FEDERAL RESERVE BANK OF ST. LOUIS

OCTOBER 1979

REVIEW

CONTENTS

Vol. 61, No. 10

The Review *is published monthly by the Research Department of the Federal Reserve Bank of St. Louis. Single-copy subscriptions are available to the public free of charge. Mail requests for subscriptions, back issues, or address changes to: Research Department, Federal Reserve Bank of St. Louis, P.O. Box 442, St. Louis, Missouri 63166.*

TTL Note Accounts and the Money Supply Process

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SINCE November 1978, when the Treasury changed its cash management procedures, the Federal Reserve has been faced with less uncertainty in managing the week-to-week volume of bank reserves. Weekly swings in the Treasury's balances at Federal Reserve Banks have been smaller, and the decreased volatility of these balances has reduced the Federal Reserve's uncertainty about reserve positions. Consequently, Federal Reserve (Fed) open market operations that are conducted to offset the effects of fluctuations in Treasury balances on bank reserves have not had to be as large as in previous years.

This decreased volatility is the result of the introduction of the Treasury Tax and Loan (TTL) Investment Program, which enables the Treasury to invest its funds in interest-bearing notes of commercial banks. The TTL note program was designed to achieve two objectives: the payment of interest on the Treasury's cash balances at commercial banks and the stabilization of the Treasury's balances at the Federal Reserve.

The introduction of the TTL note program also has affected the relationship between bank reserves and the money supply. This article discusses the implications of this change in Treasury cash management for the Federal Reserve and the banking system.

TREASURY BALANCES AT BANKS

Background

Originally, TTL accounts at commercial banks were called Liberty Loan accounts. Created by Congress in 1917 in the Liberty Loan Act, these accounts facilitated the issuance of Treasury securities (Liberty bonds) to finance government expenditures during World War I.[1] Proceeds of the sale of Liberty bonds were deposited in Liberty Loan accounts at commercial banks instead of in the Treasury's account at the Federal Reserve Banks. Thus, the deposits used to pay for the bonds remained in the banking system until spent by the government. The Liberty Loan accounts avoided an increase in the volatility of deposit and bank reserve flows which could have resulted from the war-financing effort. Moreover, this system also encouraged banks to purchase Liberty bonds for their own accounts and to act as underwriters of these Treasury issues in selling them to the public.[2]

In 1918, the Treasury extended the provisions governing the use of Liberty Loan accounts, allowing federal income and excess profits taxes to be deposited in them. The accounts were renamed War Loan Deposit accounts, and banks were required to pay interest on the funds in these accounts at the rate of 2 percent per annum. These balances were essentially interest-earning demand deposits.

When the Banking Act of 1933 prohibited the payment of interest on demand deposits, interest payments on War Loan Deposit accounts were also eliminated. Furthermore, the Banking Act of 1935 made these accounts at member banks subject to the same reserve requirements as those placed on private demand deposits.

Balances in War Loan Deposit accounts increased rapidly during World War II with the increased issuance of government debt to finance the war. After the war, Congress continued to broaden the use of these accounts to include deposits of more types of tax receipts, including withheld income taxes and So-

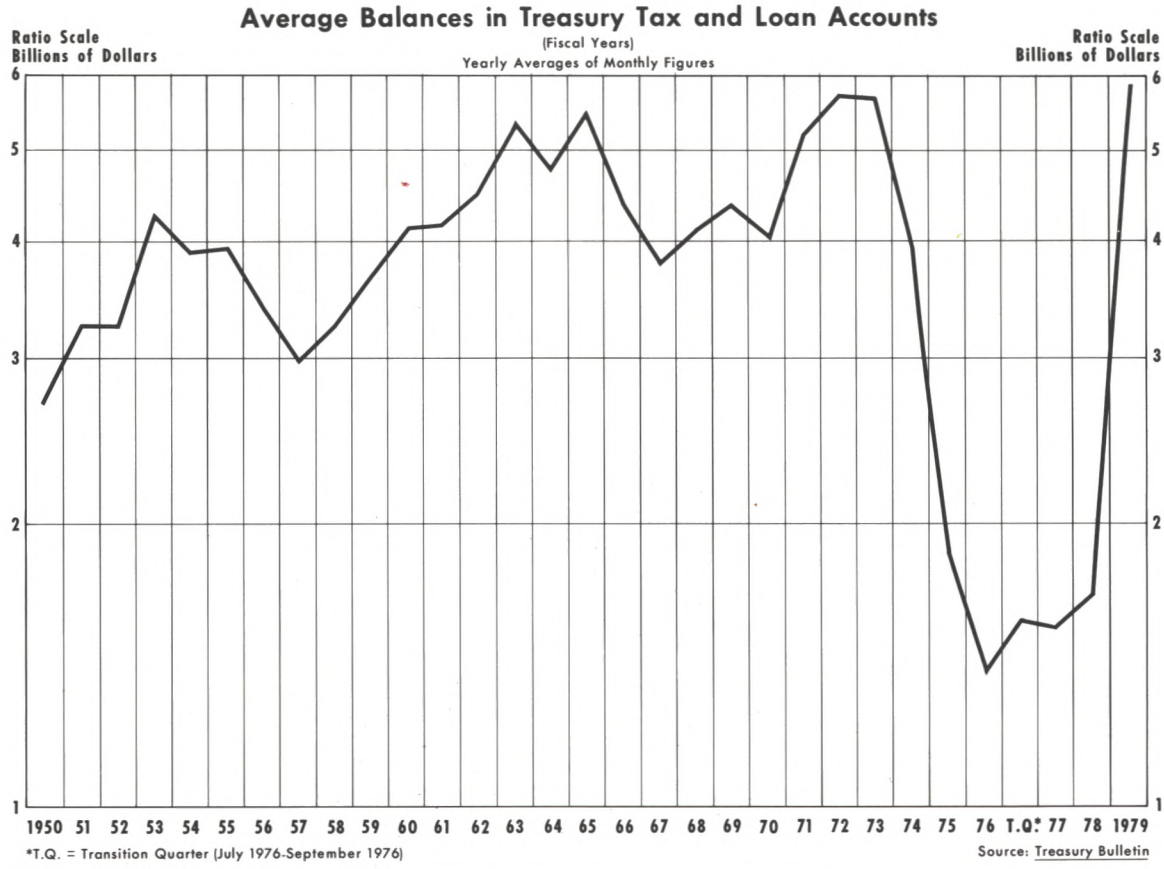
[1]Both before and after the Liberty Loan Act, the Treasury has held demand deposits at commercial banks other than those reported as Liberty Loan accounts (or Tax and Loan accounts). These other deposits declined in use after World War II, although they were used to some extent between 1972 and 1976. Balances in these deposit accounts between 1972 and 1976 were small relative to balances in TTL accounts and are ignored in the subsequent discussion. Treasury holdings of time deposits at banks, also relatively small, are likewise ignored.

[2]In addition, the congressional act that created the Liberty Loan accounts abolished reserve requirements against all U.S. government deposits at member banks. *Federal Reserve Bulletin* (June 1917), p. 458.

Chart 1

Average Balances in Treasury Tax and Loan Accounts

(Fiscal Years)
Yearly Averages of Monthly Figures



*T.Q. = Transition Quarter (July 1976-September 1976)

Source: Treasury Bulletin

cial Security payroll taxes. In 1950, the accounts were renamed Tax and Loan accounts.

Currently, TTL accounts continue to serve as deposit accounts for the proceeds from the sale of U.S. government securities (particularly savings bonds), as well as for such varied tax receipts as withheld income taxes, corporate income taxes, excise taxes, employer and employee Social Security taxes, federal unemployment taxes, and taxes under the Railroad Retirement Act of 1951.

Treasury Management of TTL Accounts

One of the main objectives of establishing the original Liberty Loan accounts was to minimize fluctuations in the aggregate levels of bank deposits and reserves that can result from sales of government bonds. This objective later was extended to include minimizing fluctuations in deposits and reserves that can result from tax payments. If the Treasury had no accounts with commercial banks, proceeds of bond sales and tax payments would be deposited in the Treasury's account at Federal Reserve Banks. Deposits thus would be transferred out of the banking system, and bank reserves would decline. These funds would be returned to the banking system only when the Treasury issued checks drawn upon its account to make purchases or transfer payments.[3]

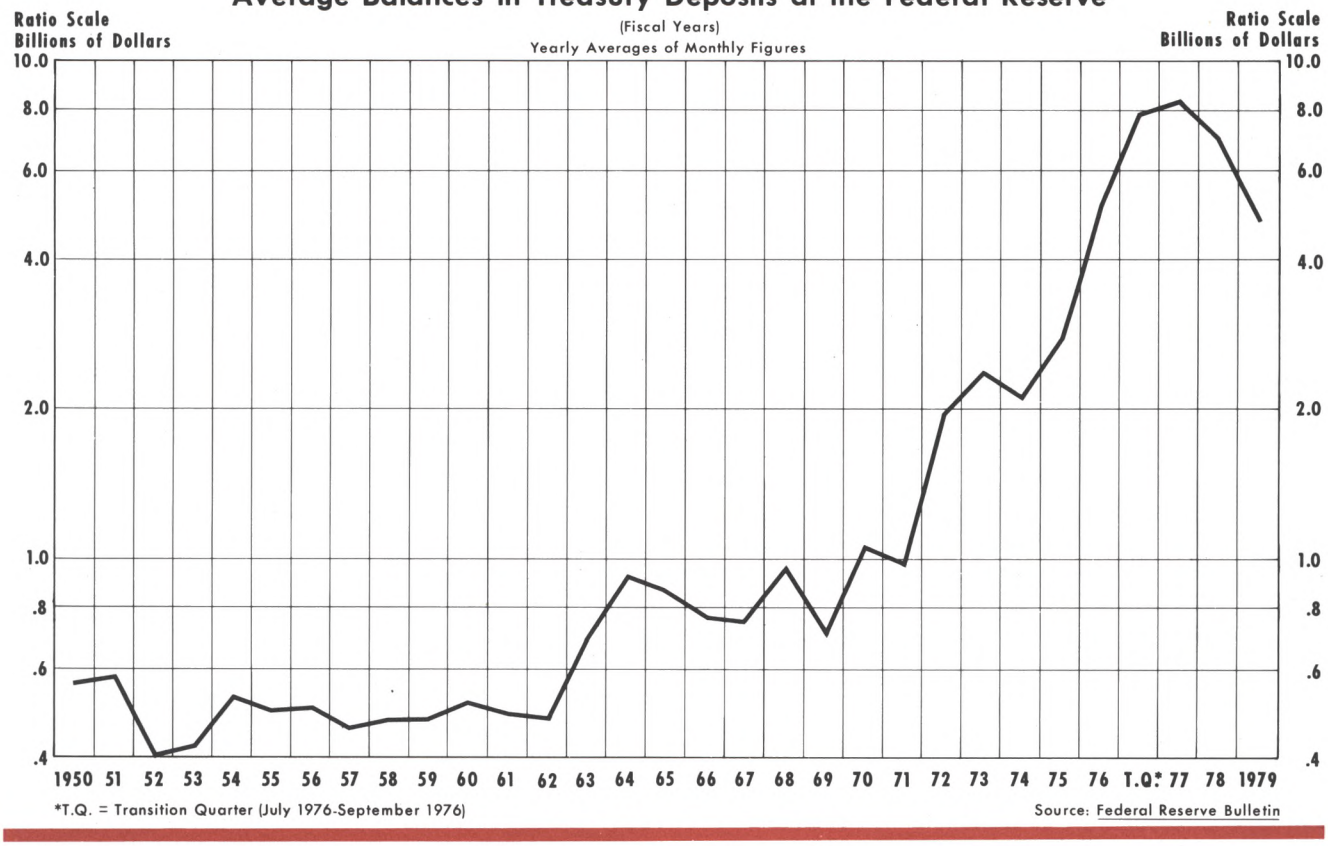
The Federal Reserve can use open market operations to offset such fluctuations in bank reserves. The Open Market Desk can purchase government securities (which increases bank reserves and deposits) when the Treasury's balance at the Fed increases, and can sell government securities when the Treasury's balance at the Fed declines. Such "defensive" open market operations effectively neutralize the effect that shifts in Treasury balances between commercial banks and the Fed have on bank reserves.

Prior to 1974, the Treasury tended to minimize fluctuations in its balances at the Fed by maintaining funds at commercial banks until they were disbursed. Consequently, the Fed had only to make relatively small defensive open market operations to smooth out

[3]For a summary of the effects of these transfers on the balance sheets of commercial banks and the Federal Reserve, see Dorothy M. Nichols, *Modern Money Mechanics*, Federal Reserve Bank of Chicago (June 1975), pp. 18-19.

Chart 2

Average Balances in Treasury Deposits at the Federal Reserve



*T.Q. = Transition Quarter (July 1976-September 1976)

Source: Federal Reserve Bulletin

changes in bank reserves associated with the Treasury's cash management.[4]

Although the Treasury earned no interest on these commercial bank accounts after 1933, it generally felt that various services provided by banks (without charge) compensated for the lack of explicit interest earnings. Such services included the sale and redemption of savings bonds, collection of taxes, and handling of Treasury checks and other Treasury securities. Two Treasury studies of TTL accounts, one in 1960 and another in 1964, found that these accounts were not a source of profit to banks; the cost of providing services to the Treasury was generally greater than the value of the TTL accounts to the banks. A similar study in 1974, however, found the reverse, primarily because of increased market interest rates and the exclusion of certain items that were previously counted as costs of providing bank services to the Treasury.[5]

In order to increase its return from TTL accounts, the Treasury proposed in 1974 that Congress permit TTL balances to earn explicit interest. While Congress debated the Treasury's proposal, the Treasury changed its cash management procedures to reduce its balances at commercial banks (chart 1). The Treasury began to quickly shift funds deposited into TTL accounts to its account at the Fed. Average Treasury balances at the Fed and their volatility increased substantially after 1974 (chart 2). Swings in the weekly Treasury balance at the Fed, which averaged $533 million in 1974, more than doubled in 1975 to an average of $1,388 million (table 1).[6]

The Treasury viewed its increased balances at the Fed as a way to earn implicit interest on its funds. The Fed would offset the decline in bank reserves result-

[4]See, for example, "Tax and Loan Accounts — Government Balances Managed to Avoid Upsetting Money Markets," Federal Reserve Bank of Dallas *Business Review* (November 1973), pp. 7-11.

[5]*Report on Treasury Tax and Loan Accounts, Services Rendered by Banks for the Federal Government and Other Related Matters*, Treasury Department, June 15, 1960; *Report on Treasury Tax and Loan Accounts and Related Matters*, Treasury Department, December 21, 1964; *Report on a Study of Tax and Loan Accounts*, Treasury Department, June 1974. For a discussion of these studies, see Peggy Brockschmidt, "Treasury Cash Balances," Federal Reserve Bank of Kansas City *Monthly Review* (July-August 1975), pp. 12-20.

[6]The same pattern of volatility before and after 1974 is also exhibited by the standard deviations of the weekly levels, or changes in levels, of Treasury deposits at the Fed.

ing from such a shift of Treasury balances by increasing its portfolio of government securities (to stabilize either the federal funds rate or the level of bank reserves). With a larger portfolio of interest-earning assets, Federal Reserve income would rise. Since the Federal Reserve turns over its earnings after expenses to the Treasury as "interest" on the issuance of Federal Reserve notes (currency), the Treasury expected its "income" from the Federal Reserve to increase under this system.

This approach to managing the Treasury's balances increased defensive open market operations and complicated both the management of bank reserves and the short-run stabilization of the federal funds rate.[7] As weekly swings in Treasury balances at the Fed became larger, weekly swings in Federal Reserve holdings of government securities (the major source of bank reserves and the monetary base) also increased (table 1). The increased volatility of the Treasury's balance at the Fed made the prediction of its effect on bank reserves more difficult. At times the Fed requested that the Treasury redeposit funds into TTL accounts, so that the Fed could avoid making direct purchases of securities to maintain its desired level of bank reserves in the face of these shifts.[8]

Table 1

Average Weekly Changes in Treasury Deposits at Federal Reserve Banks and Federal Reserve Holdings of Government Securities*

(Millions of Dollars)

Year	Treasury Deposits at the Fed	Fed Holdings of Government Securities
1967	$ 175	$ 278
1968	159	311
1969	169	302
1970	124	364
1971	221	351
1972	329	438
1973	473	712
1974	533	636
1975	1,388	1,742
1976	2,021	2,345
1977	2,110	1,984
1978	1,668	1,882
1979	378**	1,678**

*Averages are based on weekly changes without regard to sign.
**Data through September 26, 1979.
SOURCE: Federal Reserve Statistical Release H.4.1.

The TTL Note Program

Congress passed legislation in October 1977 that enabled the Treasury, "for cash management purposes, to invest any portion of the Treasury's operating cash for periods of up to ninety days in obligations of depositaries maintaining Treasury tax and loan accounts secured by a pledge of collateral acceptable to the Secretary of the Treasury as security for tax and loan accounts . . ."[9] Congress also permitted the Treasury to pay fees for certain services for which banks previously were not compensated explicitly. The program was not implemented, however, until November 1978, after Congress appropriated funds to permit the Treasury to reimburse banks and other depositaries for these services.[10]

Under the new program, banks have two options for handling Treasury funds: a remittance option and a note option. Under the remittance option, funds deposited in a bank's TTL account are transferred to the district Federal Reserve Bank after one business day. Banks selecting this option pay no interest on these funds, but member banks must hold required reserves against them, just as they did under the old program.

Under the note option, funds deposited in TTL accounts are transferred to open-ended, interest-bearing note accounts at the same bank after one business

[7]See, for example, William R. McDonough, "Treasury Cash Balances — New Policy Prompts Increased Defensive Operations by Federal Reserve," Federal Reserve Bank of Dallas *Business Review* (March 1976), pp. 8-12; Joan E. Lovett, "Treasury Tax and Loan Accounts and Federal Reserve Open Market Operations," Federal Reserve Bank of New York *Quarterly Review* (Summer 1978) pp. 43-44; Ann-Marie Meulendyke, "The Impact of the Treasury's Cash Management Techniques on Federal Reserve Open Market Operations," paper presented to the Federal Reserve System Committee on Financial Analysis, November 1977.

[8]Meulendyke, "The Impact of the Treasury's Cash Management Techniques," pp. 14-16. The Fed generally prefers to arrange security repurchase agreements (RPs) with banks and government security dealers, rather than to make direct purchases of securities, in offsetting "technical" factors that affect bank reserves, including shifts in Treasury deposits. RPs, however, require that banks and dealers have sufficient unpledged government securities to use as collateral. Such collateral was not readily available in sufficient quantity to offset the shifts in Treasury deposits that occurred after 1974. Rather than making direct purchases at these times, the Fed asked the Treasury to redeposit funds into TTL accounts at banks.

[9]Public Law 95-147, *Congressional Record*, October 11, 1977, pp. S16914-S16920.

[10]The TTL note program was also extended to allow participation of certain savings and loan associations and credit unions. Participation of these thrift institutions, however, has been minor. Only 30 savings and loans and 4 credit unions participated as of June 30, 1979, according to a Treasury-Federal Reserve survey: "TTL Release No. 20," Department of the Treasury, August 3, 1979.

day. For that one business day, the funds are treated the same way as the old TTL accounts: banks pay no interest to the Treasury on them, and member banks are required to hold reserves against them. Once the funds are credited to the note account, however, banks must pay interest on these funds at a rate 25 basis points below the prevailing weekly average federal funds rate, but member banks are not required to hold reserves against them.

Although note balances are payable on demand, the Treasury has attempted to establish a regular pattern of withdrawals from these note accounts, similar to the pattern of withdrawals it had established prior to 1974.[11] In the first 10 months of 1978, the average time that TTL balances remained in commercial banks was less than two days. Since their introduction in November 1978, the time that TTL note balances have remained in commercial banks has averaged over six days.[12]

After the introduction of the TTL note accounts, the Treasury reversed its previous cash management procedures. Treasury balances at the Fed fell substantially between October 1978 and January 1979, while Treasury balances in the banking system rose (charts 1 and 2). In the absence of offsetting Federal Reserve actions, bank reserves (and the monetary base) would have increased. The Federal Reserve offset this increase in bank reserves, however, by selling government securities in the open market. Treasury deposits at the Fed declined by $11.6 billion between October 1978 and January 1979, and Fed holdings of Treasury securities declined by about $10 billion.

Since November of last year, the volatility of Treasury balances at the Fed has declined substantially (table 1).[13] This tends to reduce the size of defensive open market operations, as indicated by the decline in 1979 in the average weekly changes in Fed holdings of government securities (table 1). The reduction in the magnitude of the swings in the Treasury's balance at the Fed and the plan to re-establish a regular pattern of withdrawals from note accounts will reduce the Fed's uncertainty about the effect of the Treasury's cash management on bank reserve positions. The decreased volatility of Treasury balances at the Fed should improve the Fed's prediction of its effect on bank reserves and, consequently, can be expected to improve its ability to achieve a desired level of bank reserves in the short run. Furthermore, this change in Treasury cash management is expected to improve the Federal Reserve's ability to execute monetary policy, whether the Fed seeks some rate of growth of bank reserves associated with a desired rate of money growth, or seeks to stabilize or obtain a desired level of the federal funds rate.

TTL NOTE ACCOUNTS AND THE MONEY SUPPLY PROCESS

The new TTL program has affected not only the Federal Reserve's management of bank reserves, but also the relationship between bank reserves and the money stock. The responsiveness of the money stock to Federal Reserve actions that change the monetary base was altered, other things being equal, by the introduction of TTL note accounts. A standard model of the money supply process can be used to investigate the effect of the introduction of the TTL note program on the money stock (see appendix). In this model, the money stock (M1) is equal to the product of the monetary (source) base (B) and the money multiplier (m):

$$M1 = mB$$

As noted earlier, the introduction of TTL note accounts led to a transition period in which the proportion of Treasury deposits held at commercial banks changed relative to its deposits at the Fed. As a result, the level of the monetary base (bank reserves plus currency in circulation) would have risen, other things being equal. For a given level of the money multiplier, this increase in the monetary base would have resulted in an increase in the money stock (see appendix). Through defensive open market operations, however, the Fed essentially offset this shift in Treasury deposits.

Changes in Treasury deposits at commercial banks, however, can affect both the reserve ratio and the Treasury deposit ratio, which are included in the money multiplier (see appendix, equation A.2). With the introduction of TTL note accounts, Treasury deposits at commercial banks include two accounts: deposits in regular TTL accounts and deposits in TTL note accounts.

[11] For a discussion of the pre-1974 schedule of withdrawals, see "Tax and Loan Accounts — Government Balances Managed to Avoid Upsetting Money Markets," Federal Reserve Bank of Dallas *Business Review* (November 1973), pp. 7-11. For a discussion of the current system, see Joan E. Lovett, "Treasury Tax and Loan Accounts and Federal Reserve Open Market Operations," Federal Reserve Bank of New York *Quarterly Review* (Summer 1978), pp. 44-46.

[12] "TTL Release No. 20," Department of the Treasury, August 3, 1979.

[13] Again, the same pattern of volatility before and after November 1978 is exhibited by the standard deviations of the weekly levels, or changes in levels, of Treasury deposits at the Fed.

The Board of Governors of the Federal Reserve System amended its regulations in May 1978 to provide that TTL note accounts not be regarded as deposits subject to reserve requirements (Regulation D) or to the limitation of the payment of interest on deposits (Regulation Q). These amendments, however, do not affect the status of funds in regular TTL accounts prior to their investment in interest-bearing notes under the new program. For the one day before funds are either remitted to the Treasury's account at the Fed or placed in a TTL note account, member banks must treat the funds as demand deposits and maintain required reserves against them. This differential treatment of note accounts and regular TTL accounts affected the level of the money multiplier as the Treasury changed its cash management procedures.

TTL Note Accounts and the Level of the Money Multiplier

In the standard money multiplier framework, one can show (see appendix) that the introduction of TTL note accounts *increases* the level of the money multiplier, but *only* to the extent that Treasury funds are shifted out of regular TTL accounts at member banks into the new note accounts at member banks. The rise in the level of the money multiplier occurs because required reserves are reduced as deposits are shifted out of reservable regular TTL accounts into nonreservable note accounts. Consequently, the money multiplier depends on the composition of Treasury deposits in the banking system, not just on the level of Treasury deposits at banks.

The effect of the introduction of TTL note accounts on the ratio of demand deposits to bank reserves is illustrated in exhibit 1, which shows a simplified example of the changes in the balance sheet of member commercial banks as Treasury funds are shifted from regular TTL accounts to TTL note accounts. In panel A of exhibit 1, banks initially have deposit liabilities of $1,000, with $900 in demand deposits of the nonbank public and $100 in regular TTL accounts. Assuming that reserve requirements are 10 percent and that banks are fully loaned up (have no excess reserves), banks' assets include $100 in required reserves and $900 in loans and securities. The ratio of private demand deposits (which are included in the money stock) to bank reserves is equal to 9 in panel A. Were there no currency in the economy, this ratio would be the money multiplier.

With the introduction of TTL note accounts (exhibit 1, panel B), half of the Treasury's funds are shifted into note accounts. Since there is no reserve requirement against TTL note deposits, there are now excess reserves of $5. If banks expand their loans and deposits to eliminate these excess reserves (panel C), and if all the deposit expansion occurs in demand deposits of the nonbank public, demand deposits expand to $950.[14] The ratio of demand deposits to reserves is now equal to 9.5. With no currency in the economy, this ratio indicates an increase in the money multiplier due to the introduction of TTL note accounts. In other words, the same amount of monetary base can now support a larger volume of deposits.

Exhibit 1

Commercial Banks

Assets			Liabilities	
Panel A				
Reserves		$100	Demand Deposits	$900
Required	100		Regular TTL Accounts	100
Excess	0		TTL Note Accounts	0
Loans & Securities		900		
Panel B				
Reserves		100	Demand Deposits	900
Required	95		Regular TTL Accounts	50
Excess	5		TTL Note Accounts	50
Loans & Securities		900		
Panel C				
Reserves		100	Demand Deposits	950*
Required	100		Regular TTL Accounts	50*
Excess	0		TTL Note Accounts	50
Loans & Securities		950		
Panel D (Offsetting open market operation)				
Reserves		95	Demand Deposits	900
Required	95		Regular TTL Accounts	50
Excess	0		TTL Note Accounts	50
Loans & Securities		905		

This increase in the ratio of demand deposits to bank reserves occurs even if the Federal Reserve absorbs the excess reserves released by the introduction of the note accounts (panel B) via open market operations. If the Fed sells securities to the banks to eliminate the $5 of excess reserves (panel D), bank reserves decline to $95, loans and securities increase to $905, and demand deposits remain at $900. The ratio of demand deposits to bank reserves again indicates an increase in the money multiplier due to the introduction

[14] If regular TTL balances increase as demand deposits of the nonbank public expand (in order to maintain some new ratio of Treasury deposits to demand deposits), this result is altered somewhat. The inclusion of other types of deposits (such as time and savings deposits) also alters this result.

of TTL note accounts, since the ratio has increased from 9 (panel A) to 9.47 (panel D).[15]

As the Treasury adapted its cash management procedures to the note account program, the average monthly regular TTL balance fell while the average monthly note balance rose. This shift, however, was not very large, amounting to only about a $1.2 billion decline in the average monthly TTL balance at member banks since November 1978, compared with the average over the previous 18 months. This shift was also a relatively small proportion of the average monthly level of total note balances, which has averaged over $6 billion since November 1978. This small decline in regular TTL balances is not surprising, considering that since 1974 the Treasury had reduced its regular TTL balances by quickly shifting these balances to the Federal Reserve Banks. Consequently, only small further reductions in average TTL balances were possible.

The $1.2 billion shift in average monthly TTL balances at member banks implies only a small reduction in required reserves of the banking system. The decline in required reserves depends on the required reserve ratio on demand deposits and on the decline in regular TTL accounts at member banks (appendix, equation A.11). Since reserve requirements on demand deposits of member banks range between 7 percent and 16.25 percent, the decline in required reserves is between $84 million and $195 million.[16] In comparison, total required reserves were over $38 *billion* in October 1978.

Although the effect of the introduction of note accounts on the money supply process is to raise the level of the money multiplier, thereby increasing the level of the money stock, these effects are estimated to have been small. With reserve requirements ranging between 7 percent and 16.25 percent, the *increase* in the money multiplier ranges between 0.0016 and 0.0037, respectively. In comparison, the money multiplier in October 1978 was approximately 2.6212. Based on the above changes in the money multiplier and a monetary (source) base of $137.8 billion in October 1978, the level of the money stock could have increased, due to the change in the multiplier alone, by between $220 million and $511 million as a result of the introduction of note accounts (see appendix, equation A.19).[17] In comparison, the money stock in October 1978 was $361.2 *billion*.

Other factors affecting the money supply process since last November have worked in the opposite direction and have had a greater impact on the money multiplier and the money stock. Last November, the Federal Reserve imposed a supplementary 2 percent reserve requirement on large-denomination time deposits ($100,000 or more), which tended to lower the money multiplier. The automatic transfer service (ATS) between checking and savings accounts, also introduced in November, again tended to lower the money multiplier.[18] The net effect of these changes has been to reduce, rather than to increase, the money multiplier.

TTL Note Accounts and the Variability of the Money Multiplier

The introduction of TTL note accounts also has an impact on the money supply process by affecting the short-run variability of the money multiplier around tax payment dates. This effect is again the result of the absence of reserve requirements against note accounts. However, the shift in deposits that is of interest here is not between regular TTL and note accounts, but between private demand deposits and note accounts.

Under the TTL program, tax payments by bank customers result in transfers of funds from private demand deposits into a TTL account, generally at the same bank. Since private demand deposits are included in the definition of the money stock, but U.S. government deposits are not, such transfers initially reduce the money stock.

Prior to November 1978, reserve requirements on private demand deposits and government deposits were the same, so that the bank's required reserve position was not affected. Consequently, the monetary base initially was not affected by such transfers. Prior

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[15]The difference in this ratio from that in panel C is due to the earlier assumption about the expansion of deposits; see footnote 14.

[16]These estimates (and the ones that follow) ignore shifts of TTL balances between banks of different sizes having different reserve requirement ratios on demand deposits.

[17]The figure of $137.8 billion for the monetary (source) base is the figure reported by the Federal Reserve Bank of St. Louis for the source base. The Board of Governors (BOG) monetary base for October 1978 was $137.5 billion. The St. Louis source base and the BOG monetary base differ in their treatment of vault cash. The results reported here are essentially the same using the BOG figure. For a discussion of the differences between the two series, see Albert E. Burger, "Alternative Measures of the Monetary Base," this *Review* (June 1979), pp. 3-8.

[18]Scott Winningham, "Automatic Transfers and Monetary Policy," Federal Reserve Bank of Kansas City *Monthly Review* (November 1978), pp. 18-27; John A. Tatom and Richard W. Lang, "Automatic Transfers and the Money Supply Process," this *Review* (February 1979), pp. 2-10.

Exhibit 2

Commercial Banks

Assets		Liabilities	
Panel A			
Reserves	$100	Demand Deposits	$1,000
Required 100		Regular TTL Accounts	0
Excess 0			
Loans & Securities	900		
Panel B			
Reserves	100	Demand Deposits	900
Required 100		Regular TTL Accounts	100
Excess 0			
Loans & Securities	900		

to 1974, however, the decline in the demand deposit component of the money stock that resulted from these transfers was reflected in a temporary decline in the money multiplier.

This can be illustrated using the ratio of demand deposits to bank reserves in a simplified balance sheet of the banking system (exhibit 2). It is again assumed that banks are "loaned up," so that desired excess reserves are zero. As taxes are paid out of private demand deposits, the Treasury's TTL balance rises by $100 but required reserves are unchanged (panel B). Consequently, the ratio of demand deposits to bank reserves declines from 10 to 9, which represents a decline in the money multiplier. In this case, there is no upward (or downward) pressure on the federal funds rate since banks' required reserves are unaffected.[19]

From 1974 to November 1978, the Treasury's policy was to quickly transfer TTL balances out of the banking system to its accounts at the Fed. This procedure would have reduced bank reserves and put upward pressure on the federal funds rate, were it not for the Fed's offsetting open market operations. By restoring the reserves to the banking system, the money multiplier was unchanged. This is illustrated in exhibit 3.

In panel C of exhibit 3, banks become deficient in required reserves as taxes paid into TTL accounts are transferred to the Fed. When the Fed offsets this reserve drain by purchasing securities (panel D), the ratio of demand deposits to bank reserves is 10, the same as its original value (panel A).[20]

Exhibit 3

Commercial Banks

Assets		Liabilities	
Panel A			
Reserves	$100	Demand Deposits	$1,000
Required 100		Regular TTL Accounts	0
Excess 0			
Loans & Securities	900		
Panel B			
Reserves	100	Demand Deposits	900
Required 100		Regular TTL Accounts	100
Excess 0			
Loans & Securities	900		
Panel C			
Reserves (Deficient)	0	Demand Deposits	900
Required 90		Regular TTL Accounts (Transferred to Federal Reserve)	0
Excess −90			
Loans & Securities	900		
Panel D (Fed purchases securities from banks)			
Reserves	90	Demand Deposits	900
Required 90		Regular TTL Accounts	0
Excess 0			
Loans & Securities	810		

Under the current TTL program, tax payments that result in transfers out of private demand deposits into TTL note accounts will lower required reserves. If the Federal Reserve does not absorb these excess reserves in response to downward pressure on the federal funds rate, the banking system will use them to expand loans and deposits. The resulting expansion of the money stock will offset the decline in the money stock from the payment of taxes, so that the money multiplier again remains unchanged.[21] This is illustrated in exhibit 4.

As tax payments are made out of private demand deposits, they flow (after one business day) into TTL note accounts (panel C). Since note accounts are not

[19]If taxpayers borrow the $100 from the banks to pay their taxes in exhibit 2, the ratio of demand deposits to bank reserves (and the money multiplier) would still decline since required reserves would increase to $110. This is the case even if the Federal Reserve provides the resulting increased required reserves to the banks via open market operations. (In this case, the Fed's reserve-supplying operation would be offsetting upward pressure on the federal funds rate).

[20]Even without offsetting open market operations, the ratio of demand deposits to bank reserves (and the money multiplier) would have been unchanged. In this case, the banks' loans and demand deposits would contract until required reserves and demand deposits were in the same proportion as before. This was not the procedure followed by the Federal Reserve, however.

If taxpayers borrow the $100 from the banks to pay their taxes in exhibit 3, the results are essentially the same: upward pressure on the federal funds rate would be offset by the Fed's open market operations, and the ratio of demand deposits to bank reserves (and the money multiplier) would be unchanged.

[21]This assumes that there are no shifts of demand deposits from one bank into note balances at another bank having a different reserve requirement ratio against demand deposits.

Exhibit 4

Commercial Banks

Assets			Liabilities	
Panel A				
Reserves		$100	Demand Deposits	$1,000
Required	100		Regular TTL Accounts	0
Excess	0		TTL Note Accounts	0
Loans & Securities		900		
Panel B (one day only)				
Reserves		100	Demand Deposits	900
Required	100		Regular TTL Accounts	100
Excess	0		TTL Note Accounts	0
Loans & Securities		900		
Panel C				
Reserves		100	Demand Deposits	900
Required	90		Regular TTL Accounts	0
Excess	10		TTL Note Accounts	100
Loans & Securities		900		
Panel D (Banks expand loans and deposits)				
Reserves		100	Demand Deposits	1,000
Required	100		Regular TTL Accounts	0
Excess	0		TTL Note Accounts	100
Loans & Securities		1,000		

subject to reserve requirements, excess reserves increase. When banks eliminate these excess reserves by expanding loans and deposits (panel D), the ratio of demand deposits to bank reserves is 10, the same as its original value, which indicates that the money multiplier is unchanged by such tax payments.[22]

In summary, the TTL program prior to 1974 resulted in short-run variations in the money multiplier around tax payment dates, with no initial change in bank reserves (or the monetary base). In order to maintain the same level of private demand deposits in the banking system after tax payment dates, the Federal Reserve would have had to supply additional reserves by purchasing government securities. From 1974 to November 1978, the Treasury's cash management procedure resulted in no short-run variations in the money multiplier, but could have resulted in large variations in bank reserves and the monetary base as balances in TTL accounts were shifted to the Fed. These potential variations in the monetary base were offset by Fed open market purchases of securities. In order to maintain the same level of private demand deposits in the banking system after tax payment dates, however, the Fed again would have had to supply even more reserves to the banks by purchasing additional securities.

Compared with the TTL program prior to 1974, the current program has reduced the short-run variability of the money multiplier around tax payment dates. Furthermore, bank reserves and the monetary base are unaffected around tax payment dates, in contrast to the 1974-78 cash management procedure. Finally, the same level of private demand deposits in the banking system will prevail after the tax payment date as before, provided the Fed allows the banking system to expand loans and deposits to reduce its excess reserves. The Federal Reserve need not supply additional reserves, then, in order to maintain the same level of demand deposits.

If the Fed seeks to smooth or confine fluctuations in the federal funds rate around tax payment dates, its actions would be different under the new TTL program than under either of the previous programs, since pressures on the federal funds rate are different.[23] Prior to 1974, there was no initial effect on the federal funds rate as taxes flowed into TTL accounts. Between 1974 and November 1978, there was upward pressure on the federal funds rate as TTL balances flowed out of the banking system into the Fed. Since then, there has been downward pressure on the federal funds rate as taxes flowed into TTL note accounts and excess reserves increased. To stabilize the federal funds rate under the current TTL program, then, the Fed would have to sell government securities to decrease banks' excess reserves. Prior to November 1978, the Fed would have had to purchase securities (the 1974-78 case) or make no purchases or sales (the pre-1974 case).[24]

SUMMARY AND CONCLUSIONS

The Treasury's new cash management procedure has reduced the uncertainty faced by the Federal Reserve in achieving a desired level of bank reserves, compared with the cash management procedure adopted in 1974. Treasury balances at Federal Re-

[22]It is also clear that if the Federal Reserve absorbed the excess reserves (panel C) via open market operations, the ratio of demand deposits to bank reserves (and the money multiplier) would also be unchanged from its original value (panel A).

If taxpayers borrow the $100 from the banks to pay their taxes in exhibit 4, the ratio of demand deposits to bank reserves (and the money multiplier) is unchanged. In this case, however, no excess reserves are generated as taxes flow into TTL note accounts since demand deposits increase by the same amount. Hence, there is no downward (or upward) pressure on the federal funds rate.

[23]See text above and footnotes 19, 20, and 22.

[24]In the event that taxpayers borrowed from banks to pay their taxes (see footnotes 19, 20, and 22), the Fed would have had to sell securities to stabilize the federal funds rate around tax payment dates, both before 1974 and between 1974 and November 1978. In this case, there would be no pressure on the federal funds rate under the current TTL program.

serve Banks have been reduced, and changes in these accounts have become less volatile since the new TTL note program went into effect in November 1978. This program has improved the Federal Reserve's ability to execute monetary policy, whether the Fed is seeking a rate of growth of bank reserves associated with a desired rate of money growth, or is seeking to stabilize or obtain a desired level of the federal funds rate.

Since there are differential reserve requirements against TTL note accounts and regular TTL accounts, the introduction of note accounts has affected the money supply process via the money multiplier. Other things being equal, the money multiplier would have risen as a result of the introduction of TTL note accounts, although the estimated increase is small. Other things were not equal, however — a supplementary reserve requirement on large-denomination time deposits was imposed, and ATS accounts were introduced in November 1978 as well. These other factors have more than offset the effect of the introduction of note accounts, so that the money multiplier has declined since November 1978.

Furthermore, as tax payments flow into TTL accounts, short-run movements of required reserves, the money multiplier, and the federal funds rate are different under the new note program than under the TTL program prior to 1974. Since there is no reserve requirement against TTL note balances, required reserves fall, and the money multiplier remains unchanged as tax payments flow out of private demand deposits into note accounts. Since reserve requirements previously were the same for demand deposits and TTL balances, required reserves remained unchanged, and the money multiplier declined as tax payments were made into TTL accounts. Consequently, Federal Reserve actions around tax payment dates will be different under the current TTL program than under previous Treasury cash management procedures.

APPENDIX

This appendix derives the effect of the introduction of Treasury Tax and Loan (TTL) note accounts on the money multiplier. A standard model of the money supply process is employed, in which the money stock (M1) is the product of the monetary (source) base and a money multiplier (m).

(A.1) $M1 = mB$

The money multiplier is given by:

(A.2) $$m = \frac{1 + k}{r(1 + t + g) + k}$$

where, m = money multiplier (M1/B)
k = currency ratio (C^p/D^p)
t = time deposit ratio (T/D^p)
g = Treasury deposit ratio (D^t/D^p)
r = reserve ratio [$R/(D^p + D^t + T)$]
M1 = money stock ($C^p + D^p$)
B = monetary (source) base ($C^p + R$)
C^p = currency held by nonbank public
D^p = net demand deposits held by nonbank public
T = time deposits held by nonbank public
D^t = Treasury deposits at commercial banks ($D^t = D^{tl} + D^{tn}$)
D^{tl} = Treasury deposits in regular TTL accounts
D^{tn} = Treasury deposits in note accounts
R = bank reserves

A change in Treasury deposits could affect both the g- and r-ratios. We can express the g- and r-ratios as:

(A.3) $g = D^t/D^p = (D^{tl} + D^{tn})/D^p$

(A.4) $r = r^d[D^m/(D^p + D^t + T)] + r^t[T^m/(D^p + D^t + T)] + e + v$

where, r^d = required reserve ratio against demand deposits
D^m = member bank demand deposits subject to reserve requirements
r^t = required reserve ratio against time deposits
T^m = member bank time deposits subject to reserve requirements
e = excess reserve (R^e) ratio [$R^e/(D^p + D^t + T)$]
v = nonmember bank vault cash (V) ratio [$V/(D^p + D^t + T)$]

It is assumed here that *desired* excess reserves (R^e) and *desired* nonmember bank vault cash (V) are unchanged by the introduction of TTL note accounts. Excess reserves and nonmember bank vault cash are both non-interest-earning assets of banks. Since banks participating in the TTL note program must pay interest on note balances at a rate 25 basis points below the prevailing federal funds rate, note balances are a relatively expensive source of funds to banks at current interest rates. These note balances must also be fully collateralized by banks' holdings of eligible securities. It is unlikely, therefore, that an increase in note balances would induce banks to increase their desired holdings of non-interest-earning assets.

The term D^m is composed of member bank demand deposits subject to reserve requirements, including net demand deposits of the nonbank public (D^{mp}) and regular TTL accounts (D^{mtl}). The increase in note accounts at the expense of regular TTL accounts decreases member bank required reserves. The decline in required reserves (RR) depends on the required reserve ratio (r^d) and on the amount that regular TTL accounts at member banks decline.[1]

(A.5) $\triangle RR = r^d(\triangle D^{mtl})$

However, only the proportion (z) of total note balances held at member banks will affect the numerator of the r-ratio as regular TTL balances at member banks decline.

(A.6) $D^{mtn} = zD^{tn}$

TTL note accounts (D^{tn}) may initially increase due to a transfer of funds from regular TTL accounts (D^{tl}) into D^{tn} or by a transfer of Treasury deposits at the Fed into D^{tn}.

(A.7) $\triangle D^{tn} = -\triangle D^{tl} + -\triangle$(Treasury deposits at the Fed)

where,

(A.8) $\triangle D^t = \triangle D^{tn} + \triangle D^{tl}$

The initial decline in regular TTL balances (D^{tl}) can be considered to be some proportion h of note balances (D^{tn}), so we can write: $-\triangle D^{tl} = h\triangle D^{tn}$ and, consequently, $-\triangle$(Treasury deposits at the Fed) $= (1 - h)(\triangle D^{tn})$. In particular, the initial decline in regular TTL balances at member banks (D^{mtl}) is considered to be the proportion h of note balances at member banks (D^{mtn}): $-\triangle D^{mtl} = h\triangle D^{mtn}$. Consequently, we have:

(A.9) $\triangle D^t = \triangle D^{tn} - h\triangle D^{tn} = (1 - h)\triangle D^{tn}$

(A.10) $\triangle D^{mt} = \triangle D^{mtn} + \triangle D^{mtl} = (1 - h)\triangle D^{mtn}$

We can now express the change in required reserves in equation A.5 as:

(A.11) $\triangle RR = r^d(\triangle D^{mtl}) = -r^d h(\triangle D^{mtn}) = -r^d hz(\triangle D^{tn})$

[1]The decrease in required reserves as note balances rise will induce banks to expand their loans and deposits. Such deposit expansion will ultimately change the levels of currency and of demand, time, and Treasury deposits. However, the k- and t-ratios will remain unchanged by this process.

The effect of the introduction of TTL note accounts on the g- and r-ratios are as follows:[2]

$$(A.12)\quad dg/dD^{tn} = \frac{dD^{tl}/dD^{tn} + dD^{tn}/dD^{tn}}{D^P} = (-h+1)/D^P$$
$$= (1-h)/D^P > 0$$
since $0 < h < 1$

$$(A.13)\quad dr/dD^{tn} = \frac{(dR/dD^{tn})(D^P + D^t + T) - (dD^t/dD^{tn})R}{(D^P + D^t + T)^2}$$
$$= \frac{r^d(dD^{mtl}/dD^{tn})(D^P + D^t + T) - (dD^{tl}/dD^{tn} + dD^{tn}/dD^{tn})R}{(D^P + D^t + T)^2}$$
$$= \frac{r^d(-h)(dD^{mtn}/dD^{tn})(D^P + D^t + T) - (-h+1)R}{(D^P + D^t + T)^2}$$
$$= \frac{r^d(-h)z(D^P + D^t + T) - (1-h)R}{(D^P + D^t + T)^2}$$
$$= \frac{-zhr^d - (1-h)r}{(D^P + D^t + T)} < 0$$

Thus, the g- and r-ratios change in offsetting ways, and the effect on the multiplier is:

$$(A.14)\quad dm/dD^{tn} = \frac{-[(dr/dD^{tn})(1+t+g) + r(dg/dD^{tn})](1+k)}{[r(1+t+g)+k]^2}$$
$$= \frac{-[-zhr^d/D^P - (1-h)r/D^P + r(1-h)/D^P](1+k)}{[r(1+t+g)+k]^2}$$
$$= \frac{(zhr^d/D^P)(1+k)}{[r(1+t+g)+k]^2}$$
$$> 0$$

With appropriate substitutions, equation A.14 can be expressed as follows:

$$(A.15)\quad dm/dD^{tn} = \frac{zhr^d m}{D^P[r(1+t+g)+k]} = \frac{zhr^d m}{B}$$

Note that, if the change in the money multiplier is evaluated with respect to note balances (D^{tn}), both the proportion of note balances that result from the decline in regular TTL balances (h) and the proportion of total note balances at member banks (z) must be evaluated. The effect of introducing note accounts on the money multiplier is then equation A.15 times the change in note balances. Alternatively, the change in the multiplier could be taken with respect to the change in regular TTL balances subject to reserve requirements (D^{mtl}). [This can be done since the only effects of D^{tn} on the multiplier that do not offset each other in equation A.14 operate on the r-ratio via the reduction in regular TTL accounts at member banks (D^{mtl}).] This yields the expression:

$$(A.16)\quad dm/dD^{mtl} = \frac{-r^d m}{B}$$

The effect on the money multiplier can then be estimated by equation A.16 times the *decline* in regular TTL balances subject to reserve requirements. The effect on the multiplier is equivalent to that obtained using equation A.15, but the proportions h and z need not be evaluated.

The effect on the money stock (M1) of introducing note accounts is a combination of the change in the multiplier and the change in the monetary (source) base that results from the decline in Treasury deposits at the Fed.

$$(A.17)\quad dM1/dD^{tn} = d(mB)/dD^{tn} = B(dm/dD^{tn}) + m(dB/dD^{tn})$$

The dollar change in the base that occurs as TTL note balances increase is equal to the proportion of note balances that result from the decline of Treasury deposits at the Fed $(1-h)$ times the dollar change in note balances $[\triangle B = (1-h)(\triangle D^{tn})]$. The dollar change in the money stock due to the effect of note accounts on the base alone is then:

$$(A.18)\quad \triangle M1 = m(\triangle B) = m(1-h)(\triangle D^{tn})$$

This assumes, of course, that the shift of Treasury deposits at the Fed to note accounts is not offset by defensive open market operations.

The dollar change in the money stock due to the effect of note accounts on the money multiplier alone is the monetary base (B) times equation A.15 times the dollar increase in note balances. Alternatively, this can be expressed in terms of the dollar *decrease* in regular TTL balances at member banks using equation A.16 as follows:

$$(A.19)\quad \triangle M1 = B(dm/dD^{tn})(\triangle D^{tn})$$
$$= B(dm/dD^{mtl})(\triangle D^{mtl})$$
$$= -B(r^d m/B)(\triangle D^{mtl})$$
$$= -r^d m(\triangle D^{mtl})$$

This is the expression used in the text to estimate the effect on the money stock of introducing note accounts, due to the impact of the change in the multiplier alone.

[2] In what follows, the expression dx/dy represents the partial derivative of x with respect to y.

Explaining the Economic Slowdown of 1979: A Supply and Demand Approach

KEITH M. CARLSON

THE long-awaited slowdown in the U.S. economy finally occurred in 1979. Whether it eventually will be labeled a recession, however, is still an open question.[1]

Whether the economy is in recession is, of course, a matter of concern for policymakers. More important for them, however, are the causes of the slowdown since the nature of these underlying causes determines the type of response that they must make to achieve the nation's economic goals.

This article analyzes the causes of the 1979 slowdown in economic activity with the use of a simple supply and demand framework. The analysis is kept simple to demonstrate that models of the economic system need not be large and complex in order to give a general picture of the forces that produce changes in output and the price level. The near-term economic outlook is then discussed within this framework. No specific forecasts are made, but, given certain assumptions about economic behavior, the implications of different policy scenarios are summarized.

The Arithmetic of the Slowdown

After expanding significantly in 1978, the pace of economic activity began to slow in early 1979. In the first four months of the year, the economic indicators were difficult to interpret because of shocks to the economic system.[2] Since spring, however, economic developments indicate that more fundamental forces have been slowing the advance of the economy. Most measures of monetary and fiscal action, for example, moved in the direction of less stimulus in late 1978 and early 1979.

The progress of the economy in the first three quarters of 1979 is summarized in table 1. These figures provide background for the analytical section that follows. For comparison's sake, percent changes for 1978 and a previous part of the expansion are also summarized.

Income and sales — The top tier of numbers summarizes the movement of the economy in nominal terms, that is, without adjustment for changes in the price level. Nominal measures provide an indication of the thrust of monetary and fiscal actions on total spending in the economy. The most important of these measures, gross national product (GNP), slowed in the first three quarters of the year relative to 1978. Personal income and retail sales also advanced more slowly, although retail sales showed substantial quarter-to-quarter variation.

Production and employment — Although nominal indicators are important in the interpretation of economic developments, real indicators must receive the major emphasis in assessing the course of economic activity. GNP (in 1972 prices) serves as the fundamental indicator of economic progress in the United States. This measure of the nation's output slowed markedly in the first quarter, declined in the second, and then increased moderately in the third quarter. Industrial production, which accounts for about 30 percent of GNP, serves as a sensitive indicator of output trends. It slowed to a 4 percent annual rate of increase in the first quarter, and changed little in the second and third quarters.

The course of production is the key to employment

[1]The National Bureau of Economic Research has not yet issued an official ruling on whether the current slowdown in the U.S. economy qualifies as a recession. Contrary to popular belief, the National Bureau does not make such a determination merely by looking at the course of constant dollar GNP. Many other economic time series are examined as part of that decision.

[2]First, there was the impact of severe weather in some parts of the country. Second, there were major work stoppages in early spring. And finally, energy prices started to accelerate in the first quarter.

Table 1

Selected Economic Indicators
(Compounded Annual Rates of Change)

	II/79-III/79	I/79-II/79	IV/78-I/79	IV/77-IV/78	IV/75-IV/77
Income and Sales					
Nominal GNP	11.0%	6.7%	10.6%	13.4%	11.1%
Personal Income	11.2	8.9	11.4	12.9	10.6
Retail Sales	16.1	2.0	7.8	12.1	10.7
Production and Employment					
Real GNP	2.4	–2.3	1.1	4.8	5.3
Industrial Production	0.8	–0.8	4.0	7.4	6.6
Total Employment	3.3	–0.7	4.2	3.9	3.8
Payroll Employment	1.9	2.9	4.3	4.7	3.9
Prices					
GNP Deflator	8.4	9.3	9.3	8.2	5.5
CPI — All Items	12.9	13.8	11.8	9.0	5.8
Producer Prices — All Commodities	13.4	13.5	14.6	9.6	5.0
Industrial Commodities	17.3	16.0	12.8	8.3	6.6
Fuels and Related Products, and Power	72.8	45.5	16.7	6.3	10.0
Farm Products, Processed Foods and Feeds	0.0	5.4	21.2	14.6	–0.2
Policy Indicators					
M1	10.0	7.8	–2.1	7.2	6.8
M2	12.5	8.9	1.8	8.4	10.4
Adjusted Monetary Base	11.2	6.0	6.1	9.5	8.6
Federal Expenditures (NIA)	19.5	5.1	6.1	8.6	8.7

trends. Its effect on employment is lagged, however, since employers are reluctant to lay off workers until convinced the signs of economic slowdown are not transitory. In the first quarter of 1979, for example, employment continued its rapid growth in the face of slowing production. Since the first quarter, however, employment growth has, on balance, moderated.

Prices — While major measures of price change accelerated in 1978, the pace stepped up further in 1979. Accelerating prices in the face of slowing production and output is not without precedent, however, since prices reflect forces that build up over time and are not particularly sensitive to short-run movements in the pace of economic activity.[3] Furthermore, the price level is subject to supply shocks, such as energy developments and agricultural conditions, which can dramatically affect prices for several months and mask the movement of the underlying trend in inflation. Two primary measures of these shock effects are summarized in table 1 as "producer prices for fuels and related products, and power," and "farm products, processed foods and feeds." Energy prices rose at a very high rate in the first three quarters of 1979. Farm prices, on the other hand, vacillated in 1979 but, on balance, increased at about the same rate as overall prices.

Policy indicators — Finally, table 1 summarizes the movements of some major policy indicators. Interpretation of the monetary aggregates, the fundamental indicators of monetary policy, has been made difficult because of innovations in the financial industry.[4] Yet, in perspective, the trends are quite clear. Monetary growth decelerated sharply in the first quarter, but rebounded vigorously in the second and third quarters. Federal expenditures, a summary measure of fiscal actions, showed moderate growth in the first two quarters of 1979, then rose sharply.[5]

[3]Geoffrey Moore discusses this point and finds evidence that economic slowdowns reduce the inflation rate. See Geoffrey H. Moore, "Will the Slowdown Reduce the Inflation Rate? Probably," *Across The Board*, The Conference Board Magazine (September 1979), pp. 3-7. For a contrary view, see John A. Tatom, "Does the Stage of the Business Cycle Affect the Inflation Rate?" this *Review* (September 1978), pp. 7-15.

[4]For a discussion of these innovations, see "A Proposal for Redefining the Monetary Aggregates," *Federal Reserve Bulletin* (January 1979), pp. 13-42.

[5]This pattern of slow growth for federal expenditures in the first half of the year followed by rapid growth in the second half has been occurring since 1975. See this Bank's release, "Monetary Trends."

A Framework of Analysis

The path of the economy in 1979 is quite clear — a slowing of output growth and an acceleration of prices. A description of how the economy has moved, even when accompanied with a summary of the major policy indicators, however, is of little use to policymakers unless cast within a framework of economic analysis. Only with an understanding of the forces which produce the slowdown can policymakers make a proper choice of policy.

To assist in the explanation of the 1979 economic slowdown, a model of output and price level determination is presented. The general analytical approach is that output and the price level are determined by the intersection of aggregate supply and aggregate demand. The factors which enter into the determination of supply and demand represent a complex interaction of economic forces (table 2).

Table 2

Factors Influencing Aggregate Supply and Demand

Aggregate Supply	Aggregate Demand
Technological progress	Money stock
Capital stock	Velocity
Labor force	
Nominal wage	
Price of energy	

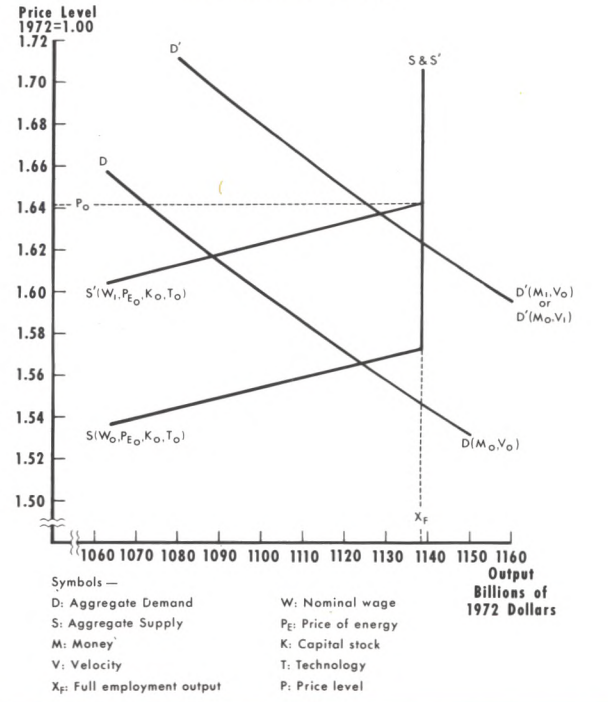
Note: This list is not exhaustive. Included here are only those factors emphasized in this article.

Aggregate demand — Figure 1, drawn to depict the economy in the fourth quarter of 1978, summarizes the model graphically.[6] Aggregate demand for output (DD) is drawn as a function of the price level, with less output demanded at higher price levels.

The shape and position of the aggregate demand curve is a subject for empirical analysis. For purposes of this discussion, however, the demand curve is drawn so that the price level times the quantity of output (that is, nominal GNP) is constant.[7] This follows from the assumption that the key determinant of the demand for money is nominal GNP. Consequently, for a given stock of money, the demand curve depicts those combinations of price level and output that equate the quantity of money demanded with a given quantity supplied. The quantity of money supplied is determined by monetary authorities, but the demand for money depends on the behavior of economic units. An alternative interpretation is to think of nominal GNP as determined by the quantity of money and its velocity of circulation.

Figure 1

Effect of Changes in Money, Velocity, and Nominal Wage



To analyze the course of economic events, it is important to identify the factors that shift the demand curve since economic analysts are interested in how forces move the economy from one position to another through time. Empirical analysis has demonstrated that shifts in aggregate demand are systematically influenced by changes in the quantity of money.[8] A complete analysis, however, requires consideration of those factors affecting the demand for money (or velocity) over time. The effect of an increase in either the money stock or velocity by 5 percent is shown as a shift upward and to the right of the

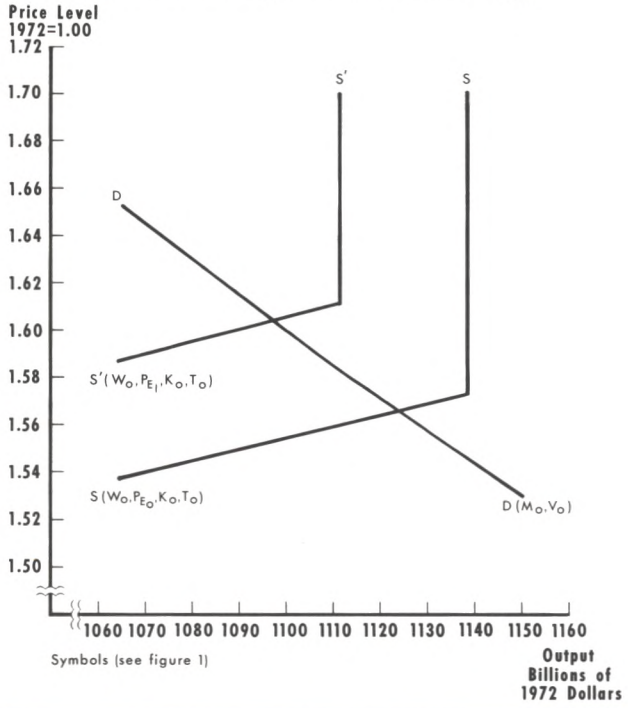
[6]Data for the private business sector are used in the construction of all the figures. Private business sector output is defined as the market value of the goods and services produced by factors of production in the United States *minus* those goods and services attributable to (1) owner-occupied dwellings, households, and nonprofit institutions, and (2) general government.

[7]The aggregate demand curve is drawn as a rectangular hyperbola in figure 1 (and in all other figures), but appears linear because of the break in both axes.

[8]The basic reference is Leonall C. Andersen and Jerry L. Jordan, "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," this *Review* (November 1968), pp. 11-24. For an update and critique of this article, see Keith M. Carlson, "Does the St. Louis Equation Now Believe in Fiscal Policy?" this *Review* (February 1978), pp. 13-19.

Figure 2

Effect of Change in Price of Energy



aggregate demand curve, from DD to D'D' in figure 1. A larger stock of money (or a reduced demand for money, that is, an increase in velocity) requires a larger nominal GNP to equate the quantity of money supplied with the quantity demanded.

Aggregate supply — The demand curve, which represents equilibrium in the money market, is not sufficient to determine how nominal GNP is divided between prices and output. To complete the model, the supply side of the market must be specified. The aggregate supply curve represents the amount of output that producers are willing to supply at various price levels. This is significantly influenced by factors affecting the labor market, that is, by the supply and demand for labor. As with aggregate demand, it is important to identify those factors that determine the shape and position of the aggregate supply curve.

The aggregate supply curve in figure 1 slopes upward to the point where labor is "fully employed;" at that point, X_F, it becomes vertical. The amount producers are willing to supply at different price levels in the short run (a period short enough that the capital stock can be assumed fixed) depends on such factors as the amount of the capital stock, the level of technology, the size of the labor force, and the prices for two variable factors of production — labor and energy.

The upward-sloping portion of the supply curve reflects the simplifying assumption that at output levels below full employment producers can hire any amount of labor that they want without affecting the nominal wage. The reason producers are willing to supply more output only at higher price levels, even if nominal wages are constant, is that the addition of more of a variable factor like labor to a set of fixed factors results in diminishing returns to the variable factor. To cover the higher cost per unit of extra product, the producer asks for a higher price. The vertical portion of the supply curve reflects the following assumption: attempts to expand output beyond levels commensurate with fully employed labor merely bid up the nominal prices of fully employed labor, capital, and energy.

Shifts in aggregate supply occur because of a change in any one or a combination of several factors. Changes in the capital stock and technology are instrumental in shifting aggregate supply over time, but these factors seldom change abruptly over short periods. The other two factors — the price of labor and the price of energy — can change dramatically in a short period of time. Movements in the price of labor will, of course, reflect productivity trends as well as past and expected price levels. The price of energy is determined by the interplay of supply and demand in world markets.[9]

Two aggregate supply curves are drawn in figure 1.[10] SS represents supply conditions as they existed in the fourth quarter of 1978. S'S' shows the effect of a nominal wage 5 percent higher than used in the construction of SS. At the higher nominal wage, less output will be produced at each price level below P_o. Once capacity output, X_F, is reached, output does not respond further to the price level because of the assumption of fully employed labor. If aggregate demand is unchanged, the effect of the higher nominal wage will be temporary. The higher unemployment coupled with competition in the labor market will reduce the nominal wage toward its equilibrium level.

Of particular significance is the effect of higher energy prices. Figure 2 illustrates this effect. SS and

[9]For an analysis of the impact of energy prices on aggregate supply, see Robert H. Rasche and John A. Tatom, "The Effects of the New Energy Regime on Economic Capacity, Production, and Prices," this *Review* (May 1977), pp. 2-12.

[10]These supply curves are constructed using a Cobb-Douglas production as estimated by Rasche and Tatom. Implicit in their construction is the assumption that a short-run equilibrium prevails in the labor market — given the nominal wage.

DD are the same as in figure 1, consistent with conditions prevailing in the fourth quarter of 1978. S'S' in figure 2, however, reflects energy prices 30 percent higher than used in the construction of SS. The effect is similar to that for a higher nominal wage with one important difference — full-employment output is reduced by an increase in the price of energy. The reason for this is that the reduction in energy use as a third factor of production lowers the productivity of labor and capital in the short run.[11] Consequently, full-employment output will be less, but the amount of labor employment consistent with that reduced output will be the same as before the increase in the price of energy.

Movements in supply and demand over time — Equilibrium is defined after the supply and demand functions have been specified; it is simply the combination of price level and output that equates supply and demand. Implicit in this equilibrium, however, is the assumption of equilibrium in both the money market, given the stock of money, and the labor market, given the nominal wage. Neither supply nor demand remains stationary, and it is the path of output and the price level traced out through time that concerns the economic analyst.

Research results support the notion that shifts of aggregate demand over time are dominated by the rate of monetary expansion. While other factors lead to changes in aggregate demand as well, they are assumed to be captured in the velocity term in this simple model.

Aggregate supply tends to shift because of changes in factors that were assumed constant in the construction of figures 1 and 2. In other words, changes in nominal wages, the price of energy, the size of the labor force, and productivity will shift aggregate supply over time. Underlying productivity changes are trends in the capital stock and technology.

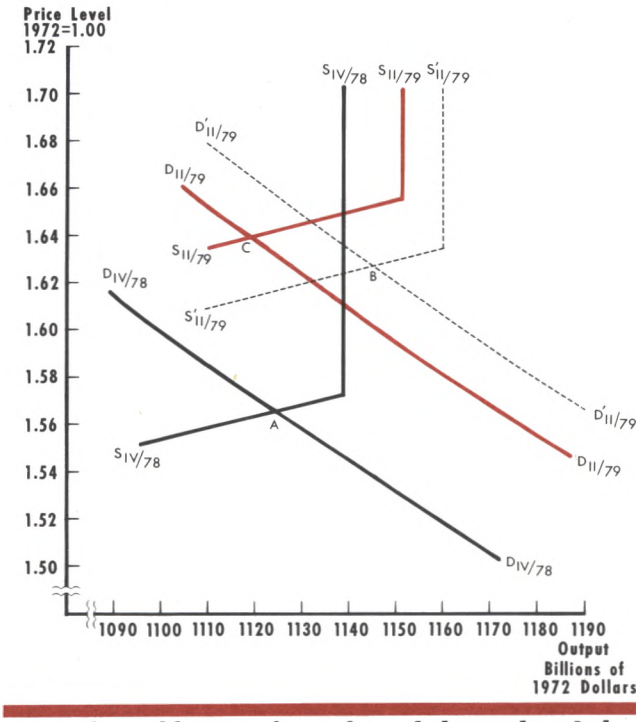
Supply and Demand Analysis of the First Half of 1979

This framework of analysis is now applied to the economic experience of the first half of 1979, from IV/78 to II/79.[12]

Defining a reference point — In figure 3, point A represents the actual position of the economy in the fourth quarter of 1978. It is assumed that this is a point of equilibrium of supply and demand and that this equilibrium occurs at less than full-employment output.[13]

Figure 3

Economic Developments: IV/1978 to II/1979



Point B represents the position the economy would have reached in the second quarter of 1979 had both aggregate supply and demand grown in line with past trends. The growth rate for aggregate supply is assumed to be a 3.8 percent annual rate of increase. Aggregate demand is drawn commensurate with a continuation of the 8 percent rate of increase in money which prevailed from III/76 to III/78.[14] Point B serves as a useful point of reference in analyzing what actually happened between IV/78 and II/79 because it represents a continuation of past trends. Departures from point B can be accounted for by factors influencing supply and/or demand.

Where the economy was in II/79 and why — The economy did not move to point B in the second quarter of 1979. Rather, it moved to point C, a point of

[11] See Rasche and Tatom, "Effects of the New Energy Regime."

[12] Preliminary data have been released for the third quarter of 1979, but because these first estimates are subject to revision, the analysis focuses on the period from IV/78 to II/79.

[13] In reality, however, the level of full-employment output is not clearly defined, and some analysts believe the economy was operating at full employment in the fourth quarter of 1978. See, for example, Phillip Cagan, "The Reduction of Inflation by Slack Demand," in William Fellner, Project Director, *Contemporary Economic Problems 1978* (Washington, D.C.: American Enterprise Institute, 1978), pp. 13-45.

[14] These rates of change are quoted for money defined to include ATS accounts and New York NOW accounts.

Table 3

Summary of Figure 3

Intersection	Price Level (1972=1.00)	Output (Billions of 1972 Dollars)	Annual Rate of Change from IV/78: Price Level	Annual Rate of Change from IV/78: Output	Explanation
$D_{IV/78} - S_{IV/78}$	1.566	$1124.1	—	—	Actual IV/78
$D'_{II/79} - S'_{II/79}$	1.627	1145.5	8.0%	3.8%	Continuation of trend from IV/78 with 8% money
$D_{II/79} - S_{II/79}$	1.640	1118.7	9.7	−1.0	Actual II/79
$D'_{II/79} - S_{II/79}$	1.646	1131.6	10.5	1.3	Effect of increases in energy prices and wages in excess of trend productivity
$D_{II/79} - S'_{II/79}$	1.620	1132.0	7.0	1.4	Effect of demand shift because of slowing in money and velocity

higher price and lower output levels than at point B. Both supply and demand shifted differently than indicated by a continuation of trends that prevailed in late 1978.

First of all, demand did not shift to the extent indicated by reference point B. One reason for this was that the growth in the money stock slowed dramatically beginning in November 1978. However, it accelerated again in the second quarter of 1979 and, on balance, showed a 6 percent annual rate of increase from III/78 to II/79. Nonetheless, the difference between the actual and the implied shifts in aggregate demand is greater than can be explained solely by the slowing in monetary growth. Velocity growth also slowed, or, in terms of the demand for money, there was an apparent increase in the quantity of money demanded at each level of nominal GNP during this period. Variations in velocity about its trend are not uncommon for short periods. Although the effects of short-term fluctuations are only temporary, the pace of activity can be affected by variations as brief as two quarters. Even if aggregate supply had shifted in accordance with its trend, output would have been affected by the slowing of the money stock and velocity.

Figure 3 also shows that aggregate supply did not shift as indicated by reference point B. Supply, instead of shifting to $S'_{II/79}$, shifted to $S_{II/79}$. Two factors contributed to this: (1) nominal wages increased 8.9 percent in excess of trend productivity instead of 8.0 percent as implied by trend factors, and (2) the relative price of energy increased at a 30 percent annual rate.

The information contained in figure 3 is summarized in table 3. Using hypothetical point B as a reference, shifts in both supply and demand contributed to the decline in output from IV/78 to II/79. For this short period, however, supply conditions were primarily responsible for an increase in the price level in excess of that suggested by the continuation of trend.

Economic Outlook

Given the explanation of how the economy moved to a higher price level and a lower output level in

Table 4

Assumptions Underlying Figure 4
(Annual Rates of Change)

	AGGREGATE DEMAND						AGGREGATE SUPPLY					
	6% Money Growth			8% Money Growth			6% Money Growth			8% Money Growth		
	Money	Velocity	GNP	Money	Velocity	GNP	Nominal Wages	Energy Prices	Full-employment Output*	Nominal Wages	Energy Prices	Full-employment Output*
II/79-IV/79	8.5%	3.8%	12.6%	9.5%	3.8%	13.6%	9.5%	54.8%	3.8%	10.1%	54.8%	3.8%
IV/79-II/80	6.0	3.8	10.1	8.0	3.8	12.2	8.5	15.9	3.8	9.8	15.9	3.8
II/80-IV/80	6.0	3.8	10.1	8.0	3.8	12.1	7.5	15.0	3.8	9.5	15.0	3.8

*Growth rate if relative price of energy were constant.

Table 5

Summary of Figure 4
(Annual Rates of Change)

Period	6% Money Path		8% Money Path	
	Price Level	Output	Price Level	Output
II/79 to IV/79	11.9%	0.6%	12.6%	0.9%
IV/79 to II/80	7.5	2.3	8.9	3.0
II/80 to IV/80	6.7	3.1	8.5	3.3

the first half of 1979, what are the implications for the future? The movement in recent months of those key variables that influence aggregate supply and demand in the short run is a primary consideration.

Recent Developments — The short-run focus of this analytical framework is on changes in the money stock, nominal wages, and the price of energy. Other factors are at work, but for the most part these factors change only gradually from past trends.

The variable for which the most current information is available is the money stock. Since the second quarter of 1979, M1 (without adjustments for ATS and NOW accounts) has increased at a 10 percent annual rate. With an allowance for these checkable deposits, the increase has probably been in excess of 11 percent. This rate of increase is one of the most rapid for periods of similar length in the postwar period.

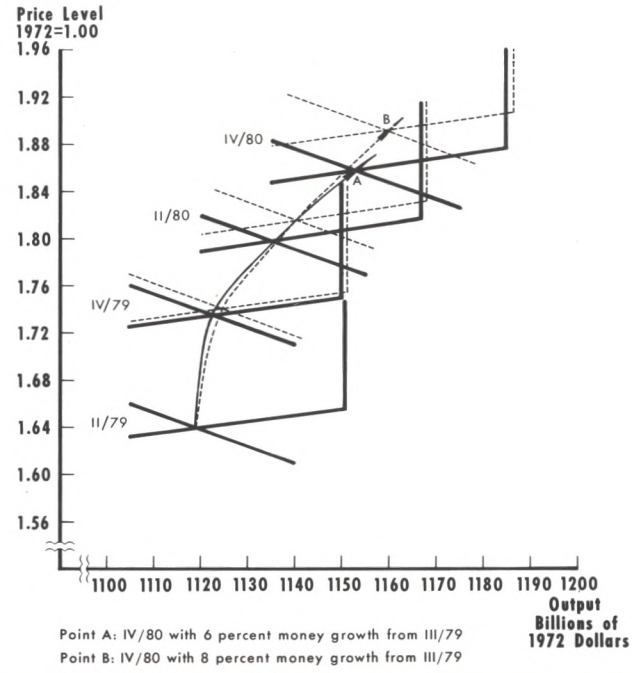
The other development of note is the continuing increase in the price of energy as the effect of OPEC cartel actions and the gradual decontrol of domestic prices work their way through the price structure. Since the second quarter of 1979, the nominal price of energy has risen at a 73 percent annual rate, which indicates that further adjustments in aggregate supply are forthcoming.

The last factor, nominal wages, has increased at a moderate rate of 8.5 percent since the second quarter. If rapid monetary growth continues and further stimulates aggregate demand, there is some question whether rates of increase in nominal wages will continue in the 8 percent to 9 percent range.

Policy Options — Given this framework of analysis and some indication of more recent developments, the impact of alternative policy scenarios can be investigated. Taking the rapid growth in money in the third quarter of 1979 as a starting point, two policy scenarios are considered: (1) the rate of money growth will be reduced to 8 percent beginning in the fourth quarter of 1979 and held steady at that rate through 1980,

Figure 4

Impact of Alternative Monetary Policies: II/1979 to IV/1980



and (2) beginning in the fourth quarter of 1979, the rate of money growth will be slowed to 6 percent. Both scenarios are based on the same pattern of energy prices, but the rate of change in nominal wages is assumed to be related to the rate of increase in the money stock.[15] The excess by which nominal wages increase over trend productivity is assumed to approach the rate of monetary growth by the second half of 1980.[16] The assumptions underlying these policy scenarios are summarized in table 4.

Figure 4 and table 5 summarize the results. The bottom pair of supply and demand curves shows the position of the economy in the second quarter of 1979. The succession of supply and demand intersections for every other quarter through the fourth quarter of 1980 shows two paths corresponding to the two monetary policy scenarios. The solid lines represent the 6 percent case while the dashed lines represent the 8 percent case. Full-employment output is projected to change only slightly from II/79 to IV/79, then resume

[15]This assumption is quite arbitrary, but does reflect preliminary research into the relationship between nominal wages and money.

[16]Relative to accumulated empirical evidence, this speed of adjustment is probably too fast. Consequently, the scenarios should be interpreted as optimistic and perhaps in line with the rational expectations literature.

its increase from IV/79 to IV/80. This pattern reflects the assumption that the rapid acceleration in energy prices will slow by the beginning of 1980.

The path for 6 percent money growth is shown by connecting the intersections of the solid lines, and for 8 percent by connecting the intersecting dashed lines. Because of the assumed interdependence *over time* of aggregate supply and demand (reflecting the assumption that wages are influenced by money growth), the two paths appear to be quite close together. However, by the second half of 1980, the price level would be rising more rapidly along the 8 percent path than along the 6 percent path, even though the rates of output growth would be similar.

The course of the economy is still being influenced by the rapid acceleration in the price of energy which began in early 1979. This factor is largely responsible for the rapid upward shifts in aggregate supply into 1980. Given this assumed pattern of increase in energy prices, the role for monetary policy is to follow a moderate course, avoiding extremes of stimulus or restraint. Price level increases attributable to energy prices cannot be reduced by restrictive monetary actions. On the other hand, stimulative actions to restore output to its original growth path (a failure to recognize the impact of energy prices on full-employment output) will lead to sharply accelerating prices.

Summary and Conclusions

The economic slowdown in the first half of 1979 can be attributed to shifts in aggregate supply and demand. Aggregate demand slowed because both money growth and velocity dropped below previous trends. Aggregate supply, on the other hand, was affected by energy prices and a rise in nominal wages well in excess of trend productivity.

An examination of the near-term economic outlook within the framework of supply and demand indicates that energy prices will continue to have adverse effects on aggregate supply through 1979. The rapid growth of money in the third quarter of 1979 will tend to dampen the decline in output, but eventually will result in further upward price movements. Assuming that energy prices moderate in the near future, the rate of inflation should again reflect more closely the growth rate of money.

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