckable accounts — we found that the estimated short-run interest elasticity of currency increased by a statistically significant amount. In fact, it more than doubled from −.014 to −.031.

REFERENCES

Barro, Robert J. and Anthony M. Santomero. "Household Money Holdings and the Demand Deposit Rate," *Journal of Money, Credit and Banking,* Vol. IV, May 1972.

Baumol, William J. "The Transactions Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics,* Vol. LXVI, November 1952.

Flannery, Mark J. "Retail Bank Deposits as Quasi-Fixed Factors of Production," *American Economic Review,* Vol. 72, No. 3, June 1982.

Huizinga, John and Frederick S. Mishkin. "Monetary Policy Regime Shifts and the Unusual Behavior of Real Interest Rates," unpublished paper. National Bureau of Economic Research, Cambridge: March 1985.

Judd, John P. and John Scadding. "The Search for a Stable Money Demand Function," *Journal of Economic Literature,* Vol. XX, No. 3, September 1982.

Judd, John P. "Deregulated Deposit Rates and Monetary Policy," *Economic Review,* Federal Reserve Bank of San Francisco, Fall 1983.

Judd, John P. and Brian Motley. "The Great Velocity Decline of 1982-83: A Comparative Analysis of M1 and M2," *Economic Review,* Federal Reserve Bank of San Francisco, Summer 1984.

Keeley, Michael C. and Gary C. Zimmerman. "Competition for Money Market Deposit Accounts," *Economic Review,* Federal Reserve Bank of San Francisco, Spring 1985.

Klein, Benjamin. "Competitive Interest Payments on Bank Deposits and the Long-Run Demand for Money," *American Economic Review,* Vol. 64, No. 6, December 1974.

Plosser, Charles I. and G. William Schwert. "Money, Income and Sunspots: Measuring Economic Relationships and the Effects of Differencing," *Journal of Monetary Economics,* Vol. 4, 1978.

Plosser, Charles I., G. William Schwert and Halbert White. "Differencing as a Test of Specification," *International Economic Review,* Vol. 23, No. 3, October 1982.

Santomero, Anthony and Jeremy J. Siegal. "Deposit Deregulation and Monetary Policy," #16-85. Rodney L. White Center for Financial Research, 1985.

Simpson, Thomas D. "Changes in the Financial System: Implications for Monetary Policy," *Brookings Papers on Economic Activity.* Vol. 1, 1984.

Startz, Richard. "Competition and Interest Rate Ceilings in Commercial Banking," *Quarterly Journal of Economics,* May 1983.

Startz, Richard. "Implicit Interest on Demand Deposits," *Journal of Monetary Economics,* Vol. 5, 1979.