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Contemporaneous vs. Lagged Reserve Accounting: Implications for Monetary Control

By David S. Jones

To enhance the Federal Reserve System’s ability to control the nation’s supply of money and credit, commercial banks and other depository institutions are required by law to hold some of their assets as reserves. The amount of an institution’s legal reserve requirement, which may be met with vault cash or demand balances at Federal Reserve Banks, is related to its deposit liabilities. Under the present system of lagged reserve accounting (LRA), the reserve requirement for a given settlement period—seven days ending each Wednesday—is based on deposit liabilities two weeks earlier.

The present LRA structure has been in place since September 1968. Previously, reserve accounting was contemporaneous in that the reserve requirement for a given settlement period was based on deposit levels for that same period.

Over the past few years, many economists have argued that a return to contemporaneous reserve accounting (CRA) would improve the precision of monetary control. Although other economists have questioned this claim, in the fall of 1980 the Board of Governors of the Federal Reserve System announced its disposition to return to CRA, pending a further review of its operational practicality. On October 9, 1981, the Board requested public comment on a specific CRA proposal that would introduce essentially contemporaneous reserve requirements on transactions accounts for medium-sized and large depository institutions.

The eventual decision to return to CRA or to continue with an LRA system must weigh any anticipated improvement in monetary control under CRA against the additional costs that CRA will impose on both the Federal Reserve and depository institutions. The central issue is whether the expected degree of improvement in monetary control under CRA compensates for the additional economic costs.

The purpose of this paper is to assess the likely improvement in monetary control that would accompany a return to CRA. A formal cost-benefit analysis is not undertaken, however, because reliable estimates of the additional costs associated with implementing CRA are not presently available. In the first section of the article, the history of the reserve accounting system is reviewed. The second section sets forth a simple theoretical model of the monetary control process and, within the context of this model, discusses the major empirical issues relating to monetary control under...
LRA and CRA. The third section reviews the existing empirical research relating to monetary control under LRA and CRA. The fourth section then presents new evidence derived from simulations of a weekly econometric model of the U.S. money market developed for this study. A summary and concluding remarks appear in the fifth section.

THE PRESENT RESERVE ACCOUNTING SYSTEM

The present LRA system, as mentioned above, has been in place since September 1968. Previously, reserve accounting was contemporaneous in that an institution’s reserve requirement for a given settlement period was based on its deposit liabilities during that same period. Another important feature of the earlier reserve accounting system was that reserve vault cash consisted of vault cash held during the settlement period. Also, a limited “carryover provision” allowed a bank to carry forward into the following settlement period a reserve deficiency of up to 2 percent of its reserve requirement without penalty, although positive excess reserves could not be carried forward. Finally, while the settlement period for reserve city banks was one week ending each Wednesday, the settlement period for country banks was two weeks ending every other Wednesday.

A number of considerations motivated the abandonment of the earlier CRA system in favor of the present reserve accounting structure. One consideration was that, due to large revisions in required reserves and vault cash, CRA complicated the Federal Reserve’s efforts to achieve its objectives for net free reserves, a key operating target for monetary policy at the time. Also, it was thought that the reserve accounting system contributed to sharp movements in the federal funds rate that sometimes occurred toward the end of statement weeks, as member banks scrambled to sell excess reserves in the federal funds market. A major reason for this volatility in the federal funds rate, it was thought, was the inability of member banks to carry positive excess reserves forward into the following settlement period. A contributing factor was thought to be the inability of banks to predict their reserve requirement accurately.

A third, but related, consideration was that CRA unduly exacerbated the burden of Federal Reserve membership.

In light of the perceived problems with the earlier system, the Federal Reserve’s Regulation D, which defines the reserve accounting structure, was amended effective September 12, 1968, to incorporate several important changes. New methods for computing required reserves and reserve vault cash were adopted to improve the estimates of these quantities. Required reserves under the new formula were based on deposit levels two weeks earlier, while reserve vault cash was redefined to consist of vault cash held two weeks earlier. In addition to simplifying the conduct of monetary policy, these modifications were expected to contribute to more efficient and less costly reserve management by member banks and, as a result, lessen the membership burden.

The carryover provision was also liberalized to permit member banks to carry forward into the following settlement period positive excess

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1 There was, however, an effective lag of one day because required reserves were based on deposit levels at the beginning of the day, whereas reserves were equal to end-of-day balances at Federal Reserve Banks and beginning-of-day vault cash.
4 See Federal Reserve Board Staff, October 6, 1977.
reserves of up to 2 percent of reserve requirements. This action was expected to create an incentive for banks not to sell excess reserves into the federal funds market at temporarily depressed interest rates, thereby helping to moderate downside interest rate fluctuations toward the end of statement weeks.

In brief, the amendments to Regulation D were expected to simplify the conduct of monetary policy, ease the burden of reserve management for member banks, and temper intraweekly interest rate fluctuations. To some extent, these expectations were realized. Federal Reserve estimates of required reserves and reserve vault cash did improve substantially after September 12, 1968. Moreover, member banks generally favored the lagged reserve accounting structure, especially small banks and banks with extensive branch systems. Contrary to expectations, however, intraweekly federal funds rate volatility initially intensified rather than diminished under the new system. This increased volatility was partially attributed to the greater sensitivity of the federal funds rate to reserve supply shocks under LRA. The problem was arrested by an enlarged volume of defensive open market operations undertaken by the Federal Reserve. By 1974, intraweekly fluctuations in the federal funds rate had fallen back to levels comparable with those prevailing before September 1968.

While LRA was partly successful in helping solve some problems faced by monetary policymakers in 1968, many economists and public officials have argued that a return to CRA would improve monetary control. On August 15, 1980, the Board of Governors announced its disposition to return to CRA pending a further review of its operational practicality. On October 9, 1981, the Board requested public comment on a specific CRA proposal which would introduce essentially contemporaneous reserve requirements on transactions accounts for medium-sized and large depository institutions.

Under the October 1981 proposal, CRA would apply only to institutions that report their deposit levels weekly to the Federal Reserve. Affected institutions would compute required reserves against transactions deposits and other reservable liabilities on the basis of average deposit levels over two-week computation periods ending on Monday. Required reserves against transactions deposits would be maintained during a two-week maintenance period ending on the Wednesday two days after the computation period. Required reserves against other reservable liabilities, however, would be posted in a two-week maintenance period beginning 17 days after the computation period, on a Thursday. Vault cash, eligible to be counted as a reserve during the maintenance period, would continue to be lagged and would be equal to vault cash holdings during the computation period ending 17 days prior to the beginning of the maintenance period. The proposal would retain

6 A contributing factor was that, in addition to the amendments cited above, the September 1968 amendments to Regulation D also changed the settlement period of country banks from biweekly to weekly.
7 A change in the U.S. Treasury's cash management procedures also complicated the Open Market Desk's efforts to reduce the volatility of the federal funds rate. See Federal Reserve Board Staff, October 6, 1977.

the current limit of plus or minus 2 percent of daily average required reserves that applies to the carryover of reserve surpluses or deficiencies into the next reserve period. However, lengthening the reserve period from one week to two weeks would provide the same additional flexibility for managing reserve positions as would a doubling of the carryover limit with a one-week period.

The case for returning to CRA is based on the view that monetary control, especially in the shorter run of a month or so, would be more precise under CRA than under LRA. Proponents of CRA argue that it is particularly attractive under a reserves targeting monetary control procedure like the nonborrowed reserves procedure adopted on October 6, 1979. CRA proponents also claim that, in practice, CRA is a prerequisite for adopting an operating procedure involving the targeting of total reserves or the monetary base, should the Federal Reserve wish to adopt either procedure at some future date.

Although monetary control might be enhanced under CRA, there are two reasons why returning to CRA may not be desirable. One is the implementation and operating costs to the Federal Reserve and to private institutions. While the Federal Reserve's membership problem has been solved, the System properly remains concerned about the economic cost of its regulatory actions. For the Federal Reserve, returning to CRA would necessitate reprogramming its computers and developing and administering new monitoring systems. For private depository institutions, the additional costs would be associated with modifying their existing internal deposit monitoring and reserve management systems.

The second reason that a return to CRA may not be desirable is that the possible improvement in monetary control may be small. Thus, the benefits of returning to CRA may not outweigh its attendant costs. In assessing CRA, therefore, it is useful to examine both the theoretical and empirical evidence on the monetary control issue.

RESERVE ACCOUNTING AND MONETARY CONTROL

This section analyzes the theoretical implications of the reserve accounting system for short-run monetary control. The analysis is conducted within the framework of a theoretical model that shows how the weekly stock of money is determined and controlled.

A Model of the Determination of the Stock of Money

The stock of money, along with the short-term interest rate, is determined by the public’s demand for money, by depository institutions’ demand for reserves, and by the supply of reserves made available through the Federal Reserve. The quantity of money demanded by the public is related mainly to the short-term rate of interest and the level of economic activity—measured, for example, by the level of income. Increases in the market interest rate, other things equal, induce individuals and firms to transfer some of their money balances to higher yielding market instruments. For a given interest rate, as the level of income rises, the public requires a greater quantity of money to carry out a larger volume of economic transac-


tions. Thus, the demand for money is related positively to the level of income and negatively to the level of the short-term interest rate.

The curve, MD, in the left-hand panel of Figure 1 illustrates the relationship between the demand for money and the short-term interest rate. For a fixed level of income, the curve shows the quantity of money demanded at different interest rate levels. Thus, given an interest rate, r₀, and income level, Y, the quantity of money demanded by the public is M₀. The MD schedule slopes downward, reflecting the presumption that the public holds less money as the short-term interest rate rises.

The effect of a change in income on the demand for money may be represented by a horizontal shift in the MD curve. For example, an increase in income from Y to Y' will shift the MD curve rightward—say, from MD to MD' in Figure 1—as the public demands more money balances at every interest rate in order to carry out a higher volume of economic transactions.

The short-term interest rate, on which the demand for money partially depends, is determined by the demand for and supply of reserves, that is, the short-term rate of interest adjusts until reserve demand and supply are equal. The supply of total reserves available to depository institutions equals the sum of borrowed reserves—reserves that institutions borrow from the Federal Reserve through the discount window—plus nonborrowed reserves, NBR, that is, reserves arising from all other sources. The Federal Reserve proximately controls the level of nonborrowed reserves through open market operations. Borrowed reserves, on the other hand, are determined by the willingness of depository institutions to borrow at the discount window. Borrowings tend to be positively related to the spread between the short-term market interest rate and the discount rate, which is taken to be fixed in this analysis. The greater this spread, the more profitable it is for banks to borrow from the discount window and, hence, the greater the level of borrowed reserves. Administrative pressure and bankers' traditional reluctance to borrow from the discount window account for the failure of banks

**Figure 1**

THE MONEY AND RESERVES MARKET
to completely arbitrage away differences between the short-term market interest rate and the discount rate.

The RS curve in the right-hand panel of Figure 1 represents the supply of total reserves to the financial system at various rates of interest. This curve is drawn assuming a fixed level of nonborrowed reserves, NBR\(Q\). RS is vertical for short-term interest rates below the discount rate, reflecting the fact that discount borrowing is minimal at such levels because it is unprofitable from the standpoint of institutions. For interest rates above the discount rate, RS is positively sloped as higher money market rates induce higher levels of borrowings.\(^{12}\)

A change in the level of nonborrowed reserves is represented by a horizontal shift in the RS curve. For instance, an increase in NBR will shift the entire RS curve rightward by the amount of the increase.

The demand for reserves is the sum of depository institutions' required reserves and desired excess reserves. Because required reserves are computed differently under LRA and CRA, the demand for reserves in each case must be treated separately. Under LRA, required reserves in any week are predetermined by deposit levels two weeks earlier. Thus, under LRA, given the assumption that the demand for excess reserves does not depend on interest rates,\(^{13}\) the demand for total reserves in any week may be represented by a vertical curve, such as RDLRA in Figure 1. Changes from week to week in desired excess reserves or in required reserves—due, say, to a shift in the MD curve of Figure 1—imply rightward or leftward shifts in RDLRA as the sum of required and desired excess reserves increases or decreases. However, under LRA, the reserve demand curve will not shift in the same week as the shift of the MD curve. Rather, RDLRA will shift in later weeks as future reserve requirements are affected.

Under CRA, the demand for reserves is not represented by a vertical curve in any given week. This is because changes in interest rates during the week may affect required reserves in the same week by affecting the public's holdings of money. For instance, under CRA an increase in the rate of interest will generally lower the quantity of money demanded by the public, thereby lowering required reserves for the same week. The reserve demand schedule under CRA, therefore, is negatively related to the interest rate as illustrated by RDCRA in Figure 1.

Because reserve demand is contemporaneously linked to money demand under CRA, a shift in the money demand curve in a given week will induce a sympathetic shift in the reserve demand curve. To illustrate, suppose a rise in income causes MD to shift to MD' in Figure 1. This shift will induce a rightward shift in RDCRA, say, to RDCRA', as required reserves rise along with the increase in the demand for money.

The money demand and reserve supply and demand curves in Figure 1 can be used to illustrate graphically the process which determines the money supply and short-term interest rates. Suppose LRA is in effect and that, given past deposit levels, the demand for reserves may be represented by RDLRA. Also suppose that the Federal Reserve pursues a nonborrowed reserves operating strategy, setting the level

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\(^{12}\) The shape of the RS curve is affected by the Federal Reserve's choice of operating target. For example, the RS curve in Figure 1 presumes a nonborrowed reserves operating target. That is, over the operating period—say, one week—the level of nonborrowed reserves is fixed. Under a total reserves targeting procedure, the RS curve would be vertical at that level of total reserves supplied by the Federal Reserve. Operationally, the Federal Reserve could implement a total reserves targeting procedure either by ensuring that the discount rate always exceeded money market rates or by continually adjusting nonborrowed reserves over the operating period to offset discount window borrowings.

\(^{13}\) The results of this section are not qualitatively affected if excess reserves are interest-sensitive.
of NBR at NBR\(_0\) during the week. Under these demand and supply conditions, the short-term interest rate that equilibrates the reserves market is \(r_0\). For rates below \(r_0\), reserve demand will exceed supply and banks will bid more aggressively for reserves, pushing the level of short-term rates toward \(r_0\). For rates above \(r_0\), reserves supply exceeds demand and banks will lower their bids for reserves.

Given the equilibrium interest rate, \(r_0\), and the level of income—assumed predetermined during the week—the money demand schedule can be used to determine the equilibrium stock of money. This is done graphically in the left-hand panel of Figure 1, which shows that the equilibrium money stock is \(M_0\).

Under CRA, essentially the same process determines the money stock and the short-term interest rate. Under CRA, however, the RD schedule is different from that under LRA, as shown in Figure 1. Nonetheless, Figure 1 is drawn so that the equilibrium short-term interest rate and the money stock are the same under CRA and LRA, given MD and NBR.

The overall strategy of monetary control under a nonborrowed reserves operating procedure can be conveniently described with the above diagrammatic apparatus. The Federal Reserve first estimates the positions of the money demand and reserve demand schedules, and the shape of the reserve supply curve, that is, the shape of the relationship between borrowing and the short-term interest rate. Given these estimates, the Federal Reserve then determines the level of nonborrowed reserves thought to be consistent with its short-run objective for the money stock.\(^{14}\)

To illustrate, suppose that LRA is in effect, that the MD and RD\(_{LRA}\) curves in Figure 1 represent estimates of the demand for money and for reserves, and that the RS curve has the estimated shape of the reserve supply schedule. Suppose further that \(M_0\) is the money stock objective. Figure 1 reveals that—conditional on forecasts of MD, RD, and the shape of RS—a nonborrowed reserves target of NBR\(_0\) is consistent with the money stock objective of \(M_0\). Thus, the Federal Reserve attempts to provide this targeted amount of nonborrowed reserves during the week. A similar procedure would be followed under CRA. Figure 1 is constructed so that NBR\(_0\) is the targeted amount of nonborrowed reserves under both CRA and LRA.

**Monetary Control Under CRA and LRA**

Under the reserves targeting procedure described above, if the Federal Reserve’s forecasts of the demand for money, the demand for reserves, and the supply of reserves are accurate, then the actual money stock during the week will equal the objective. In practice, however, forecast errors associated with one or more of these curves generally cause the actual money stock to differ from the objective. Whether LRA or CRA yields more precise short-run monetary control depends upon the sources and magnitudes of these forecast errors and the behavioral structure of the financial system.

**Sources of Forecast Errors.** There are potentially three sources of forecast errors corresponding to the MD, RS, and RD curves. A forecast error arises when the actual position of one of these three curves is different from that anticipated by the Federal Reserve.

If MD is the source of forecast errors, monetary control will be more precise under CRA than under LRA. This is illustrated in Figure 1 where it is assumed that an unexpectedly high level of income in the current

\(^{14}\) Under a total reserves targeting procedure, the strategy is similar, except that the RS curve under total reserves targeting is vertical. Of course, the procedures actually employed by the Federal Reserve are in practice more complex than those described here. However, these differences are not important to the LRA-CRA debate.
week causes the actual money demand curve, MD', to lie to the right of that forecast, MD. In this situation, the actual money stock deviates from the objective, M_0, under both CRA and LRA.

Under CRA, the deviation in the actual money stock from the objective is smaller than the deviation under LRA. Graphically, the difference in CRA and LRA may be seen by noting that under CRA, the actual reserve demand lies to the right of that forecasted by the Federal Reserve as higher than anticipated money holdings on the part of the public imply higher than anticipated required reserves in the current week. Thus, in Figure 1, the actual reserve demand curve, RD_CRA', lies to the right of the forecasted curve shown as RD_CRA. In contrast, the actual reserve demand curve under LRA, RD_LRA, is the same as that forecast because the higher than anticipated money holdings are not accompanied by greater reserve demand in the current week. The flatter reserve demand curve, together with the greater reserve demand under CRA compared with LRA, leads to a higher interest rate under CRA than under LRA. Thus, with CRA, the misforecast of MD implies a misforecast of the interest rate, which through its effect on money demand partly offsets the forecast error in MD. This effect is absent under LRA, where the actual money stock deviates from the objective by the full amount of the MD forecast error.

The graphical analysis may be extended to show that CRA also leads to more precise monetary control when forecast errors emanate from the reserve supply schedule, RS, or from the demand for excess reserves. In both cases, the improvement in monetary control under CRA reflects an interaction of the interest-sensitive money demand curve and a smaller interest rate forecast error under CRA.

CRA will not improve monetary control, however, to the extent that forecast errors are associated with the demand for required reserves. In principle, such misforecasts are not important under LRA, since required reserves are predetermined and known before the current settlement week begins. This is not true of CRA. For example, suppose that under CRA, an unanticipated increase in the average reserve ratio against monetary deposits causes an underforecast of the RD curve in the current week, as illustrated in Figure 2. The figure shows that the actual money stock under CRA, M_CRA, falls short of the objective, M_0, as the higher than expected demand for reserves causes the actual interest rate to be higher than expected. With LRA, on the other hand, the higher than expected reserve ratio does not affect required reserves until two weeks later, giving the Federal Reserve ample time to recognize the situation and accommodate the increase in required reserves.

Table 1 summarizes the short-run monetary control implications of LRA and CRA for various types of forecast errors, showing that neither CRA nor LRA results in superior monetary control under all circumstances. Generally speaking, CRA implies more precise short-run monetary control when forecast errors emanate from the demand for money, the supply of reserves, and the demand for excess reserves. CRA impairs monetary control when forecast errors emanate from the demand for required reserves that the Federal Reserve would have time to offset them under LRA.

The Behavior of the Financial System. In general, for a particular type of forecast error, the degree of improvement in monetary control under CRA or LRA depends on the size of the error and the behavioral structure of the financial system. Clearly, if forecast errors are small, the difference in monetary control under LRA and CRA is small. With regard to the structure of the financial system, monetary control is not much different under LRA and CRA if money demand is interest-inelastic, so that MD is nearly vertical: if discount window borrowings are
Figure 2
IMPACT OF MISFORECAST OF REQUIRED RESERVES

![Graph showing the impact of misforecast of required reserves.]

<table>
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<tr>
<th>Table 1</th>
<th>THE EFFECT OF RESERVE ACCOUNTING STRUCTURE ON SHORT-RUN RESPONSE OF MONEY MARKET TO ALTERNATIVE ERRORS</th>
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<td></td>
<td>Type of Forecast Error</td>
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<tr>
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<td>CRA</td>
</tr>
<tr>
<td>Reserve Accounting Structure Yielding Smallest Change in Contemporaneous Interest Rate</td>
<td>LRA</td>
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*An example of an MD error is an unanticipated increase in personal income causing the MD curve and RD_{CRA} to unexpectedly shift to the right.
†An example of an RS error is an unanticipated increase in float which causes the RS curve to unexpectedly shift to the right.
‡This is meant to reflect unforeseen changes in required reserves not induced by MD or RS errors. Examples of such an error are an unexpected increase in the average reserve ratio against demand deposits due to a redistribution of deposits between banks, or an unanticipated increase in reservable nonmonetary liabilities of banks.
very interest-elastic, so that the vertical portion of RS is very flat; or if the reserve ratio against monetary liabilities is small, so that RD is nearly vertical.

Monetary control is not affected by the reserve accounting structure when money demand is interest-inelastic because the only link between the stock of money and the reserve accounting system is the interest rate and its effect on money demand. If money demand is insensitive to the rate of interest, then neither the demand for nor the supply of reserves has an effect on the stock of money.

When discount window borrowings are sensitive to the interest rate, implying that RS is very flat for interest rates above the discount rate, the interest rate responses to forecast errors are nearly identical under LRA and CRA. And if the short-term interest rate is virtually independent of the reserve accounting system, the money stock is also independent. Similarly, if the reserve ratio applicable to monetary deposits is small and RD is nearly vertical under CRA as well as under LRA, monetary control under the two systems is about the same.

To summarize, under a nonborrowed reserves operating procedure, CRA will significantly enhance monetary control to the extent that (1) forecast errors emanating from the demand for money, the supply of reserves, and the demand for excess reserves are large in comparison to those emanating from the demand for required reserves, and (2) short-run money demand is interest-elastic, the borrowing function is inelastic, and the reserve ratio applicable to monetary deposits is large.

In actual practice, the Federal Reserve does not attempt to maintain close control of the money stock from week to week as implied by the above model. Instead, its current operating procedures focus on influencing changes in the monetary aggregates, especially M1-B, over periods between FOMC meetings, while the directive establishes money growth objectives over horizons of several months. Extending the above analysis to control horizons exceeding one week will not qualitatively alter conclusions concerning the major determinants of the improvement in monetary control forthcoming under CRA. Since both the direction and the magnitude of the change in monetary control associated with CRA revolve around empirical relationships which cannot be determined by theory alone, the article next turns to the empirical evidence.

**PREVIOUS EMPIRICAL STUDIES**

A number of empirical studies have been undertaken to investigate the short-run monetary control impact of LRA vs. CRA. These studies may be broadly divided into money supply regression studies and econometric simulation studies.

**Reduced Form Regression Studies**

One study compares the closeness of the supply relationship between money and reserves in the pre-September 1968 period and the post-September 1968 period.13 The authors of this study argue that if the relationship is closer in the pre-1968 period, this is evidence that CRA provides better monetary control. To measure the closeness of the money-reserves relationship, the study uses monthly data to estimate regressions of money on current nonborrowed reserves, the discount rate, and a short-term interest rate. One regression is performed using pre-1968 data and another using post-1968 data. The closeness of the relationship within each period is measured by that period's regression standard error. The study finds that the regression standard error is substantially smaller in the pre-1968 period, suggesting that

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13 See Federal Reserve Board Staff, October 6, 1977. In addition to using total reserves as a regressor, the study also performs the same analysis using nonborrowed instead of total reserves.
short-run monetary control would be enhanced under a return to CRA.

Because several significant changes to Regulation D went into effect simultaneously with LRA in 1968, and because Federal Reserve operating procedures and objectives have changed since LRA was introduced, the authors do not immediately attribute all of the deterioration in the regression performance to LRA. To measure the deterioration associated with LRA, an additional regression using post-September 1968 data was performed in which total reserves led one month were included as an additional explanatory variable. The reduction in the regression standard error of the post-September 1968 regression due to this additional regressor was interpreted as the deterioration in the money supply relationship due to LRA. The authors find that the decrease in the regression standard error associated with the additional regressor is large. In fact, the inclusion of reserves led one month reduces the uncertainty of the post-September 1968 money supply relationship back to that for the pre-September 1968 period, suggesting that most of the observed deterioration in the money supply function from pre- to post-September 1968 was due to LRA.

This study may be criticized on two grounds. First, differences in the money supply relationship under the present two-week LRA system and CRA may not be accurately revealed by the authors' empirical procedures using monthly data. Analyses using weekly data would avoid this time aggregation problem.

Second, the conventional money supply relationship between the contemporaneous money stock and contemporaneous total reserves, which the authors attempt to estimate, is not relevant for monetary control under LRA because there is no automatic link between required reserves and the money stock during the same week. Since the study also ignores money demand, the authors' tests do not provide reliable information concerning either the direction or the degree of improvement in monetary control likely to be forthcoming under CRA.16

Econometric Model Simulation Studies

A second class of empirical studies focuses on complete structural models of the money supply process in an effort to estimate the overall effect of the reserve accounting structure on monetary control.17 These structural models of the money supply process include separate equations for the demand for money and the supply of and demand for reserves. The basic methodology of the two papers in this category involves specifying alternative structural models for LRA and CRA systems and simulating these models under identical simulated money demand and/or money supply forecast errors. The differences in the simulated money stocks in the two models give an indication of the degree to which monetary control under LRA and CRA would differ. These simulation studies suggest that monetary control, over operating periods of three months or more, would be virtually the same under LRA and CRA for both nonborrowed and total reserves targeting procedures, provided that future money supply and money demand forecast errors are similar to those experienced historically.

Much as with the first study discussed above, these simulation studies may be criticized. The use of monthly data in one study subjects it to

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16 A criticism essentially identical to that described above can be levied against the authors' regressions which employ nonborrowed instead of total reserves.
the same potential time aggregation problem that was alluded to earlier. In addition, neither of these studies really attempts to estimate the impact of the reserve accounting structure on monetary control over periods as short as, say, one month.

**NEW EVIDENCE FROM A WEEKLY MONEY MARKET MODEL**

This section presents new evidence on the LRA-CRA monetary control issue. The first subsection describes a structural weekly model of the money supply process that was constructed to analyze short-run monetary control under LRA and CRA. Then, the methodology used to stochastically simulate this model is described. Finally, the results are presented.

**The Model**

To avoid potential time aggregation problems and to analyze the short-run monetary control implications of LRA and CRA within a setting more closely resembling the environment faced by actual policymakers, a structural weekly, rather than monthly, model of the U.S. money supply process was constructed. The overall structure of this model is in many respects similar to that of the theoretical model discussed in the section entitled "Reserve Accounting and Monetary Control." After the model was specified, the behavioral equations of the model were estimated using nonseasonally adjusted data over sample periods ranging from 1974:1 through 1978:52.

There are four equation blocks within the weekly econometric model: a money demand block, a reserve supply block, a reserve demand block, and a block of term-structure equations. In addition, a reserve market equilibrium identity ensures that reserve supply and demand are equal and proximately determines the federal funds rate.

In the demand for money block are conventional behavioral equations explaining the demand for nominal currency, transactions and time and savings deposits in terms of nominal personal income, market interest rates, and seasonal dummy variables.

The reserve supply block consists of equations for nonborrowed reserves and for borrowed reserves. The equation for nonborrowed reserves is definitional and states that nonborrowed reserves is equal to ex cess reserves plus required reserves minus borrowed reserves. The equation for borrowed reserves is a behavioral relationship, stating that discount window borrowings depend mainly on a scale variable—required reserves lagged one week—and the current spread between the federal funds rate and the discount rate. The specification of this equation is consistent with the facts that aggregate borrowed reserves cannot be negative and that the relationship between borrowings

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18 Similar experiments using a monthly model have recently been reported by P. Tinsley, "A Field Manual for Stochastic Money Market Impacts of Alternative Operating Procedures," mimeo, Special Studies Section, Board of Governors of the Federal Reserve System, June 1981.

19 This empirical model is described in detail in David S. Jones, Federal Reserve Bank of Kansas City, Research Working Paper, forthcoming.

20 The GLS procedure used to estimate the equations assumed additive autoregressive errors with lags ranging from 1 to 52 weeks.

21 Nominal rather than real specifications were employed for these demand equations because when current and lagged prices were included as separate regressors in the nominal specifications, their coefficients were not significantly different from zero at the 5 percent confidence level. The implied long-run income elasticities for currency and time and savings deposits are 0.82 and 0.72, respectively. The long-run income elasticity for transactions deposits was constrained to be unity; however, this hypothesis could not be rejected at the 5 percent level of significance.

The interest rate appearing in the transaction deposits equation is the 3-month prime commercial paper rate. The own yield appearing in the time and savings deposits equation is the rate on large 3-month certificates of deposit, while the cross yield is the 3-month Treasury bill rate. The implied long-run interest elasticity for transactions deposits is -0.12, while the long-run own and cross yield elasticities for time and savings deposits are 0.22 and -0.21, respectively.
and the spread appears to be highly nonlinear.\footnote{22}

Within the reserve demand block are two sub-blocks. The first determines excess reserves as a function of required reserves from the previous week—a scale variable, the expected change in the federal funds rate as measured by the negative of the current change in the federal funds rate, aggregate potential net carryover into the current week, and seasonal factors. Net carryover, in turn, depends upon lagged excess reserves, the lagged level of the federal funds rate, and seasonal factors.\footnote{23}

The second sub-block within the reserve demand block determines required reserves. Since the computation of required reserves differs under LRA and CRA, two versions of the model—one for LRA and one for CRA—are constructed. The two versions differ only in their treatment of the determination of required reserves.

In both the LRA and CRA versions of the model, required reserves equal the sum of required reserves against transactions deposits, required reserves against time and savings deposits at member banks, and miscellaneous required reserves. Miscellaneous required reserves are treated as exogenous in this study. Required reserves against transactions deposits and time and savings deposits depend on the levels of these deposits—in the relevant week—together with the appropriate average required reserve ratio. The average required reserve ratios against transactions and time and savings deposits are endogenously determined within both versions of the model. These ratios depend exclusively on their own lagged values and seasonal factors.\footnote{24}

Within the LRA version of the model, the required reserves computation is based on transactions and time and savings deposits levels from two weeks earlier. Under the CRA version, while required reserves against transactions deposits are based on current deposit levels, required reserves against time and savings deposits continue to be based on deposit levels from two weeks earlier.\footnote{25} This scheme is consistent with the view that the Federal Reserve is primarily interested in controlling M1-B.

The final block of equations consists of term-structure equations, which relate the model's longer term interest rates to the federal funds rate. These longer term interest rates are the 3-month prime commercial paper rate, the 3-month bank large CD rate, and the 3-month Treasury bill rate.

To summarize, the model's major endogenous variables are currency, transactions deposits, time and savings deposits, the federal funds rate, excess reserves, aggregate potential net carryover, borrowed reserves, the average reserve ratios against transactions and time and savings deposits, required reserves, the 3-month Treasury bill rate, the 3-month prime commercial paper rate, and the 3-month large CD rate. The model's exogenous variables, on the other hand, are nominal personal income, miscellaneous required reserves, seasonal factors, and

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22 The estimated borrowings equation implies that, over the sample period, a 100 basis point increase in the spread generated, on average, $495 million in discount window borrowings.

23 The estimated excess reserves equation implies that, over the sample period, a 100 basis point increase in the federal funds rate would, on average, have reduced excess reserves in that week by $95 million.

24 These ratios and the data for required reserves have been break-adjusted so as to remove the effects of changes in required reserve ratios. The nonborrowed reserves series has also been break-adjusted. In effect, these break-adjustments are designed to make these series behave as if the October 1, 1981, reserve requirement structure had been in place over our entire sample period.

25 This simulated CRA structure assumes identical one-week reserve computation and settlement periods. Consequently, this CRA structure differs from that proposed by the Board on October 9, 1981, which involves two-week computation and settlement periods.
nonborrowed reserves.

The Simulation Methodology

The stochastic simulation methodology described below was designed to estimate the short-run—one-month—improvement in monetary control associated with moving to the CRA structure described above. Three steps were taken to design a stochastic simulation procedure capable of addressing this issue. First, a simulation period was chosen. This period was taken to be the four weeks of January 1978. Given the stochastic simulation methodology used in this study, the simulation results are not sensitive to this particular choice.

In the second step, weekly target paths were constructed for nonborrowed reserves. In constructing these paths, three assumptions were made. First, it was assumed that the four weekly targets for nonborrowed reserves were constructed by the Federal Reserve immediately before the start of the simulation period and not revised during the period. Second, it was assumed that the monetary authority expected the time paths of the model’s exogenous variables to equal their actual historical values over the simulation period. Third, it was assumed that, in the absence of any forecast errors, the federal funds rate implied by the Federal Reserve’s weekly target path for nonborrowed reserves would be constant over the simulation period.

Given these assumptions, the four weekly targets for nonborrowed reserves were constructed by using the model to solve for the weekly nonborrowed reserve levels that, in the absence of forecast errors, would yield a prespecified level of the federal funds rate during the simulation period. Since the weekly model is nonlinear, simulations were performed using three different federal funds rate assumptions, 6.5, 7.5, and 9.5 percent. In the absence of forecast errors, these alternative federal funds rate assumptions would have generated spreads between the federal funds rate and the discount rate of 0.5, 1.5, and 3.5 percentage points, respectively. The simulated total reserves operating procedure was identical to the nonborrowed reserves procedure described above, except in its treatment of the discount rate during the simulation period. The discount rate was held fixed during the simulation period under the nonborrowed reserves procedure. Under the total reserves procedure, the discount rate was varied from week to week so that it exceeded the simulated federal funds rate by 2 percentage points. This procedure ensured that borrowings would remain at very low levels so that total reserves would be approximately equal to nonborrowed reserves.

Finally, in the third step, for both the nonborrowed and the total reserves targeting procedures, the LRA and CRA versions of the model were dynamically simulated 100 times over the simulation period. Each simulation assumed a different set of forecast errors, constructed to reflect, as nearly as possible, the degree of uncertainty actually faced by monetary policymakers. 26 For each reserve accounting system and each operating procedure simulated, the 100 sets of simulated forecast errors produced a series of weekly and monthly deviations of the simulated money stock,

26 To facilitate cross-comparisons between models, each alternative model specification was stochastically simulated with the same sets of forecast errors. Simulated forecast errors were taken to be normally distributed with zero means. The simulated forecast errors associated with the model’s estimated structural equations were taken from populations having the same joint variance-covariance matrix as the residuals from the estimated equations. The variance of the simulated forecast errors for the logarithm of nonborrowed reserves was taken to be .0052, approximately the actual variance of the Federal Reserve’s Wednesday morning forecast errors (in percentage terms) for weekly nonborrowed reserves during 1978. These forecast errors were assumed to be independent of the other forecast errors in the model.

In addition to the simulated forecast errors described above, simulated projection errors were also generated for monthly personal income during the simulation period and transactions and time and savings deposits for the two
Table 2
STOCHASTIC SIMULATION RESULTS
USING THE WEEKLY MONEY MARKET MODEL: M1-B

<table>
<thead>
<tr>
<th>Federal Funds Rate Assumption</th>
<th>Operating Target</th>
<th>Reserve Structure</th>
<th>RMSE for Monthly M1-B*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.5</td>
<td>NBR</td>
<td>LRA</td>
<td>5.3</td>
</tr>
<tr>
<td>6.5</td>
<td>NBR</td>
<td>CRA</td>
<td>4.9</td>
</tr>
<tr>
<td>6.5</td>
<td>TR</td>
<td>LRA</td>
<td>19.9</td>
</tr>
<tr>
<td>6.5</td>
<td>TR</td>
<td>CRA</td>
<td>15.3</td>
</tr>
<tr>
<td>7.5</td>
<td>NBR</td>
<td>LRA</td>
<td>5.3</td>
</tr>
<tr>
<td>7.5</td>
<td>NBR</td>
<td>CRA</td>
<td>5.0</td>
</tr>
<tr>
<td>7.5</td>
<td>TR</td>
<td>LRA</td>
<td>19.7</td>
</tr>
<tr>
<td>7.5</td>
<td>TR</td>
<td>CRA</td>
<td>15.1</td>
</tr>
<tr>
<td>9.5</td>
<td>NBR</td>
<td>LRA</td>
<td>5.3</td>
</tr>
<tr>
<td>9.5</td>
<td>NBR</td>
<td>CRA</td>
<td>5.1</td>
</tr>
<tr>
<td>9.5</td>
<td>TR</td>
<td>LRA</td>
<td>18.8</td>
</tr>
<tr>
<td>9.5</td>
<td>TR</td>
<td>CRA</td>
<td>14.5</td>
</tr>
</tbody>
</table>

*The RMSE is a measure of the imprecision of monetary control. The RMSE’s in this table are expressed in terms of annualized growth rates, computed by multiplying the root-mean-squared errors of the logarithmic deviations between actual and targeted monthly M1-B by 12. Thus, they measure the extent that the growth rate of M1-B may be expected to deviate from the targeted growth rate. For example, an RMSE of 5 indicates that there is a 33 percent probability that M1-B’s actual growth rate will deviate from its targeted growth rate by more than 5 percentage points.

M1-B, from the target money stock implied by the weekly nonborrowed reserves targets. A series of deviations of the simulated federal funds rate from its expected value was also generated. These deviations are analyzed in the next subsection.

**Stochastic Simulation Results**

Table 2 reports the root-mean-squared errors (RMSE’s) of the series of deviations of simulated monthly M1-B from target expressed in terms of annualized growth rates. These RMSE’s give an indication of the likely imprecision of monetary control under alternative operating procedures and reserve accounting structures. The higher the RMSE for any alternative, the greater the degree of imprecision of monetary control. Monetary control is enhanced under CRA regardless of the operating procedure. Under a nonborrowed reserves operating procedure, however, this improvement is quite small. For the month as a whole, this improvement amounts to only a few tenths of 1 percentage point in terms of annualized growth rates. The percentage decline in the RMSE associated with moving from LRA to CRA under the nonborrowed reserves operating procedure is only about 6 percent under the 7.5 percent federal funds rate assumption.27

With total reserves targeting, the improvement in monthly monetary control associated with CRA is considerably larger than under the nonborrowed procedure, being around 4.5 percentage points in terms of annualized growth rates. The improvement associated with CRA is about 23 percent with the 7.5 percent federal funds rate assumption.28 The RMSE’s associated with total reserves targeting under both LRA and CRA are uniformly greater than those for the nonborrowed reserves procedure under either LRA or CRA.

The RMSE’s reported in Table 3 measure the federal funds rate uncertainty—that is the extent that the funds rate would deviate from its expected value—associated with LRA and CRA.

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27 Similar results are reported by P. Tinsley, June 1981. These results are not qualitatively affected when the variance-covariance matrix of the simulated forecast errors are estimated from the models out of sample, rather than within sample, prediction residuals.

28 P. Tinsley, June 1981, reports almost a 50 percent reduction in RMSE associated with CRA under total reserves targeting.
under nonborrowed and total reserves targeting. The stochastic simulation results suggest that federal funds rate uncertainty under LRA and CRA would be about the same with nonborrowed reserves targeting. Under total reserves targeting, however, CRA is seen to substantially reduce this uncertainty relative to LRA. However, federal funds rate uncertainty is substantially higher with total reserves than with nonborrowed reserves targeting.

The RMSE's relating to monetary control and interest rate uncertainty under LRA and CRA and nonborrowed and total reserves operating procedures are not very sensitive to the federal funds rate assumption.

The above simulation results are subject to an important bias that affects the LRA results more than those for CRA. This bias arises because the simulation methodology does not permit the nonborrowed or total reserves paths to be revised during the simulation period. In practice, these paths are adjusted weekly in light of new information on money demand, reserve supply, and reserve demand. By not permitting such midcourse revisions to the reserves paths, the simulation procedure overstates the true uncertainties associated with monetary control and interest rates. This bias affects the LRA results more than those for CRA, having a greater impact on the LRA RMSE's than on the CRA RMSE's.\(^9\) Thus, the simulation results reported in Table 2 probably overstate the degree of improvement in monetary control that would be expected to result from a return to CRA, given the model's specifications of the structure of the financial system and assumptions about Federal Reserve forecast errors. Given these specifications and assumptions, the results reported in Table 2 provide a measure of the upper limit of any

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Federal Funds Rate Assumption & Operating Target & Reserve Structure & RMSE for Federal Funds Rate* \\
\hline
6.5 & NBR & LRA & 0.8 \\
6.5 & NBR & CRA & 0.7 \\
6.5 & TR & LRA & 12.2 \\
6.5 & TR & CRA & 7.5 \\
7.5 & NBR & LRA & 0.5 \\
7.5 & NBR & CRA & 0.5 \\
7.5 & TR & LRA & 12.5 \\
7.5 & TR & CRA & 8.0 \\
9.5 & NBR & LRA & 0.5 \\
9.5 & NBR & CRA & 0.5 \\
9.5 & TR & LRA & 13.1 \\
9.5 & TR & CRA & 8.9 \\
\hline
\end{tabular}
\caption{STOCHASTIC SIMULATION RESULTS USING THE WEEKLY MONEY MARKET MODEL: FEDERAL FUNDS RATE}
\end{table}

\(29\) Under LRA, the bias is also likely to be larger for the total reserves simulation than for the nonborrowed reserves simulations. Beyond the bias mentioned in the text, the simulation results are subject to additional biases, although these biases do not appear to favor either LRA or CRA.

One bias arises from the assumption, used in the simulations, that the forecast errors are normally distributed, which was made for convenience, but appears to be violated in practice. Preliminary evidence suggests that the actual distribution of regression residuals are more heavily tailed than the normal distribution. This misspecification would tend to cause the RMSE's reported in Tables 2 and 3 to underestimate the true uncertainties associated with monetary control and interest rates. There is, however, no reason to expect that this bias favors either LRA or CRA systematically.

Another potential problem with the above simulation procedure, as well as the other studies reviewed in this article, concerns the implicit assumption that the behavioral relationships in the model are invariant to the Federal Reserve's operating procedures and the reserve accounting system. This assumption is especially dubious for comparisons between nonborrowed and total reserves operating procedures, since interest rate uncertainty is so much larger under total reserves targeting than under nonborrowed reserves targeting. The problem may be less important for comparisons between LRA and CRA since interest rate uncertainty under each reserve system is of the same order of magnitude.

Federal Reserve Bank of Kansas City
CRA-related improvement in monetary control. Under the nonborrowed reserves operating procedure now being employed by the Federal Reserve, the estimate of this upper limit is small, suggesting that a return to CRA may at best provide only a slight improvement in monetary control.

Finally, the simulation results suggest that, under a total reserves operating procedure, at the upper limit CRA would result in moderately better monetary control than LRA. However, the results also suggest that, under both LRA and CRA, monetary control may be worse under a total reserves operating procedure than under the nonborrowed reserves procedure now being employed. In other words, the results suggest that a return to CRA accompanied by the adoption of a total reserves operating procedure would worsen monetary control.30

30 The poor performance of the total reserves operating procedures is due to a large extent to the existing structure of reserve requirements across depository institutions. As the structure established under the Monetary Control Act of 1980 is phased in, the relative performance of the total reserves operating procedure would be expected to improve.

SUMMARY AND CONCLUSIONS

This paper has attempted to examine the implications for monetary control of moving from the present lagged reserve accounting system to a system of contemporaneous reserve accounting. A theoretical analysis of this issue indicated that the degree of improvement in monetary control under CRA would depend on the sources and magnitudes of forecast errors made by the Federal Reserve and by the behavioral structure of the financial system.

To obtain quantitative estimates of the likely improvement in monetary control under CRA, the existing empirical evidence on this issue was reviewed and new evidence derived from stochastic simulations of a structural weekly money market was presented. In general, the existing evidence and the new evidence presented in this paper suggest that returning to CRA would not appreciably improve the precision of short-, medium-, or long-run monetary control under the nonborrowed reserves operating procedure now being employed by the Federal Reserve.
State and Local Governments: Their Stake in Federal Budget Reform

By Dale Allman and Dan M. Bechter

State and local government budgets are under siege. Voters have been resisting tax increases and rejecting spending proposals. And now the combination of cutbacks in federal grants-in-aid together with a sluggish economy appears likely to further curb both receipts and expenditures of state and local governments. But such forecasts of imminent decline in state and local government activities are based on incomplete analysis. In particular, any projection of spending by state and local governments should include consideration of the impacts of all the relevant features of the new federal budget and of the economic outlook associated with that budget.

The purpose of this article is to determine the implications of the Reagan administration's economic plan for total expenditures by state and local governments in the 1981-84 period. The article presents a forecast of state and local spending that is conditional on the implementation of the administration's planned fiscal policies and on the success in achieving the level of economic activity that the administration believes to be consistent with these policies.

The first section of the article provides a brief history of state and local government spending in the post-World War II period. The second section presents a statistical model designed to explain state and local government spending. The model is then used in the third section to forecast state and local government expenditures through 1984. The forecasts of spending by state and local governments incorporate the Reagan administration's projections of employment, inflation, federal income taxes, and federal grants-in-aid to state and local governments. The final section summarizes the findings reported in the article.

PURCHASES OF GOODS AND SERVICES BY STATE AND LOCAL GOVERNMENTS, 1947-80

Purchases of goods and services by state and local governments formed two distinct patterns between 1947 and 1980.\(^1\) From 1947 to 1970,

\(^1\) State and local government purchases of goods and services account for nine-tenths of total spending by these government units. The remaining one-tenth goes for transfer payments. In subsequent analysis and discussion, purchases of goods and services by state and local governments are used as the measure of their economic activity. Transfer payments are omitted because they can be considered negative taxes instead of expenditures, which raises doubts as to whether transfers are explained by the same variables as those explaining purchases of goods and services.

The combined 1980 budgets of all state and local govern-
total purchases by state and local governments grew at an almost constant rate of 5.5 percent, once allowance is made for the illusion of acceleration due to rising rates of inflation. After 1970, growth in these purchases slowed markedly to 2.4 percent, dropping well below trend, as depicted in Chart 1.

The growth rate of purchases by state and local governments over the 1947-70 period exceeded the growth rate posted by the general economy. Consequently, real purchases by state and local governments rose from below 9 percent of real gross national product in the late 1940s to about 13 percent in the early 1970s. This statistic is not of incidental significance; it implies that the rising standard of living of the postwar generation included not only rising per capita expenditures on consumer goods and housing, but also rising per capita usage of goods and services provided by state and local governments. During the more recent 1971-80 period, in contrast, a decline in the public's standard of living is in part implied by a reduction in the growth rate of real dollars spent by state and local governments.

But what about future state and local government purchases? One way to forecast such expenditures is simply to extend the trend established in the past. But that method, as indicated in Chart 1, would not have provided accurate forecasts in recent years. Moreover, trend extrapolation says nothing about economic behavior and about how that behavior is affected by changes in economic policy and other variables. To incorporate such behavior, as well as alternative policy assumptions, it is generally agreed that the most ap-
appropriate forecasting tool is a behavioral economic model.

A MODEL OF STATE AND LOCAL GOVERNMENT PURCHASES

The Theoretical Formulation

A logical candidate for a behavioral economic model of state and local government purchases is the theory of consumer choice. According to that theory, a consumer spends his limited funds in such a way as to maximize his satisfaction. For example, if there are only two goods from which to choose, the factors important in determining the most satisfying purchasable combination are the prices of the two goods, the consumer's income, and the consumer's tastes, or how much he likes each of the goods. The theory of consumer choice is used primarily as a basis for studies of consumer demand for goods and services bought in the market for private consumption. The same theory can be extended, however, to explain the indirect consumer purchase of public goods from the government by the payment of taxes.²

Suppose that the consumer's income is defined to be net of federal income taxes. How will this income be spent? By a simple extension of the two-goods example, the consumer can be thought of as choosing between two types of goods and services: those provided by state and local governments and those provided by the private sector. The former are paid for by general taxation as well as by user fees, while the latter are paid for by market purchases.³

This model of individual consumer choice must then be aggregated across all consumers in order to focus on total state and local government purchases. The aggregation implies a behavioral economic model in which the quantity of state and local goods and services "purchased" by all consumers depends on the total real income of consumers after federal taxes, as well as on the price of these public goods and services relative to the price of private goods and services.

The economic behavioral model must also consider the impact of federal grants-in-aid to state and local governments, since these grants lead to purchases that are not financed by consumers paying state and local government taxes or fees. More specifically, federal grants-in-aid net of public assistance grants should be considered since public assistance grants are almost wholly used for state and local government transfer payments. The presumed effect of nonpublic-assistance grants is to increase total state and local government purchases of goods and services, although these federally financed purchases may substitute in part for what consumers would otherwise pay for with state taxes.

Finally, allowance should also be made in the model for the effect of interest rates on the quantities of state and local goods purchased. The level of interest rates affects state and local government spending decisions by affecting


3 Social goods—goods or services whose total production is available to each consumer, regardless of his contribution—present some problems for the theory of consumer demand. Police protection, flood control, and other forms of public safety are good examples. Social goods cannot be sold, because the voluntary exchange principle of markets requires the consumer's enjoyment of a good to be determined by price payments. Since social goods are enjoyed by everyone but not marketable, they are naturals for government finance, where the power to tax can be combined with voting or other political processes to force a sharing of their cost. The complications arising from the existence of social goods are primarily those associated with finding a way within the democratic process to induce each consumer-voter to reveal his true preference for these goods. These complications are simplified by assuming that the consumer-voter pays taxes for social goods in a manner representative of his true preference. See Richard A. Musgrave, The Theory of Public Finance, New York: McGraw-Hill, 1959, pp. 9-12, 73-84, and 116-135.
borrowing costs and earnings on bonds held. When the effect on borrowing costs is greater than the effect on bond yields, state and local governments will reduce spending in response to an increase in rates. On the other hand, when an increase in interest rates has a greater impact on bond yields, state and local governments will realize an increase in earnings on net financial assets. The increase in earnings would then serve as a stimulus to increased purchases.

Preparing the model for statistical verification requires defining the quantity, income, and interest rate variables in measurable fashion and specifying how they are related to one another. For the quantity of total state and local government purchases, which is the variable to be explained, the definition chosen is the national income accounts measure of state and local government purchases, adjusted for inflation. For consumer income, the measure used is spendable earnings after adjustment for inflation, in other words, real take-home pay. Real take-home pay is defined as the purchasing power of the wages of an average production or nonsupervisory worker, after deducting federal employment taxes and federal income taxes withheld. To arrive at an aggregate measure of real income, average real take-home pay is multiplied by the number of workers in nonagricultural employment.

The quantity of state and local government purchases is specified to be related to the described measure of total real spendable pay in a linear fashion. A linear specification means that changes in consumer demand for state and local government purchases are assumed to be proportional to changes in total real spendable pay, with the coefficient of proportionality to be estimated by statistical procedures. Linearity is also assumed between state and local government purchases and federal grants-in-aid, and between purchases and the real rate of interest, as measured by the municipal bond rate minus the rate of inflation. The price variable does not appear in the reduced form of the model used for estimation.

**Statistical Estimation**

The model described above was estimated using annual data covering the period 1947-80. The results of the reduced form estimation are summarized in Table 1. As indicated by the value of the coefficient of determination, or $R^2$, which is 0.98, the model explains almost all of the growth in state and local government purchases in the past 34 years, including the marked slowdown in that growth since 1970.

The variable used for consumer income is found to be an important determinant of total state and local government purchases. Specifically, the equation in Table 1 shows that for every $1 increase in total real spendable pay, total state and local government purchases rise by about 34 cents. In the context of this ar-
Federal grants-in-aid to state and local governments, net of public assistance grants, are also found to increase total spending. The 1.08 coefficient estimate for the AID variable in Table 1 shows that a $1 increase in federal grants-in-aid adds about $1.08 to total state and local government expenditures. The grants-in-aid coefficient is not statistically significantly different from one, however, implying that state and local government purchases are increased by about one dollar for every one dollar increase in grants.

The results in Table 1 also indicate that as the real interest rate increases, state and local government purchases of goods and services increase. Specifically, the 0.79 coefficient for the variable indicates that if the real bond yield increases 1 percent, real state and local government purchases will increase $0.79 billion. This result may imply that the ability to finance additional purchases out of additional interest receipts outweighs the drain on purchases that additional interest payments would have on state and local governments.

FORECASTS OF STATE AND LOCAL GOVERNMENT PURCHASES

This section examines the implications for state and local government expenditures of alternative federal government fiscal policies.

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8 The model of state and local government expenditures presented here can also be considered a model of state and local government budgets, reduced to its primary explanatory variables. Reduced form models recognize the simultaneity in economic relationships, which in this case relates to the joint determination of the revenues and the expenditures of state and local governments. The first researcher to address this simultaneity explicitly in an econometric model was Edward M. Gramlich. “State and Local Governments and Their Budget Constraint,” *International Economic Review*, Vol. 10, No. 2, June 1969, pp. 163-182. Gramlich’s model was a quarterly econometric model which contained equations for different types of state and local government purchases. While still a standard for comparison, his model and those similar to it are more disaggregated and detailed than is required for purposes of this article.
The examination is conducted by using the economic model described above to forecast real state and local government purchases. The forecasts are made for three years—1982, 1983, and 1984—under five sets of assumptions regarding the future paths of employment, earnings, inflation, federal personal income taxes, and federal grants-in-aid to state and local governments.

The “baseline” forecast is taken from the projections that appeared in the 1982 United States budget, submitted by President Carter to the United States Congress in January 1981. That budget projected continued increases in nominal amounts of federal grants-in-aid to state and local governments. In real, or constant dollar terms, grants were projected to remain roughly flat through 1984. No significant reductions in personal income taxes or in employment taxes were proposed in Carter’s 1982 budget. The assumptions underlying his budget included success of monetary and fiscal policies in reducing inflation, as well as in supporting moderate growth in real income and employment.

The other forecasts of state and local government purchases, which are compared with the baseline forecast, reflect some of the budget initiatives of the Reagan administration. The “reduced taxes” forecast shows the results of three successive reductions in federal personal income taxes. The “declining grants” forecast reflects the impact of proposed reductions in federal grants-in-aid to state and local governments. The “lower inflation” forecast assumes a faster decline in the rate of inflation than projected in the baseline forecast. Finally, a “combined effect” forecast reflects the total impact of reduced taxes, declining grants, and lower inflation.

The five forecasts are summarized for comparative purposes in Tables 2 and 3. Under the assumptions of the baseline forecast, the quantity of state and local government purchases is projected to increase at an average annual rate of 1.1 percent from 1981 through 1984. In the reduced taxes forecast, slightly more growth in state and local government purchases is projected. Currently, scheduled cuts in federal personal income tax rates reduce the rate of growth of federal taxes withheld from 14.9 percent in the baseline forecast to 14.1 percent (see Table 2). These tax rate reductions increase the average growth in real spendable earnings of consumers from 1.4 percent to 2.1 percent which, in turn, supports the faster growth in state and local spending.

The assumed reduction in federal grants-in-aid is found to reverse the growth in state and local government purchases. Such a reduction by itself results in a projected decline of 0.6 percent in state and local government spending.

President Reagan’s budget reform plan differs from the Carter budget not only in its proposals for taxes and expenditures, but also in its projections for progress against inflation. A lower rate of inflation than assumed in the baseline forecast increases both total real spendable earnings and real federal grants-in-aid, each of which acts to increase real state and local government purchases. The purchasing power of take-home pay rises when less inflation is assumed, and total real spendable earnings also rise as a result of the faster growth in employment that would accompany lower inflation, given unchanged amounts of fiscal and monetary stimulus. Budgeted dollars for federal grants-in-aid also have higher real value if inflation is lower.

A significant decline in the rate of inflation would, by itself, give a big boost to state and

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9 The Reagan administration seeks not only to reduce the level of federal support to state and local governments, but also to change the mix of the types of grants, particularly from categorical grants to block grants. The forecasts presented here do not include estimates of the additional impact on state and local government purchases that would result from such compositional changes.
local government activity. Table 2 shows the lower inflation assumption increasing the 1981-84 growth rate of real state and local purchases to 3.8 percent as against 1.1 percent in the baseline forecast.

Finally, when combined with reduced taxes and declining grants, the lower inflation assumption yields a growth rate of 2.1 percent in state and local government purchases, as shown in the combined effect forecast of Table 2.

## CONCLUSION

The outlook for expenditures by state and local governments in the years ahead depends importantly on the paths taken by some key economic variables. Cuts in federal grants-in-

### Table 2

**FORECASTS OF AVERAGE ANNUAL GROWTH RATE OF TOTAL REAL STATE AND GOVERNMENT PURCHASES, 1981-84**

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Reduced Taxes</th>
<th>Declining Grants</th>
<th>Lower Inflation</th>
<th>Combined Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forecast of real state and local government purchases</td>
<td>1.1</td>
<td>1.2</td>
<td>-0.6</td>
<td>3.8</td>
<td>2.1</td>
</tr>
<tr>
<td>Assumed growth rates of:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total spendable earnings</td>
<td>1.4</td>
<td>2.1</td>
<td>1.4</td>
<td>4.2</td>
<td>2.8</td>
</tr>
<tr>
<td>employment</td>
<td>1.9</td>
<td>1.9</td>
<td>1.9</td>
<td>2.2</td>
<td>4.1</td>
</tr>
<tr>
<td>average real spendable earnings</td>
<td>-0.5</td>
<td>0.2</td>
<td>-0.5</td>
<td>1.9</td>
<td>1.8</td>
</tr>
<tr>
<td>average earnings</td>
<td>9.3</td>
<td>9.3</td>
<td>9.3</td>
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</tr>
<tr>
<td>federal personal income and employment taxes</td>
<td>14.9</td>
<td>14.1</td>
<td>14.9</td>
<td>13.5</td>
<td>14.1</td>
</tr>
<tr>
<td>Consumer Price Index</td>
<td>9.0</td>
<td>9.0</td>
<td>9.0</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Federal Grants-in-Aid in constant dollars</td>
<td>0.3</td>
<td>0.3</td>
<td>-10.1</td>
<td>0.6</td>
<td>-9.8</td>
</tr>
<tr>
<td>in current dollars</td>
<td>8.0</td>
<td>8.0</td>
<td>-3.2</td>
<td>8.0</td>
<td>-3.2</td>
</tr>
</tbody>
</table>

### Table 3

**IMPACT OF DIFFERENT FISCAL POLICIES AND INFLATION ASSUMPTIONS ON STATE AND LOCAL GOVERNMENT SPENDING**

(Billions of 1972 Dollars)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>I. Baseline forecast</td>
<td>179.8</td>
<td>179.8</td>
<td>182.1</td>
<td>185.7</td>
<td>1.1</td>
</tr>
<tr>
<td>II. Reduced taxes forecast</td>
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<td>180.6</td>
<td>183.3</td>
<td>186.3</td>
<td>1.2</td>
</tr>
<tr>
<td>III. Declining grants forecast</td>
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<td>174.3</td>
<td>173.3</td>
<td>174.5</td>
<td>-0.6</td>
</tr>
<tr>
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<td>185.8</td>
<td>194.0</td>
<td>200.0</td>
<td>3.8</td>
</tr>
<tr>
<td>V. Combined effect forecast</td>
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<td>181.2</td>
<td>185.8</td>
<td>188.2</td>
<td>2.1</td>
</tr>
</tbody>
</table>
aid will reduce state and local government spending, other things equal. But this contractionary effect will be largely offset by the scheduled reduction in federal personal income tax rates. Lower federal income and employment taxes will leave consumers with more spendable earnings, and their enhanced well-being may be expected to support increased state and local government activity as well as increased consumption and saving.

Real income, and therefore the level of economic activity, will continue to be the single most important determinant of the size of state and local government budgets. For the next several years, growth in real income will be primarily dependent on progress against inflation. The lower the amount of inflation, the greater the amount of economic growth and the greater the increase in state and local government purchases. The more optimistic outlooks for declines in inflation, such as those associated with the Reagan administration’s budget and economic policy, imply relatively strong growth in real expenditures by state and local governments over the years 1982-84. Moreover, even the somewhat less optimistic forecasts for inflation, such as in the last Carter budget, imply continued though moderate growth in state and local government spending over the years ahead.