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Defense Spending and Economic Activity

By Glenn H. Miller, Jr., and Stephen L. Able

Events in southwest Asia in late 1979 and early 1980 have led the United States to reevaluate the urgency and size of its national defense needs. Should such reevaluation lead to a significant military buildup, a substantial impact on economic activity may be expected to result. In contrast to the experience during the Vietnam war buildup of the 1960s, though, a better understanding now exists of the effects of a military buildup on economic activity.

A number of factors contributed to a slow recognition of the expansionary impact on the economy of the Vietnam war buildup. These factors included uncertainty about the U.S. commitment in Vietnam, difficulty in forecasting defense spending, and an incomplete understanding of the manner and timing of a military buildup's effect on economic activity. Furthermore, timely statistics on business activity in the defense production sector were less than readily available and not completely appropriate for analytical purposes. For example, data on manufacturers' orders, inventories, and shipments of defense goods were mixed with data on civilian activity in reports for industries such as aircraft production. Not until mid-1967 were important data series on defense activity gathered and published in a single report. In addition, budget estimates of future defense spending turned out to be wide of the mark and such errors added to the difficulties of economic analysis and policymaking. The need for accurate, up-to-date forecasts of defense spending soon became evident at that time, but the Vietnam defense spending bulge had largely worked its way through the economy before significant success was achieved in providing such forecasts.

As a result of the attention directed at the problems associated with the Vietnam military buildup, there has been an improvement in the understanding of the defense spending process, in presentation of data, and in analysis and forecasting. To familiarize the reader with this improved understanding, this article first discusses the Federal spending process and its effect on the timing of economic activity. Next, current measures of defense activity and their relationships are presented. The article concludes with a simple empirical analysis of leading and final indicators of defense activity, an analysis which is used to forecast defense goods purchases and to estimate the impact of a military buildup on economic activity. Alternative assumptions about a defense buildup in 1980 and 1981 are made, and simulations

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undertaken to show the estimated increase in economic activity that would be associated with each assumption.

UNDERSTANDING THE SPENDING PROCESS AND ITS EFFECT ON ECONOMIC ACTIVITY

The Federal spending process begins with the President's request to Congress for funds to support his programs. Programs are authorized by Congress and funds are appropriated to the operating agencies who then incur obligations, or commitments—to pay money for wages and salaries, and for the purchase of buildings, equipment, materials, and land. Actual outlays by the Federal government are recorded by the Treasury when payments are made, and these outlays appear in the Federal purchases sector of the GNP accounts when the goods are delivered.

As a result of this spending sequence, there is a lag between obligations and outlays, or expenditures. The lag is shorter for goods purchased from producers' stocks than for goods produced on order or under special contract. In the latter case, the lag occurs because it takes time after orders are received for the private sector to make plans, obtain resources, negotiate subcontracts where necessary, undertake production, and deliver the product. Thus, the employment of resources and the production of goods—those private sector activities that make demands on the economy's capacity to produce—precede delivery to, and payment by, the government. Even though the government is clearly affecting the economy, the data on Federal purchases in the GNP accounts do not reflect that fact. In short, Federal purchases in the GNP accounts are shown on a delivery basis (the endpoint in the government spending process), but the major impact of the spending programs occur earlier in the process, beginning with the letting of contracts and the placing of orders (the obligation stage).

The fact that changes in government demand for output show up in Federal purchases in the GNP accounts only after a considerable time lag means that "the Federal purchases figures are a misleading clue to the current impact and the timing of the cyclical impact of the Federal government on output."[1] Thus, understanding the Federal expenditure process, and knowing when that process most significantly affects the private sector, are important to an analysis of the direct impact of fiscal action on economic activity. When there is little change in government demand, there is little need for concern about the timing of its impact. But when government demand is changing rapidly and is a particularly dominant force in the economy, understanding the Federal spending process and the timing of its impact on economic activity is especially important for proper interpretation and evaluation of economic developments. Such a situation often is associated with a sharp military buildup because defense outlays usually involve long lags between orders and deliveries.

When the government places contracts or orders with a private firm, the latter begins to order materials, hire workers, place subcontracts, and perhaps even invest in new plant and equipment. These steps often inspire similar action elsewhere in the economy. As production by the private firm moves ahead, the inventory component of GNP increases, i.e., production on government order appears as private inventory investment in goods in process. Not until the final products are delivered to the government does the Federal sector of the GNP accounts reflect the increase in economic activity. When the goods are

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[1] Joseph Scherer, "On Measuring Fiscal Policy," *The Journal of Finance*, December 1965, p. 684.

delivered, the recorded increase in Federal purchases offsets the reduction in private inventories in the GNP accounts—thus leaving no apparent effect on the level of total economic activity at that time.[2]

Because the Federal spending process works in the above fashion, it is generally agreed that the best indicator of the current impact of defense activity on the economy is not just Federal defense purchases, but rather Federal defense purchases plus the change in private inventories due to changes in the defense goods production sector.

MEASURES OF DEFENSE ACTIVITY

Once it is recognized that the timing of the Federal spending process is important in understanding the impact of a military buildup on economic activity, and that inventory change in the defense goods production sector is a significant part of the total impact, the need for statistical data reflecting these relationships becomes evident. Fortunately, some improved data series have become available since the Vietnam buildup period and can be used to follow current changes in defense activity.

Each month *Business Conditions Digest,* a publication of the U.S. Department of Commerce, includes time series data on a set of defense indicators. These indicators are divided into advance, intermediate, and final measures of defense activity. Among these indicators are the following:

Advance Indicators

1. Defense Department gross obligations incurred.

> This series measures legally binding commitments for payment of funds, as recorded in in official accounting records. Included in the series are commitments for compensation of personnel, procurement of equipment, research and development, and construction. Thus it includes both orders for items with long lead times, such as aircraft, and for other commitments with very short lags between obligation and spending, such as personnel compensation.

2. Defense Department military prime contract awards.

> Military prime contract awards are orders placed with prime contractors for equipment, supplies, research and development, and construction. Because it excludes some items found in the gross obligations series, such as personnel compensation, the prime contract series is more heavily weighted towards large-scale hardware items with long lags between order and delivery.

3. Manufacturers' new orders, defense products.

> The Bureau of the Census collects information on new orders received by manufacturers of defense products. Data come from separate reports covering

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[2] Murray L. Weidenbaum pioneered in calling attention to this subject. See Murray L. Weidenbaum, "The Federal Government Spending Process," in U.S. Congress, *Subcommittee on Fiscal Policy of the Joint Economic Committee, Federal Expenditures Policy for Economic Growth and Stability—Papers Submitted by Panelists,* 85th Congress, 1st Session, 1957, pp. 493-506; and his "The Economic Impact of the Government Spending Process," The University of Houston *Business Review,* Spring 1961, pp. 7-13.

only the defense work of large contractors in the following industries: ordnance, communications equipment, aircraft, aircraft parts, and shipbuilding. Although its coverage is somewhat smaller than the prime contract awards series, the manufacturers' new orders series also emphasizes large, long-lead-time items.

Intermediate Indicators

1. Manufacturers' inventories, defense products.

This series records the book value of stocks held by manufacturers, including materials, goods in process, and finished goods. Its industry coverage is the same as the new orders series.

2. Manufacturers' unfilled orders, defense products.

This series measures the value of orders received that have not been completed and shipped. Again, the industry coverage is the same as for the new orders series.

Final Indicators

1. Federal government purchases of goods and services for national defense (GNP accounts).

This most comprehensive measure of defense activity includes personnel compensation, cost of new construction, and value of all other defense purchases. Defense purchases make up about 65 per cent of total Federal purchases of goods and services, and are recorded when delivery is made to the government.

2. Manufacturers' shipments, defense products.

Shipments represent the value of products shipped, after discounts and allowances and excluding freight charges and excise taxes. For multi-unit companies, interplant transfers are included as shipments. Industry coverage is the same as for new orders; thus manufacturers' new orders, inventories, unfilled orders, and shipments of defense products make up a consistent set of data.

Using the set of data on defense products orders, inventories, and shipments as an illustration, the following process may be expected to occur. New orders would be the first indicator to reflect an increase in defense programs. As a leading indicator of activity in the defense production sector, a change in this series alerts the analyst that Government action is, or very soon will be, influencing overall economic activity. Next, production activity moves into the intermediate stage of the process. As production proceeds, pressures on capacity mount, backlogs of unfilled orders increase, and the ratio of unfilled orders to shipments rises. Later, as production catches up with commitments, backlogs rise less rapidly and the ratio of unfilled orders to shipments levels off. But even as new orders stop increasing and unfilled orders grow more slowly, a sizeable amount of output may remain in the defense products pipeline. Thus inventories may continue to rise

rapidly after the other series level off or grow less rapidly. In this set of indicators, the final stage of the process is represented by the shipments series, whose lagging behavior has already been discussed.

The 1970s did not produce a military buildup of the size and sharpness of those associated with the Korean war in the 1950s and the Vietnam war in the 1960s. Therefore dramatic changes in—and a demonstration of the relationships between—advance, intermediate, and final measures of defense activity are not readily evident in the data. However, the relationships are still present. Federal defense purchases appear to have lagged both obligations and prime contract awards by about a year at the series troughs in the early 1970s (Chart 1). The intermediate indicators (inventories and unfilled orders) appear to lag behind the turnaround in new orders by about half a year at the trough in the early 1970s, and shipments seem to lag new orders at that turning point by nearly a year (Chart 2). The availability of these and other related data on a timely and readily accessible basis will certainly aid analysts and policymakers should the nation face another period of sharp military buildup.

FORECASTING DEFENSE PURCHASES AND INVENTORY CHANGE

One successful effort to develop accurate and timely forecasts of defense spending as shown in the GNP accounts was conducted by Harvey Galper and Edward Gramlich in 1968.[3] They used some of the leading indicator series of defense activity along with other variables in a regression analysis to provide quarterly forecasts of defense purchases. Their model gave quite accurate quarterly predictions for 1966, a critical and difficult year for defense spending forecasts. They also made assumptions about the relationship between production and contract awards in order to derive estimates of private inventory accumulation consistent with their defense spending forecasts, which could then be combined to shed some light on the total impact of defense activity on the economy.

For this article, a version of the Galper-Gramlich model was constructed to provide some quantitative information on the expected impact of defense spending in 1980 and 1981. First, a simplified version of their model relating contract awards to defense spending was estimated over the period from 1968 through 1979. Next, the model was expanded to include a regression equation relating contract awards to defense-related inventory investment, making use of the expanded and improved data described in the preceding section.

In the model, the defense spending variable used as a dependent variable is total Federal purchases of goods and services for national defense, less personnel compensation. While data are unavailable for the defense-related portion of inventory investment as given in the GNP accounts, data do exist for manufacturing inventories of defense products. The latter data series was therefore used as the dependent variable in the model's inventory equation. The only independent variables included in the forecasting equations are current and past values of military prime contract awards. Despite significant differences in coverage from the dependent variables, contract awards worked well as an explanatory variable in both equations.

The basic equations contained in the model are as follows:

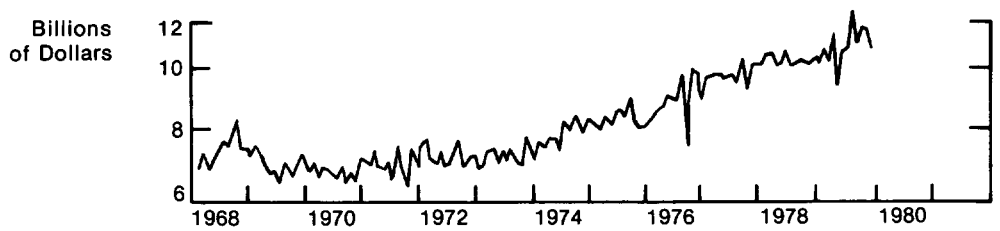
$$(1)\quad DG = a_1 + \sum_{i=o}^{n} b_{1_i} \cdot DCA_{-i}$$

[3] Harvey Galper and Edward Gramlich, "A Technique for Forecasting Defense Expenditures," *The Review of Economics and Statistics*, Vol. 50, No. 2, May 1968, pp. 1-13.

Chart 1

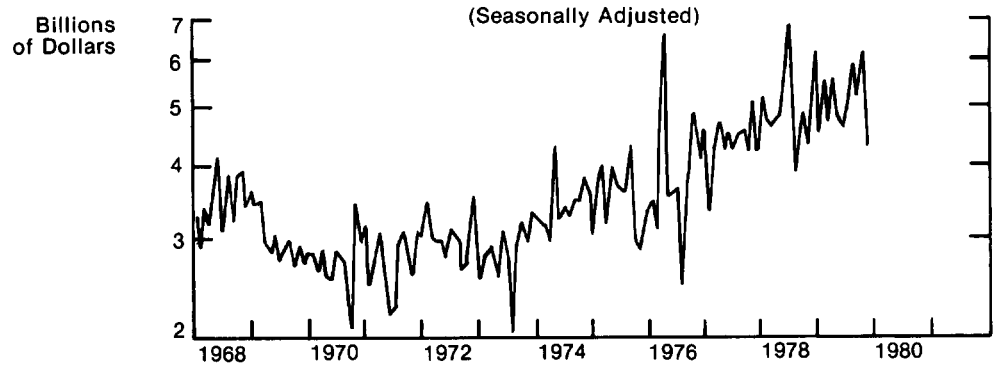
DEFENSE DEPARTMENT GROSS OBLIGATIONS INCURRED

(Seasonally Adjusted)



DEFENSE DEPARTMENT MILITARY PRIME CONTRACT AWARDS

(Seasonally Adjusted)



FEDERAL GOVERNMENT PURCHASES OF GOODS AND SERVICES FOR NATIONAL DEFENSE

(Seasonally Adjusted Annual Rate)

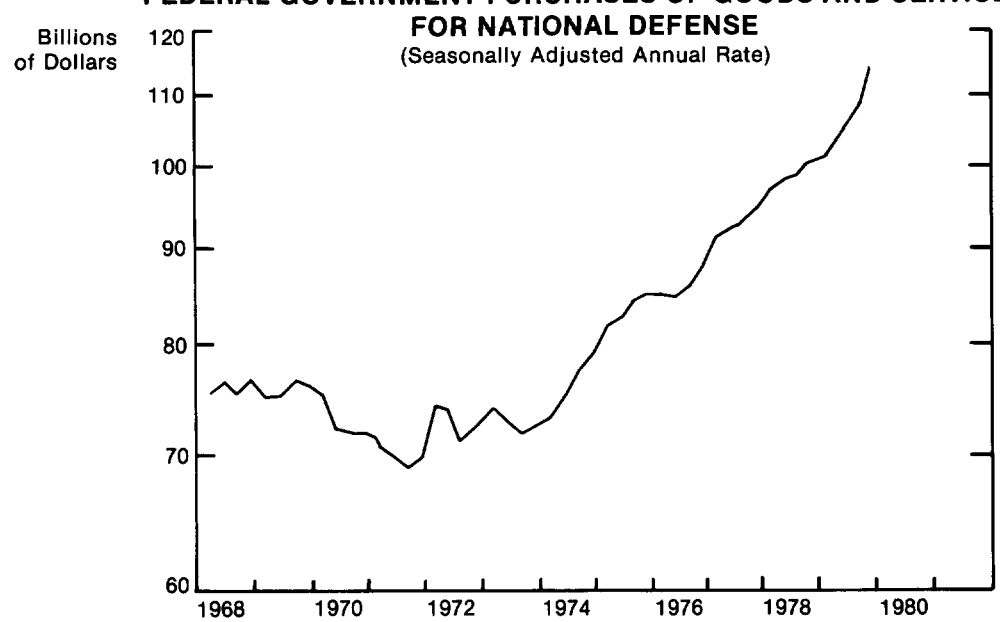
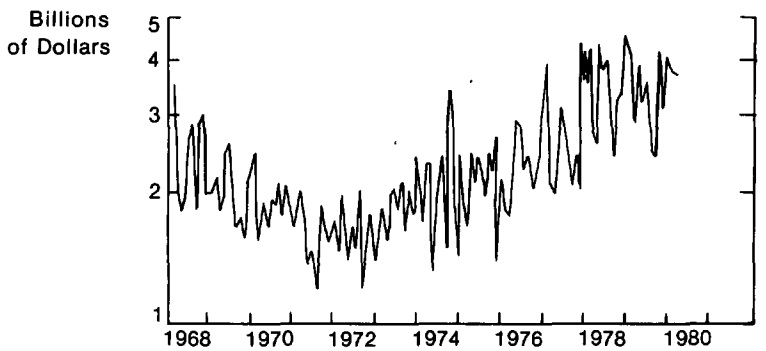


Chart 2

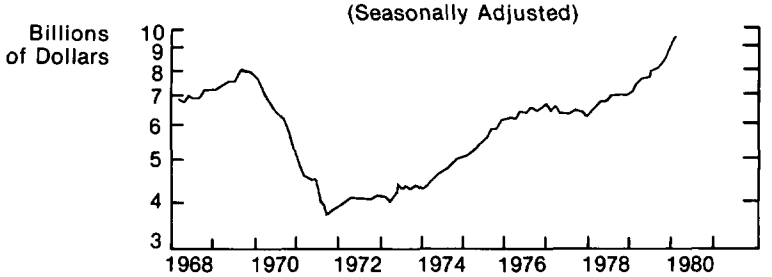
MANUFACTURERS' NEW ORDERS, DEFENSE PRODUCTS

(Seasonally Adjusted)



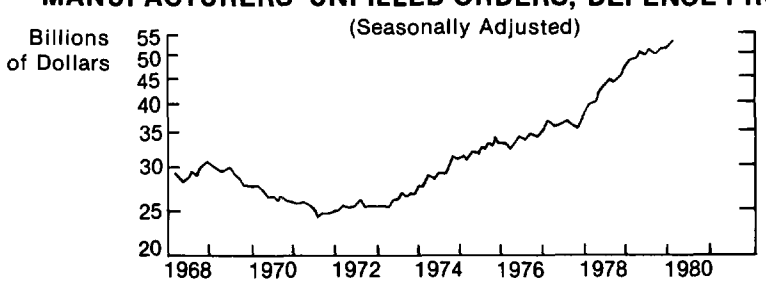
MANUFACTURERS' INVENTORIES, DEFENSE PRODUCTS

(Seasonally Adjusted)



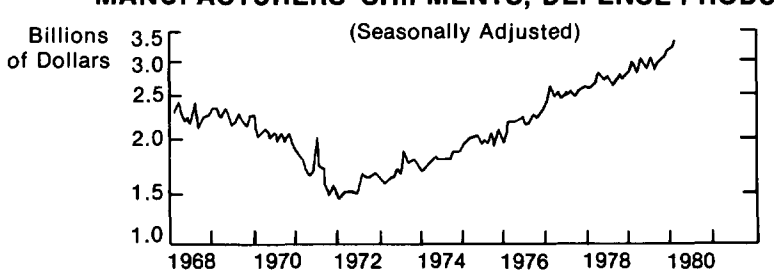
MANUFACTURERS' UNFILLED ORDERS, DEFENSE PRODUCTS

(Seasonally Adjusted)



MANUFACTURERS' SHIPMENTS, DEFENSE PRODUCTS

(Seasonally Adjusted)



and

$$(2)\quad DII = a_2 + \sum_{i=o}^{n} b_{2_i} \cdot DCA_{-i}$$

where

DG = national defense goods purchases,
DII = investment in manufacturers' inventories for defense products,
DCA = military prime contract awards, and
a_1 and a_2 = constant terms representing the differences in coverage.

The econometric estimates of equations (1) and (2) appear in the Appendix. These estimates indicate that a substantial lag exists between a change in contract awards and subsequent changes in defense goods purchases and inventory investment. The nature of the lagged relationships may be seen in Table 1, which presents the quarter-by-quarter response of defense goods purchases and defense-related inventory investment to a one-quarter-only increase of $10 billion in contract awards.

The impact on defense goods purchases of a change in contract awards is completed after 11 quarters (Table 1, column 2). Only 25 per cent of the defense goods purchases induced by a change in contract awards is completed during the year of that change. As mentioned earlier, though, using defense purchases as the measure of defense-related economic activity is misleading because a step-up in private production and inventories precedes the increase in the delivery of finished goods that is recorded as Federal defense purchases. Including the rise in private defense goods sector activity provides a better indicator of the total economic impact of an increase in defense activity, and an estimate of inventory investment by defense producers furnishes that information. The timing of the relationship is important: column 3 of Table 1 shows the impact on inventory investment of a change in

Table 1
CHANGE IN DEFENSE GOODS PURCHASES AND INVENTORY INVESTMENT, IN RESPONSE TO A SINGLE QUARTER $10 BILLION INCREASE IN MILITARY PRIME CONTRACT AWARDS
(Billions of Dollars)

Quarter Following Change in Contract Awards	Single Quarter Change in DG	Single Quarter Change in DII	Single Quarter Change in DG + DII
0	.27	.24	.51
1	.50	.36	.86
2	.70	.38	1.08
3	.85	.33	1.18
4	.96	.23	1.19
5	1.02	.10	1.12
6	1.04	−.05	.99
7	1.01	−.19	.82
8	.92	−.29	.63
9	.78	−.35	.43
10	.58	−.33	.25
11	.32	−.22	.10
12	0	0	0

contract awards to be positive in the periods immediately following that change—as production is begun and work-in-progress inventories accumulate—and negative thereafter, as inventory stocks are depleted upon the shipment of finished goods.

Adding estimated defense inventory investment to defense goods purchases results in an improved estimate of the total impact of increased defense activity on output growth. Thus, the impact on economic activity of the change in contract awards is shown in column 4 of Table 1 as the sum of defense purchases and inventory investment (columns 2 and 3). The response of this measure of total economic activity is more rapid than is that of purchases, with 40 per cent of the total impact occurring within the year of the change in contract awards.

The model presented in equations (1) and (2) has so far been used to support the notion that a substantial amount of time passes between a decision to increase defense spending and the actual increase in the Federal purchases measure. In addition, the model supports the view that a shorter period of time passes before these decisions are reflected in increased economic activity, measured as the sum of defense purchases and inventory accumulation. The model may also be used to forecast future defense-related economic activity.

To forecast defense goods purchases and inventories using the model presented in equations (1) and (2), it is necessary to project the level of contract awards over the period for which the forecast is to be made. Three alternative assumptions were used to project the growth of military prime contract awards during 1980 and 1981, in each case assuming contracts increased at a constant rate through the period.

1. Contract awards were assumed to increase at about the rate of increase that occurred, year-over-year, in the 1976 to 1978 period—about 12 per cent.

2. A slightly more rapid military buildup was assumed, about a 20 per cent year-over-year increase in contracts.

3. Rapid military buildup about the same as that which occurred in the Vietnam war buildup was assumed—a 30 per cent year-over-year increase.

The quarterly forecasts for 1980 and 1981 of defense goods purchases, inventory investment, and total defense-related economic activity resulting from the three alternative contract awards projections are presented in Table 2. Despite the differences in projected contract awards, the forecasts are quite similar—especially in the earlier quarters of the period. This is because much of the total defense goods purchases of 1980 and 1981 results from contracts awarded prior to 1980. The nature of the lag relationships shown in column 1 of Table 1 is such that changes in contract awards do not produce substantial differences in defense goods purchases for several quarters. By the fourth quarter of 1981, however, the level of defense goods purchases—and of GNP—is about $3 billion higher if contracts were awarded at the rapid military buildup rate than if the 1976 to 1978 rate of increase were maintained. Because the levels of defense goods purchases are much greater than those of inventory investment, total defense-related activity (purchases plus investment, shown at the bottom of Table 2) does not show much change in the earlier quarters of the period. Over the full period of 1980 and 1981, however, the inclusion of inventory growth makes a significant contribution to the rise in total

Table 2
FORECASTS OF DEFENSE GOODS PURCHASES AND INVENTORY INVESTMENT, QUARTERLY FOR VARIOUS ASSUMED INCREASES* IN MILITARY PRIME CONTRACT AWARDS
(Seasonally Adjusted Annual Rates)

Quarter	Twelve Per Cent Increase in Contract Awards	Twenty Per Cent Increase in Contract Awards	Thirty Per Cent Increase in Contract Awards
	Defense Goods Purchases, Billions of Dollars		
1980:1	$62.68	$62.69	$62.71
:2	63.40	63.46	63.54
:3	63.98	64.10	64.30
:4	64.41	64.64	65.02
1981:1	64.99	65.39	66.03
:2	65.58	66.20	67.19
:3	66.73	67.62	69.07
:4	67.81	69.03	71.03
1980	63.62	63.72	63.89
1981	66.28	67.06	68.33
	Defense Goods Inventory Investment, Billions of Dollars		
1980:1	.81	.83	.86
:2	.57	.67	.78
:3	.49	.71	.95
:4	.64	1.02	1.46
1981:1	.82	1.41	2.10
:2	1.19	2.01	2 99
:3	1.27	2.32	3.61
:4	1.54	2.82	4.43
1980	.63	.81	1.02
1981	1.21	2.14	3.28
	Billions of Dollars		
1980:1	63.49	63.52	63.57
:2	63.97	64.13	64.32
:3	64.47	64.81	65.25
:4	65.05	65.66	66.48
1981:1	65.81	66.80	68.13
:2	66.77	68.21	70.18
:3	68.00	69.94	72.68
:4	69.35	71.85	75.46
1980	64.25	64.53	64.91
1981	67.48	69.20	71.62

NOTE: Increases at a constant rate through the period.

activity, especially in the case of a rapid military buildup.

The annual data in Table 2 emphasize how locked in total defense-related economic activity is for 1980. Defense purchases plus inventory investment for 1980 as a whole would be less than $1 billion greater if contract awards grew at a 30 per cent rate than if they grew at a 12 per cent rate. The difference in 1981 is larger—$4 billion more of defense-related economic activity is associated with a 30 per cent rise in contract awards than with a 12 per cent increase. Decisions now being made about defense spending that result in contract awards during the current year are likely to have relatively little impact before 1981.

SUMMARY

Improvements have been made since the mid-1960s in understanding the defense spending process, in the availability of data on defense activity, and in the analysis and forecasting of the economic impact of a military buildup. Data series on advance, intermediate, and final measures of defense activity are readily available and can be used in conjunction with the recognition of the timing of impact of defense activity on the economy.

Because increased defense activity shows up first in the private inventories of defense goods producers, adding that inventory investment to defense goods purchases gives a fairly good measure of the degree and the timing of changes in economic activity attributable to defense program changes. The simulation analysis presented in this article suggests that even a relatively large increase in defense activity would have little effect on economic activity in 1980, and only a modest impact in 1981.

Appendix

Equation (1) $DG = \underset{(2.9)}{7.23} + \sum_{i=o}^{11} b_i * DCA_{-i}$

$b_0 = \underset{(2.8)}{.027}$	$b_6 = \underset{(10.8)}{.104}$
$b_1 = \underset{(3.6)}{.050}$	$b_7 = \underset{(6.7)}{.101}$
$b_2 = \underset{(4.9)}{.070}$	$b_8 = \underset{(4.8)}{.092}$
$b_3 = \underset{(7.2)}{.085}$	$b_9 = \underset{(3.8)}{.078}$
$b_4 = \underset{(12.7)}{.096}$	$b_{10} = \underset{(3.1)}{.058}$
$b_5 = \underset{(18.2)}{.102}$	$b_{11} = \underset{(2.6)}{.032}$

DG = Defense goods purchases. (Federal purchases of goods and services for national defense less personnel compensation)

DCA = Military prime contract awards.

$\bar{R}^2 = .904$

$n = 37$

Equation (2) $DII = \underset{(.4)}{-1.14} + \sum_{i=o}^{11} b_i * DCA_{-i}$

$b_0 = \underset{(3.5)}{.024}$	$b_6 = \underset{(-.9)}{-.005}$
$b_1 = \underset{(3.6)}{.036}$	$b_7 = \underset{(-1.9)}{-.019}$
$b_2 = \underset{(3.8)}{.038}$	$b_8 = \underset{(-2.3)}{-.029}$
$b_3 = \underset{(4.1)}{.033}$	$b_9 = \underset{(-2.5)}{-.035}$
$b_4 = \underset{(4.6)}{.023}$	$b_{10} = \underset{(2.6)}{-.033}$
$b_5 = \underset{(3.2)}{.010}$	$b_{11} = \underset{(-2.7)}{-.022}$

DII = Manufacturers' inventory investment, defense products.

$\bar{R}^2 = .368$

$n = 37$

NOTE: The relationships were estimated by means of the Almon polynominal lag regression technique.

Free Reserves and Monetary Policy

By Bryon Higgins

Since October 6, 1979, the Federal Reserve System has implemented monetary policy by focusing primarily on the relationship between growth of bank reserves and growth of money and credit. The increased importance of reserves in policy implementation has led to closer scrutiny of the role of discount window borrowing and excess reserves in analyzing the relationship between Federal Reserve actions and monetary growth.

Free reserves, which are defined as excess reserves minus discount window borrowing, play a crucial role in determining the growth rates of the monetary aggregates. However, many observers have misinterpreted the appropriate use of free reserves in monetary analysis and policy implementation. The level of free reserves is not, as some have assumed, the best gauge of the stance of monetary policy nor the best proximate objective to guide open market operations. Nevertheless, the concept of free reserves is extremely useful in analyzing the effect of policy actions on the growth of money and credit. Moreover, information on the behavior of free reserves is useful in the process of implementing monetary policy.

The purpose of this article is to analyze the proper role of free reserves in monetary analysis and the proper use of free reserves in policy implementation. The role of free reserves in determining monetary growth is discussed in the first section. The second section examines the importance of free reserves under alternative operating procedures for the conduct of open market operations. In the final section, the appropriate use of free reserves in the implementation of monetary policy is analyzed.

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FREE RESERVES AND MONETARY GROWTH

The rate of monetary growth is determined by interaction of factors affecting the demand for and the supply of money. The amount of free reserves banks want to hold—that is, the demand for free reserves—is a major factor influencing the supply of money and can therefore have a major impact on monetary growth. To understand how free reserves affect monetary growth, it is necessary to analyze the determinants of the demand for and the supply of money.[1]

The demand for money depends on the levels of GNP and interest rates. Households and

[1] For simplicity, bank deposits are considered to be equivalent to money. Although some definitions of money include currency and certain deposits at nonbank financial institutions, bank deposits constitute the largest portion of most measures of money. In addition, the Federal Reserve accommodates the public's desired mix between currency and deposits. Therefore, the analysis is not substantially affected by failing to take account explicitly of assets other than bank deposits.

firms hold money as a medium of exchange for buying and selling goods and services, and the aggregate value of those goods and services can be measured by the level of GNP. Therefore, the demand for money increases as GNP rises. The incentive to economize on money balances is directly related to the yield on alternative assets. Thus, the demand for money declines as the level of interest rates increases.

The supply of money by banks depends on the amount of reserves provided through Federal Reserve open market operations and on the demand for free reserves by banks. The effects of these two factors on the supply of money may be shown by deriving a money supply function from analysis of the sources and uses of member bank reserves.

The sources and uses of total reserves, TR, are shown in equations (1) and (2).

$$(1)\ TR = RR + ER$$

$$(2)\ TR = NBR + BR$$

Equation (1) shows the two uses of reserves. Reserves used by banks to meet legal reserve requirements are defined as required reserves, RR. Reserves used by banks for purposes other than fulfilling minimum legal requirements are defined as excess reserves, ER. Equation (2) shows the two sources of reserves. The first source of reserves is borrowing, BR, from the Federal Reserve at the discount window. Those reserves not borrowed from the System are termed nonborrowed reserves, NBR. Federal Reserve open market purchases are the primary source of nonborrowed reserves.[2]

Since the total sources of member bank reserves must equal the total uses of member bank reserves, nonborrowed reserves plus borrowed reserves must be equal to required reserves plus excess reserves. This is shown in equation (3).

$$(3)\ RR + ER = NBR + BR$$

Equation (4) shows that required reserves are equal to nonborrowed reserves minus free reserves. The equation is obtained by rearranging the terms in equation (3) and substituting free reserves, FR, for excess reserves minus borrowed reserves.

$$(4)\ RR = NBR - FR,$$
where $FR = ER - BR$.

Equation (4) may now be used to obtain a money supply function. The amount of required reserves that is associated with a given value of the money stock depends on reserve requirements established by the Federal Reserve. If the average reserve requirement is γ, the ratio of the money stock to required reserves is $1/\gamma$, which can be thought of as the money-required reserves multiplier.[3] Thus, equation (4) can be rewritten as a money supply function,

$$(5)\ M^S = \frac{1}{\gamma}[NBR - FR].$$

The money supply function in equation (5) shows that an increase in nonborrowed reserves

[2] Although numerous technical market factors—such as Federal Reserve float and Treasury balances—influence nonborrowed reserves, the Federal Reserve tends to offset through open market operations the undesired impact of these technical factors on reserve availability. In practice, therefore, net open market purchases of securities by the Federal Reserve are by far the most important determinant of nonborrowed reserves.

[3] To understand the importance of free reserves, it is more useful to focus on the required reserves-money multiplier than the total reserves-money multiplier or the monetary base-money multiplier. For a more complete analysis of reserve requirements and money multipliers, see J. A. Cacy, "Reserve Requirements and Monetary Control," *Monthly Review*, Federal Reserve Bank of Kansas City (May 1976).

—resulting from open market purchases by the Federal Reserve—increases the supply of money. The equation also shows that an increase in free reserves reduces the supply of money.

Due to the linkage between the money supply and free reserves, the supply of money depends positively on market interest rates. An increase in market interest rates encourages banks, in adjusting their reserve positions, to hold fewer excess reserves and to undertake more discount window borrowing. The accompanying decline in free reserves—which equal excess reserves less discount window borrowing—increases the amount of reserves available to support expansion of the money supply. In other words, when market interest rates rise, there is an increase in the amount of reserves available to support expansion of the money supply because fewer reserves are used as excess reserves and because discount window borrowing is used as an additional source of reserves. Thus, an increase in market interest rates leads to a reduction in free reserves that, in turn, leads to an increase in the money supply. For this reason, the supply of money depends positively on interest rates.

The money stock is determined by interaction of the supply of and demand for money. In equilibrium, the supply of money, M^s, must be equal to the demand for money, M^d, as is shown in the following equation.

$$(7)\ M^s = M^d$$

Substituting the supply of money relationship from equation (5) into equation (7) yields:

$$(8)\ M^d = \frac{1}{\gamma}[NBR - FR]$$

Equation (8) shows that, for given values of nonborrowed reserves and the money multiplier, the money stock is mutually determined by the public's demand for money and banks' demand for free reserves. Since interest rates affect both money demand and free reserves, interest rates adjust as necessary to maintain equality between the supply of and demand for money.

Determination of the money stock by supply and demand factors is depicted graphically in Figure 1. The demand for money curve is shown as a negative function of the interest rate, r, and the supply of money curve is shown as a positive function of the interest rate. The position of the money demand curve is determined primarily by the level of income. The position of the money supply curve is determined by the amount of nonborrowed reserves furnished by the Federal Reserve relative to the portion of the demand for free reserves that is unrelated to market interest rates.[4]

The positions of the money supply and money demand curves depicted in Figure 1 would result in a money stock of M_e and an interest rate of r_e. A higher level of income would lead to an increase in the demand for money and thus a higher interest rate and money stock. An increase in nonborrowed reserves or a decline in the demand for free reserves that is not related to market interest rates would result in a greater supply of money and thus a higher money stock and a lower interest rate. Therefore, a change in any of the factors affecting the supply of or demand for money causes a change in both interest rates and the money stock.

[4] Numerous factors other than market interest rates affect banks' demand for free reserves. For example, the Federal Reserve's discount rate is a principal determinant of discount window borrowing and would therefore affect the position of the money supply curve. An increase in the discount rate would increase the demand for free reserves and thereby reduce the amount of money banks are willing to furnish at every level of market interest rates. Therefore, an increase in the discount rate would result in a leftward shift in the position of the money supply curve.

Figure 1

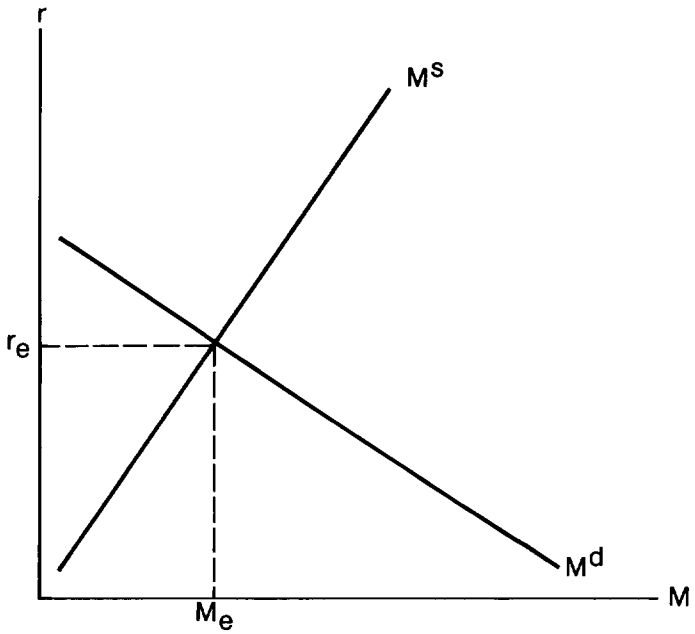
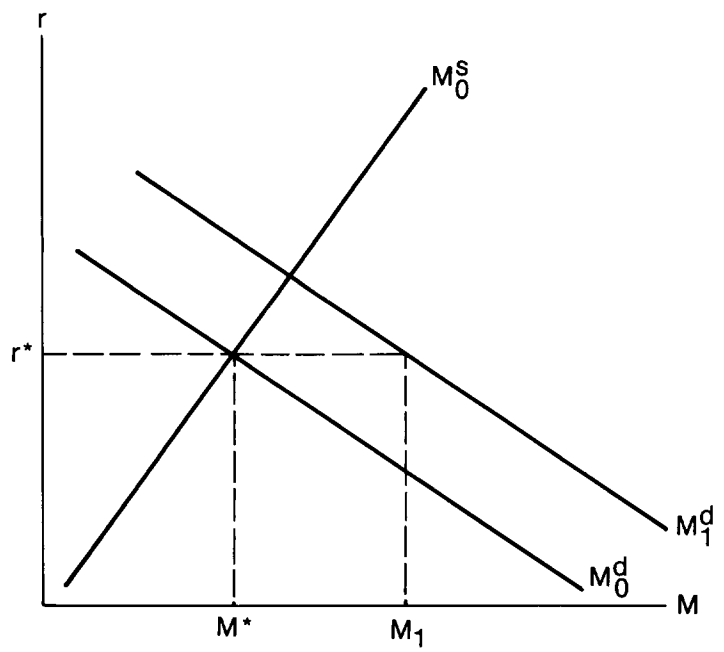


Figure 2



THE IMPORTANCE OF FREE RESERVES UNDER ALTERNATIVE MONETARY CONTROL PROCEDURES

Different operating procedures can be used to control monetary growth. For most of the past decade, the Federal Reserve used an interest rate approach, which relied heavily on the predictability of money demand relationships. Since October 1979, however, the Federal Reserve has used a reserve aggregate approach to monetary control. The reserve approach relies much less on predictability of money demand relationships. The behavior of free reserves was relatively unimportant under the interest rate approach but is very important under the reserve aggregate approach.

The Interest Rate Approach

Under an interest rate approach to monetary control, open market operations are conducted to maintain a key short-term interest rate at the level believed to be consistent with the desired rate of monetary growth. Any change in the demand for reserves by banks is accommodated by adjusting nonborrowed reserves to keep interest rates constant. Assume, for example, that the Federal Reserve chooses an interest rate target of r*, as shown in Figure 2. To maintain the interest rate at r*, the Federal Reserve will supply an amount of nonborrowed reserves that is equal to the amount of required reserves and free reserves demanded at that rate. Moreover, since the supply of nonborrowed reserves adjusts to accommodate banks' demand for reserves, banks will supply whatever amount of money the public desires to hold at the fixed level of interest rates.

The strategy for monetary control with an interest rate approach is also depicted in Figure 2. Assume that the desired money stock is M* and that the expected position of the money demand curve is M_0^d. In this situation, the Federal Reserve would set an interest rate target of r* and would anticipate furnishing enough nonborrowed reserves to establish the money supply curve at M_0^s. However, if the anticipated level of nonborrowed reserves turns out to be inconsistent with the interest rate target, nonborrowed reserves would be adjusted as necessary to maintain the interest rate at r*. Thus, under an interest rate approach to monetary control, the Federal Reserve conducts open market operations to maintain the interest rate at the level thought to be necessary to induce the public to hold the desired quantity of money.

The behavior of free reserves is not important when the Federal Reserve uses an interest rate approach to monetary control. Since open market operations accommodate banks' demand for reserves, a change in the demand for free reserves has no impact on monetary growth. For example, an increased demand for free reserves would reduce the amount of reserves available to support the money supply and would thereby place upward pressure on market interest rates. However, the upward pressure on interest rates would be offset automatically by an increase in the supply of nonborrowed reserves in whatever amount is necessary to maintain the money supply curve and interest rates at the initial levels. Because of the accommodating changes in nonborrowed reserves, the increased demand for free reserves has no impact on interest rates or monetary growth. Therefore, one of the beneficial aspects of an interest rate approach to monetary control is that unanticipated changes in the demand for free reserves do not adversely affect the ability to achieve the desired rate of monetary growth.

A second reason free reserves are not important under an interest rate approach is that they do not absorb any of the effects of shifts in money demand. Instead, changes in nonborrowed reserves completely accommodate

changes in required reserves associated with shifts in the demand for money. However, complete accommodation of changes in money demand to prevent deviation from the target interest rate has undesirable consequences for monetary control. For example, an unexpected shift in the money demand curve to M_1^d in Figure 2 would cause an increase in the money stock to M_1, well above the desired level of M*. Since the Federal Reserve would increase nonborrowed reserves to accommodate the increased demand for required reserves that accompanies the surge in money demand, there would be no increase in interest rates to dampen the undesirably rapid monetary growth. Thus, use of an interest rate strategy allows the full effect of changes in money demand to be reflected in the rate of monetary growth. To the extent that the demand for money is unpredictable, therefore, an interest rate approach to monetary control can result in large deviations from the desired rate of monetary growth.[5]

The Reserve Aggregate Approach

Under the reserve aggregate approach to monetary control adopted in October 1979, open market operations are conducted to provide the amount of nonborrowed reserves believed to be consistent with the desired rate of monetary growth.[6] Changes in banks' demand for required reserves are not accommodated by adjusting nonborrowed reserves. Instead, interest rates must adjust to equate banks' demands for free reserves and required reserves to the fixed supply of nonborrowed reserves.

A number of factors must be taken into account in determining the appropriate level of nonborrowed reserves. The first step in deriving reserve targets is to estimate the growth in required reserves that would be associated with the desired rate of monetary growth. The anticipated level of excess reserves is then added to the estimated required reserves to obtain a target path for total reserves. Finally, the expected level of borrowing is subtracted from the total reserve path to obtain a target path for nonborrowed reserves. Achieving the path level of nonborrowed reserves is the primary objective of open market operations under the recently adopted reserve approach to monetary control.

The strategy for monetary control with a reserve aggregate approach is depicted in Figure 3. If the desired money stock is M* and the expected position of the money demand curve is M_0^d, the Federal Reserve's objective is to determine the quantity of nonborrowed reserves that will yield a money supply function corresponding to M_0^S. As pointed out above, prospective levels of excess reserves and discount window borrowings must be estimated to determine the appropriate nonborrowed reserve path. In other words, the Federal Reserve relies on implicit estimates of the demand for free reserves in establishing a nonborrowed reserve path that is consistent with the desired rate of monetary growth.

Free reserves are important under the

[5] In some circumstances, it might be desirable to change the monetary growth target itself in response to changes in money demand. For example, if a shift in the money demand curve were caused by an unexpected change in the public's liquidity preferences that was unrelated to income, the original monetary target would no longer be consistent with attaining the desired level of income, which is often presumed to be the best summary of ultimate policy goals. However, in this article it is assumed that deviation from the initial target rate of monetary growth results in deviation from the desirable growth in income.

[6] For a more detailed description of the new operating procedures, see "Description of the New Procedures for Controlling Money," hearings on the conduct of monetary policy before the House of Representatives Committee on Banking, Finance, and Urban Affairs (February 29, 1980).

recently adopted nonborrowed reserves approach in part because unexpected changes in the demand for free reserves pose problems for monetary control. The success of the reserve aggregate approach in achieving the desired rate of monetary growth can be impaired by unexpected changes in the demand for free reserves. For example, with a constant supply of nonborrowed reserves, an increase in free reserves would be associated with an undesirable decline in the supply of money. The effects of an increase in the demand for free reserves and the associated decline in the supply of money are shown in Figure 4. The decline in the money supply curve from M_0^s to M_1^s would result in an increase in interest rates from r_0 to r_2 and a decline in the money stock from the desired level, M*, to M_2.

The extent of deviation from the desired money stock resulting from a change in the demand for free reserves depends in part on the interest sensitivity of the demand for free reserves. If banks' demand for free reserves were relatively unresponsive to interest rates, the money supply curve would be very steep, and changes in free reserves would have a large impact on monetary growth. If the demand for free reserves were very sensitive to interest rates, on the other hand, the money supply function would be relatively flat, and free reserve disturbances would have only a small effect on the money stock. The extent to which monetary growth is insulated from unexpected changes in free reserves under the reserve aggregate approach, therefore, depends to some extent on the degree to which banks adjust their demand for free reserves in response to changes in interest rates.

The second reason free reserves are important under the nonborrowed reserve approach is that they cushion the impact on the money stock of unexpected changes in the public's demand for money. Equation (8) shows that changes in money demand are associated with changes in free reserves if the level of nonborrowed reserves is held constant.

Figure 3

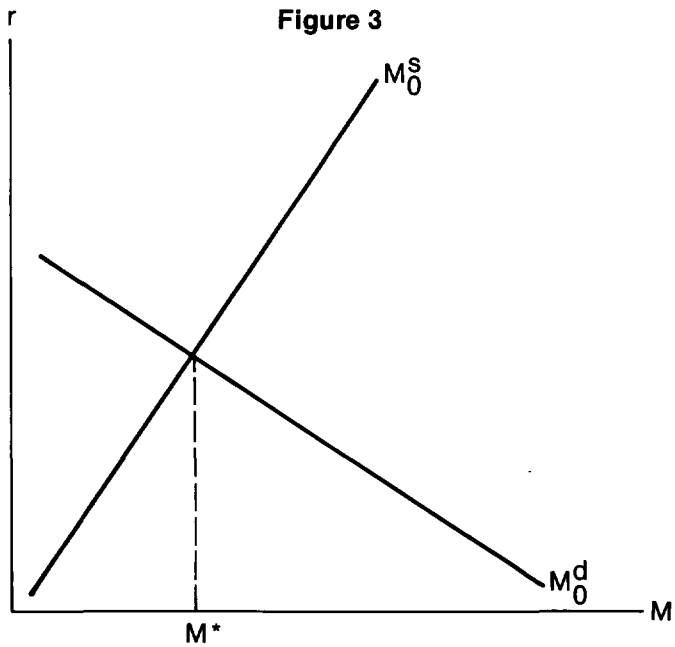


Figure 4

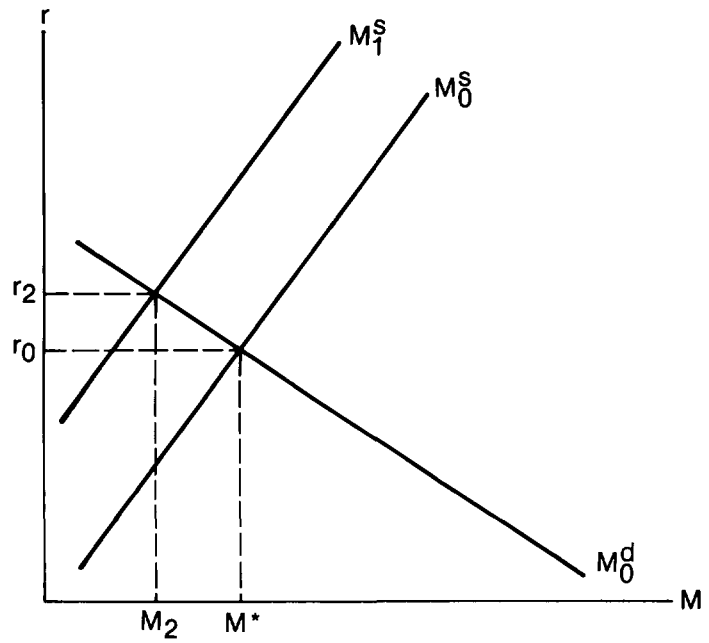
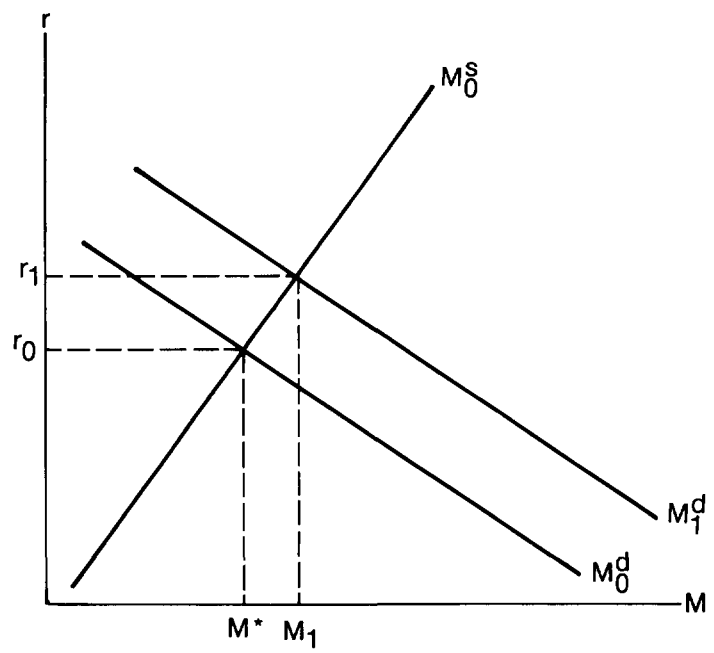


Figure 5



Moreover, the change in interest rates that accompanies a change in free reserves counteracts part of the undesirable impact on monetary growth of an unanticipated change in the strength of money demand. For example, if nonborrowed reserve supply is constant, an unexpected increase in money demand results in a reduction in free reserves. The rise in interest rates necessary to induce banks to reduce their free reserves counteracts part of the strength in money demand, thereby reducing the amount by which monetary growth exceeds the desired rate below what it would be if interest rates did not adjust. Thus, the negative relationship between interest rates and the demand for free reserves provides an automatic mechanism for insulating monetary growth from unexpected changes in money demand when the Federal Reserve uses a nonborrowed reserves approach to monetary control.

The effects of an increase in money demand are shown in Figure 5. The unexpected increase in money demand from M_0^d to M_1^d would result in an increase in the interest rate from r_0 to r_1 and an increase in the money stock from the desired level, M*, to M_1. Comparison of Figure 2 and Figure 5 indicates that an upward-sloping money supply function—which results from a constant level of nonborrowed reserves and the interest sensitivity of the demand for free reserves—provides an automatic tendency to offset part of the effect on the money stock of a change in the demand for money.

The size of the deviation from the desired money stock caused by money demand disturbances depends on the interest sensitivity of free reserves. If banks' demand for free reserves were relatively unresponsive to interest rates, the money supply curve would be very steep, and money demand disturbances would have very little impact on the money stock. If the demand for free reserves were very sensitive to interest rates on the other hand, the money supply function would be relatively flat, and money demand disturbances would have a large effect on the money stock. The degree to which monetary growth is insulated from unexpected changes in money demand under the recently adopted reserve operating approach, therefore, depends to some extent on the interest sensitivity of the demand for free reserves.

To the extent that the demand for free reserves is less predictable than the demand for money, monetary control would be improved by a very interest-sensitive demand for excess reserves and discount window borrowings. The opposite would be true, of course, if money demand disturbances were the chief impediment to monetary control. In either case, though, the importance of understanding the behavior of free reserves has been enhanced by adoption of a reserve aggregate approach to monetary control.

THE USE OF FREE RESERVES IN THE IMPLEMENTATION OF MONETARY POLICY

The recently adopted change to a reserve aggregate approach to monetary control has increased the significance of free reserves for monetary policy. There are a number of alternative ways for using a variable in the implementation of monetary policy. A variable may be used as an indicator of policy, as a target of policy, or as an information variable. The level of free reserves has been interpreted by some as a good indicator of the stance of monetary policy or as the proximate target of open market operations. Neither of these interpretations is correct. Instead, the Federal Reserve uses information provided by the behavior of free reserves to adapt open market policy to evolving financial conditions. In other words, free reserves are used as an information variable.

Free Reserves as a Monetary Policy Indicator

A monetary policy indicator may be defined as a variable whose value characterizes "the thrust of monetary policy."[7] A monetary policy indicator may be useful to the public as a simple way of measuring whether monetary policy actions are restrictive or expansionary. Moreover, an indicator may be useful to the Federal Reserve in evaluating past policy actions. Some analysts have assumed that the level of free reserves is a good indicator of the stance of monetary policy under a reserve aggregate approach to monetary control. They have interpreted declines in free reserves as an indication of a more restrictive monetary policy and increases in free reserves as an indication of a more expansionary monetary policy.

Use of free reserves to measure the stance of monetary policy can be very misleading, however, regardless of Federal Reserve operating procedures. Under either an interest rate approach or a reserve approach to monetary control, a given change in the level of free reserves can be associated with a variety of monetary growth rates and can be expansionary in some circumstances and contractionary in other circumstances. For example, a modest decline in free reserves during a period of rapidly growing demand for money and credit may be associated with accelerating monetary growth. Accommodative open market policy can furnish enough nonborrowed reserves to support rapid growth in money and credit at the same time that free reserves are declining. Indeed, the increase in interest rates that is generally associated with rapidly growing demand for money and credit reduces banks' demand for free reserves. Thus, declining free reserves in these circumstances may result from lower demand for free reserves rather than a restrictive monetary policy. During the recent economic expansion, for example, a decline in the level of free reserves from $137 million in 1976 to −$668 million in 1978 was accompanied by an acceleration in M1-B growth from 6.0 per cent to 8.2 per cent over the same period.[8] As measured by the effect on monetary growth, therefore, monetary policy was becoming more expansionary over this period even though the level of free reserves was declining. Measured by the same criterion, however, a comparable decline in free reserves in the future could be associated with increasingly restrictive monetary policy if interest rates and the demand for money and credit were falling. Thus, the behavior of free reserves must be interpreted within the context of overall economic and financial conditions to determine the implications of changes in free reserves for monetary growth. For this reason, the behavior of free reserves taken by itself is not a reliable indicator of the thrust of monetary policy.

Free Reserves as a Monetary Policy Target

A monetary policy target may be defined as a variable used "to guide monetary policy operations in the money markets under the conditions of uncertainty and lags in the receipt of information about the more remote goals of policy."[9] The ultimate goals of monetary policy are economic growth, high employment, price

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[7] For a more complete discussion of targets and indicators of monetary policy, see Karl Brunner, editor, *Targets and Indicators of Monetary Policy*, Chandler Publishing Company (1969).

[8] The annual level of free reserves was computed by averaging the monthly levels. Annual rates of monetary growth were computed by taking the percentage change from the fourth quarter of the preceding year to the fourth quarter of the year in question.

[9] Brunner, p. 2.

stability, and a substainable pattern of international transactions. It is often useful to focus on more immediate objectives in policy implementation, however, because reliable information is not immediatly available on the goal variables and because there are numerous sources of uncertainty about the effects of policy actions on the goal variables. The growth rates of money and credit are themselves intermediate targets that are not directly controllable, however. Various types of uncertainty cause unpredictability in the relationship between policy actions and monetary growth. For this reason, it is necessary to focus on a proximate target in short-run policy implementation. The choice among variables that could be used as proximate targets for monetary policy depends on the primary source of uncertainty.

The Federal Reserve has chosen to use nonborrowed reserves rather than free reserves as the proximate monetary policy target in part because the strength of money demand is a major source of uncertainty in policy implementation. Although both free reserves and nonborrowed reserves are related to monetary growth, use of a nonborrowed reserves target is more conducive to monetary control. As explained in the preceding section, keeping nonborrowed reserves at a predetermined target level mitigates the effects on monetary growth of unanticipated changes in the demand for money. In contrast, maintaining a constant target level of free reserves would lead the Federal Reserve to accommodate unexpected shifts in money demand by adjusting the level of nonborrowed reserves to the demand for required reserves. For this reason, nonborrowed reserves is preferable to free reserves as a monetary policy target when the primary source of uncertainty is the inability to predict money demand. Since inability to predict the growth of income and other factors affecting money demand has been an important impediment to monetary control in recent years, nonborrowed reserves rather than free reserves is the most useful target for monetary policy.

Recent experience demonstrates the superiority of nonborrowed reserves over free reserves as a monetary policy target. The sharp unexpected decline in money demand in April of this year resulted in substantial increases in free reserves because the Federal Reserve adhered to its nonborrowed reserves path. In particular, the decline in M1-B at an annual rate of 14.1 per cent in April 1980 was associated with an increase in free reserves from –$2.5 billion in late March to –$1.0 billion in early May and a decline in the Federal funds rate from 17.8 per cent to 15.1 per cent over the same period. The increase in free reserves and a decline in interest rates set the stage for subsequent monetary growth more nearly in line with the announced monetary targets. In contrast, use of a free reserves target during this period would have resulted in only modest declines in interest rates, which would have been inadequate to prevent a substantial shortfall in monetary growth relative to targets.

Free Reserves as an Information Variable

An information variable may be defined as a variable that provides information on current relationships in the economy.[10] The Federal Reserve must make decisions on the basis of estimated relationships among numerous economic variables. Because various occurrences can alter these relationships, it is necessary for the Federal Reserve to update its

[10] A thorough discussion of the use of information variables in policy implementation can be found in John H. Kareken, Thomas Muench, and Neil Wallace, "Optimal Open Market Strategy: The Use of Information Variables," *American Economic Review* (March 1973).

estimates of economic relationships on the basis of incoming data on a number of important economic and financial variables. Even though unpredictability of money demand is the primary source of uncertainty in policy implementation, other sources of uncertainty can also impair monetary control.

Free reserves is useful as an information variable under the current reserve strategy for monetary control. Initial estimates of the prospective demand for excess reserves and discount window borrowing are used to construct the nonborrowed reserve path believed to be consistent with the Federal Reserve's monetary objectives. However, these estimates often prove to be inaccurate. Although the inability to predict strength of money demand has been the chief impediment to accurate monetary control, uncertainty regarding banks' demand for free reserves can also impair monetary control. Thus, it is necessary to take account of unexpected changes in free reserves in policy implementation. Preliminary information on free reserves is available daily, and this incoming information can be used to update the estimate of demand for free reserves. On the basis of this updated estimate of the demand for free reserves, the Federal Reserve may decide to alter its open market operations. For example, when incoming data indicate that the original assumption about the demand for free reserves was incorrect, the Federal Reserve can use this information to update the nonborrowed reserves target and thereby improve the chances of achieving the desired growth rates of money and credit.

Recent experience indicates the usefulness of free reserves as an information variable. In December 1979 and January 1980, free reserves rose substantially above levels that could have been predicted from previous experience because of an unexpected increase in excess reserves from $155 million in November 1979 to $394 million in December 1979 and $242 million in January 1980.[11] If the Federal Reserve had taken no action to accommodate the temporary increase in the demand for excess reserves, the resulting reserve shortage would have caused an increase in interest rates above the levels consistent with the desirable rate of monetary growth. Instead, the System accommodated the increased demand for free reserves by adjusting the nonborrowed reserves path upward. Thus, by using free reserves as an information variable, the Federal Reserve was able to improve the degree of monetary control achieved with the new reserve aggregate operating procedure.

CONCLUSION

The recent change to a reserve aggregate approach to monetary control has increased the importance of free reserves for monetary policy. The interest sensitivity and the level of the demand for free reserves are important determinants of the rate of monetary growth under the new procedures. Therefore, a clear understanding of the behavior of free reserves is an important element in the successful use of reserve aggregates for achieving the Federal Reserve's monetary and credit objectives.

Public perception of the use of free reserves in monetary policy implementation has often been misguided, however. The level of free reserves is neither a good indicator of the thrust of monetary policy nor the most useful target to guide open market operations. Instead, the level of free reserves provides information on current economic and financial relationships that can be used to adjust the nonborrowed reserve path and thereby improve the chances of achieving the desired rate of monetary growth.

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[11] Monthly levels of free reserves are computed by averaging the daily figures.

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