

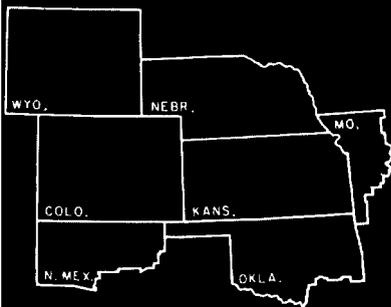


monthly review

MAY 1977

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FEDERAL RESERVE BANK OF KANSAS CITY

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THE ECONOMIC REALITIES OF DROUGHT

By C. Edward Harshbarger
and Marvin Duncan

Drought! Just mentioning the word is enough to send a chill down the spine of almost any farmer who has previously experienced the problem. The totally helpless feeling that comes with watching crops and pastures withering away in the broiling sun can be devastating. Dreams suddenly vanish, economic hardships descend rapidly, and the long struggle for survival must begin anew.

*Drought is not a new problem for agriculture. In fact, history is replete with different episodes on the subject, including the Biblical story in which Joseph offers some timely advice to the Egyptians on grain reserves. Since ancient times, much has been learned about weather **patterns** and the incidence of drought. Although the question of whether drought is a cyclical event—and hence predictable—or whether it is strictly a random event has not been resolved, it is clear that few regions in the temperate zones of the world are completely immune to the problem.*

By definition, drought is a lack of precipitation over a protracted period of time. Therefore, many economic hardships frequently arise in this kind of environment. For individual farmers, the impact of drought is reasonably clear: production will be seriously curtailed and financial losses will likely be heavy. If the farmer is vulnerable to sharp financial setbacks, his ability to repay loans and meet normal living expenses will be jeopardized. Multiplying this situation by the total number of farmers who are similarly affected by drought provides a glimpse into the impact on regional economies. In short, the agribusiness complex begins to shrink because farmers have less to sell. Merchants and dealers will see the demand for their goods and services dwindle, forcing cutbacks in their operations. Moreover, commercial banks and other lenders will likely encounter problems with customer repayment schedules, requests for renewals and extensions, and more delinquencies. In the general economy, consumers may face higher food prices. Clearly, a widespread and prolonged drought can significantly alter the

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course of economic activity and affect overall employment and income levels.

THE CURRENT SITUATION— HOW DRY IS IT?

Since 1973, when net farm income reached an **alltime** high, drought has been one of the major problems experienced by farmers in a large part of the nation. In general, the area most seriously affected by drought in the past year lies west of the Mississippi River, primarily the Great Plains region from the Texas Panhandle into Canada, and the Pacific Coast region. Weather information from the Department of Commerce shows that during the spring of 1976, precipitation in the eastern part of North and South Dakota, western Minnesota, northeastern Colorado, and central California was at or below 50 per cent of normal. During the summer, this condition spread to the western Corn Belt and most of the central high plains region. The drought condition did not ease appreciably in the fall and less-than-normal amounts of precipitation were received through the winter months over much of this area. Consequently, by spring, soil moisture levels were very low. Furthermore, the reduced mountain snowpack—needed for supplying water to reservoirs and streams for irrigation purposes—is almost certain to lead to water rationing in several places this summer.

The odds are not favorable that adequate precipitation will be received this year to produce normal yields. Within the Tenth District, for example, the chances that the 1977 winter wheat crop will receive precipitation equal to or greater than the amount needed for a normal yield are less than 50-50.¹ And the probabilities for the fall crops, which require a

lot of moisture during the hot summer months, are even less favorable than for wheat. This information suggests, therefore, that even if 1977 is a year of normal rainfall, moisture supplies will likely remain deficient in many areas and crop output may fall short of expectations.

The drought situation in California is very serious. Two consecutive years of below-normal precipitation have resulted in water rationing and economic hardships for many Californians. Although ground water supplies are not critically low, the thin **snowpack** in the mountains and the half-empty reservoirs throughout the state offer little promise that irrigation water will be adequate this summer. A continuation of the drought in 1977 will likely reduce gross farm income in California by at least \$1 billion, or by about 15 per cent of last year's figure of \$8.9 billion. To prepare for this contingency, California's farmers and bankers are working together to develop production plans that will utilize available water supplies most efficiently. Although total output will probably decline this year, it is hoped that net profits from farming in that state will be large enough to avert severe financial distress and a high default rate on agricultural loans.

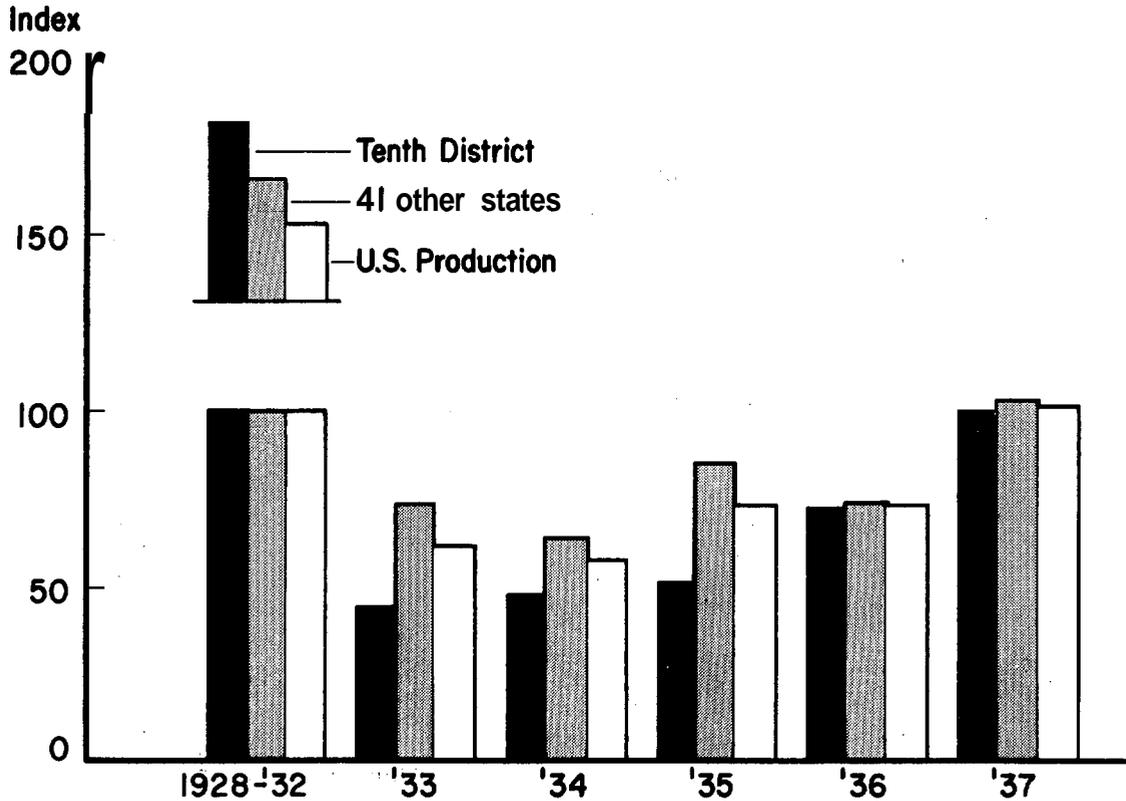
So, how dry is it? The evidence suggests that many farmers throughout the nation have been adversely affected by drought over the last two years. Although two years is not a particularly long period for drought, the current situation is somewhat reminiscent of the black blizzards of the 1930's and the scorching heat of the 1950's. Another year or two of below-normal precipitation in the grain belts and the far west would likely present the nation with some very serious problems.

¹ **Augustine Y. M. Yao**, "Probabilities of a Normal Yield in the Great Plains and Midwest in the 1977 Season," *Weekly Weather/Crop Assessment*, NOAA, U.S. Department of Commerce, February 15-21, 1977, pp. 28-37.

² See **Michael Gorham**, "Bread and Water," *Business and Financial Letter*, Federal Reserve Bank of San Francisco, March 4, 1977, for a good summary of the California drought situation.

Chart 1

WHEAT PRODUCTION ON THE UNITED STATES
AND THE TENTH DISTRICT, 1928-37



SOURCE: U.S. Department of Agriculture.

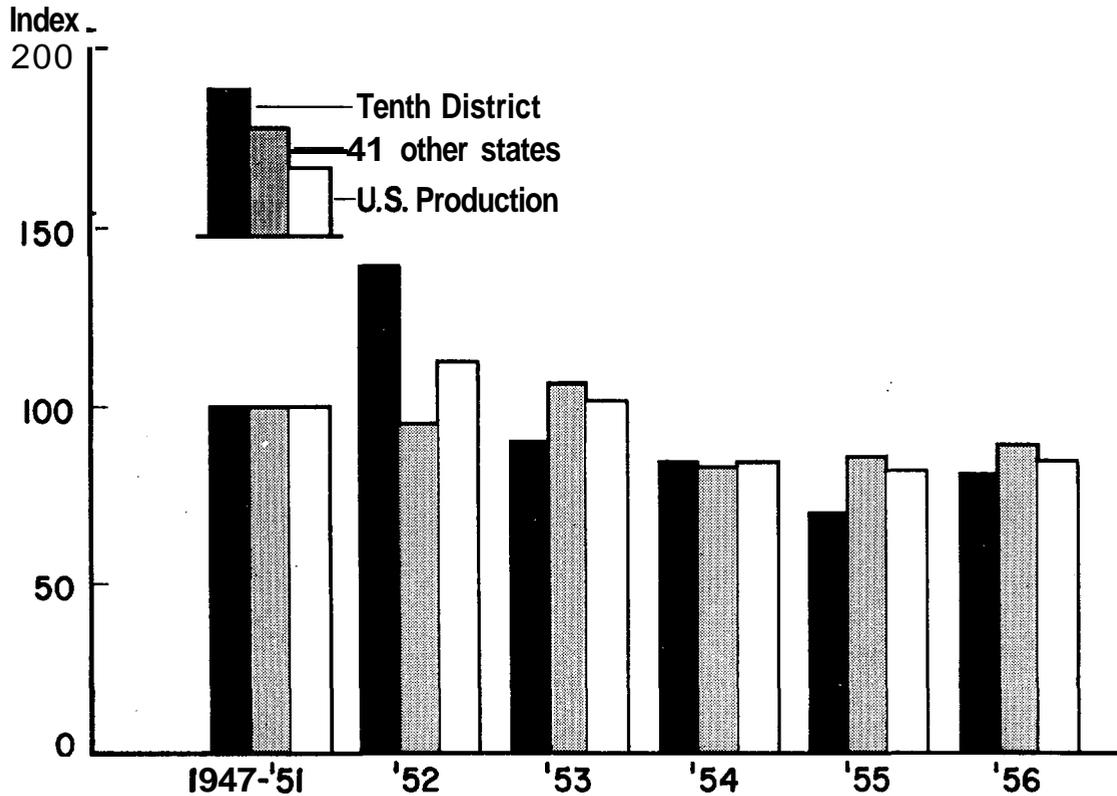
A HISTORY LESSON ON DROUGHT

Before speculating further on what might happen if the drought should continue in 1977, it might be helpful to review earlier droughts. The Tenth District has endured two very severe dry periods during the last half century—most of the decade of the 1930's and the period from 1952 to 1956. Charts 1 and 2 show what happened to wheat production in the District and the rest of the nation during each of these periods. An index is used in the charts for

comparing relative changes. Using average production from 1928 to 1932 as the base, wheat output in 1933 and 1934 fell more than 50 per cent in the District, but the relative decline in the remaining 41 states was not nearly as steep. It should be mentioned that while drought obviously contributed to the diminution in output, the economic depression probably had a strong influence on production decisions as well. Indeed, wheat acreage in the District was reduced 10 to 40 per cent during the drought period.

Chart 2

WHEAT PRODUCTION OF THE UNITED STATES
AND THE TENTH DISTRICT, 1947-56



SOURCE: U.S. Department of Agriculture.

In the 1950's the relative decline in wheat output was not as pronounced as it was 20 years earlier. A stronger economy and Government crop programs were probably responsible for holding total acreage in the District reasonably close to predrought levels. However, the drought did have an impact on total wheat production as output was reduced as much as 13 per cent below the average for

the 1947-51 period, after taking acreage changes into account. Production in the other 41 states also declined during this period, but this was due almost entirely to acreage reductions as average yields were maintained quite well.

Between 1952 and 1956, feed grain production in the District declined rather steadily, ending up about 20 per cent below the

1952 figure. For the rest of the nation, output expanded about 15 per cent during this period, which more than maintained total supplies at the national level.³ Tenth District farmers managed to keep hay output up reasonably well during the drought period by expanding acreage. However, pasture conditions deteriorated sharply, so total roughage supplies were diminished during this period. As a result, livestock producers reduced herd sizes. From the beginning of 1952 to the end of 1956, cattle numbers in District states declined approximately 5 per cent, while hog and sheep numbers were off about 5 and 10 per cent, respectively. At the national level, however, the cattle inventory expanded 5 per cent while hog numbers remained virtually unchanged; sheep numbers fell 5 per cent over the period. Interestingly, consumers may benefit from drought in the short run because meat supplies are temporarily expanded whenever livestock producers reduce breeding stock. Between 1951 and 1956, for example, beef output expanded about 20 per cent, partly reflecting the liquidation of cattle in the drought-stricken regions of the nation.

Because drought hinders productivity, it usually reduces farm incomes sharply in drought-stricken areas. However, for the nation, total farm income may actually increase as curtailed supplies lead to higher commodity prices. In fact, given the nature of demand for agricultural products, a decline in production (supply) is frequently accompanied by a proportionately larger increase in price, resulting in more total revenue than would otherwise be the case. So while drought may cause hardship for the farmers directly affected, it can also provide other producers with some material benefits.

As it turns out, net farm income trended

down during most of the 1950's, but these declines reflected buildups in commodity surpluses and falling farm prices rather than drought. However, the reduction in the Tenth District's farm income was certainly compounded by the drought. For example, net income at the national level fell about 25 per cent between 1952 and 1957, but the decline in the Tenth District was almost 50 per cent. Consequently, many producers were placed in financial jeopardy.

The number of business failures and mortgage foreclosures that occurred in the 1950's was relatively small since the drought period was preceded by the longest farm boom in U.S. history, 1940-52. But when income levels finally began to deteriorate, farmers engaged in a belt-tightening exercise. Unprofitable activities were either sharply curtailed or abandoned altogether. Family members looked for outside employment to supplement incomes. Liquid asset holdings were definitely reduced to meet living expenses and repay loans. New investments were postponed, and outstanding loans were renewed and extended (banks were very liquid) as long as there was reasonably good collateral. Good managers utilized moisture conserving techniques in their farming operations. There were some business failures, but these adaptations were enough to prevent the situation from deteriorating into a crisis.

There are a number of lessons to be learned from past drought experiences. One is not to underestimate the productive capacity of American agriculture, even under stress. A drought can cause hardship over a wide area of the country, but total food supplies are seldom reduced significantly because other regions frequently make up the difference. For example, U.S. wheat production was a record 2.14 billion bushels last year, despite less-than-favorable growing conditions in many regions of the wheat belt. In the coming season, a major drought would probably reduce output

³ For a more complete discussion of the drought experience in the 1950's, see "Impact of Drought on Tenth District Agriculture," *Monthly Review*, Federal Reserve Bank of Kansas City, May 1957.

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rather sharply, but total supplies for the next marketing year will still be ample because the beginning carryover of wheat is expected to exceed 1 billion bushels. In the case of corn and soybeans, supplies are presently relatively tight. A severe drought in the Corn Belt would cut production and raise prices, perhaps significantly, but output would be unlikely to fall more than 15 per cent below 1976 levels since these crops are also grown in other regions of the country.

A second lesson is that drought rarely leads to sharp rises in retail food prices in the short run. As noted, total grain **production** usually holds up fairly well during a dry period, while meat supplies may actually expand. If pasture conditions should deteriorate this summer, beef output in 1977 will probably match last year's record level. Nevertheless, the U.S. Department of Agriculture **has** increased its official forecast range for food prices this year to reflect the weather-related problems of recent months—but only by 1 percentage point. As it now stands, food prices are expected to increase from 4 to 5 per cent in 1977, and a large part of this rise will probably occur on services added after the products leave the farm gate. However, a continuation of bad weather would likely cause food prices to increase somewhat faster this fall and next year.

Still, it needs to be emphasized that prolonged drought does impose severe economic hardships on individual producers and regional economies. The struggle to remain financially solvent can be long and hard, although the American farmer has proved to be remarkably resilient. Certainly, the advent of drought-resistant varieties, improved irrigation systems, and better crop management practices allows farmers to cope with drought much better today than they could have 20 years ago. However, a critical factor in withstanding any adversity is the overall financial health of the industry—as well as that of individual producers.

AGRICULTURE'S FINANCIAL STATUS

The ability of agricultural producers to withstand the financial adversity associated with a major drought can be assessed in a number of ways. If the question relates to the resilience of the industry, aggregate data serve the purpose very well. If, however, the resiliency of individual operators within the industry is being questioned, aggregate data may mask the onset of even quite serious credit problems for individuals or groups of individual producers. Thus, disaggregated measures of financial strength and profitability should also be examined.

An examination of the aggregate farm balance sheet suggests a healthy and profitable industry. By almost every measure farmers are better off today than ten or even five years ago. The value of all farm assets has increased from \$281.0 billion in 1968 to an estimated \$634.0 billion on January 1, 1977—an increase of 126 per cent. Even when this increase is deflated by the index of prices paid by farmers for family-living items, the gain in constant dollars is about 27 per cent.

During this same period, the realized net farm income increased from \$12.2 billion to about \$24 billion in 1976, an increase of 97 per cent. The per capita disposable personal income of farmers as a percentage of nonfarm per capita disposable income increased from 70.5 per cent to 89.5 per cent (1975), after having peaked at 109.3 per cent in 1973. In 1956, at the end of the drought years of the early 1950's, farm per capita disposable income was only 47.7 per cent of the nonfarm level. Also, farm families derive a much higher proportion of their disposable personal income from nonfarm sources now than in 1956—50 per cent in 1975 compared to 37 per cent in 1956. This adds a measure of stability to farm income.

Proprietors' equities (net worth) have shown remarkable growth in the past decade,

increasing from \$233.6 billion in 1968 to an estimated \$534.5 billion on January 1, 1977—an increase of 128 per cent. Proprietors' equities have declined in only one year (1960) since 1956; and since 1971 have increased by yearly increments that are substantially greater than net farm income. This impressive performance has been largely due to the steady increase in farm real estate prices. In just the past five years, average land prices have doubled. In fact, land prices in the Tenth District states of Colorado, Kansas, Nebraska, and Wyoming have more than doubled. Despite some reduction in net farm income from the **alltime** record in 1973, U.S. farmland prices have continued to increase—12 per cent for 1975 and 17 per cent for 1976 (November 1 to November 1). Tenth District real estate values increased during 1976 by 10.5, 20.0, and 10.4 per cent, respectively, for nonirrigated cropland, irrigated cropland, and ranchland.

Despite the very favorable grain prices of the **mid-1970's**, and the generally favorable weather across the United States during the 1960's and early **1970's**, the substantial gains in farm assets and proprietors' equities depended heavily on the increased use of borrowed capital. Total farm debt on January 1, 1977, amounted to \$101.5 billion. Moreover, since 1950, farm debt has approximately doubled each decade. The proportion of total farm debt accounted for by real estate debt has increased slowly for many years to 56 per cent of all debt on January 1, 1977. Concurrently, nonreal estate debt represents a smaller proportion of farm debts, perhaps reflecting some gradual restructuring of the liability side of the balance sheet by farm operators. The increase in the absolute size of farm debt outstanding has not, however, resulted in substantial deterioration of the farming sector's equity position. Proprietors' equities accounted for 84 per cent of the farming sector's assets on January 1, 1977—**essentially** no different than a decade ago and only 5 per cent less than two decades earlier.

In general, the farm sector has a strong balance sheet and an excellent profit-and-loss statement (especially since 1971). Though use of borrowed capital has increased rapidly, farmers have also enjoyed rapid equity growth. Indeed, agriculture is one of the least leveraged sectors of American business.

Aggregate statistics can be deceptive, however. Farm debt is not distributed uniformly over the farm population. Many farm operators are almost debt free or hold a small amount of debt relative to their asset holdings and thus can withstand substantial adversity. Other farmers are highly leveraged and even moderate disruptions in cash flow can place the future of their businesses in jeopardy. Farmers who purchased land years ago have been rewarded with substantial capital appreciation. But those presently purchasing high-priced land find that real estate debt servicing places a heavy burden on the cash flow the land generates. Established farmers generally have built equity they can draw on to meet cash flow demands in periods of adversity. Recent entrants into farming may not have such equity reserve. Some farm **operators**—such as cattlemen—are already experiencing cash flow disruptions from sources other than drought. Consider the following cases.

The outstanding farm debt is concentrated among larger, more highly leveraged farms. These farm operations are more likely to experience **financial** distress, as a result of disrupted cash flow, than farms using less borrowed capital. In 1975, farms with gross sales of \$100,000 and over—only 3.9 per cent of all farms—held 21.8 per cent of all farm assets and 39.7 per cent of all farm liabilities. Those farms had a debt-to-asset ratio of 28.5 per cent—more than double the ratio for farms with sales between \$20,000 and \$39,999. These farms generated over 40 per cent of realized gross farm income and over 30 per cent of the realized net income as well. Furthermore, 23 per cent of the capital gains on farm physical

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assets in 1975 have accrued to this same group of farms.

Recent entrants into farming generally have not had time to acquire sufficient equity to cushion the impact of drought-reduced income. Consequently, a substantial proportion of them might be forced out of business as a result of prolonged income reductions. In 1975, almost one-fourth of all Federal Land Bank loans closed were to borrowers under 35 years of age.⁴ These young farmers were more highly leveraged than the average Land Bank borrower—they had a debt-to-net worth (leverage) ratio of 69 per cent compared to 53 per cent for all borrowers. Partly offsetting lack of equity reserves, however, 75 per cent of these young farmers received nonfarm income (averaging \$23,400).⁵

Drought may have a more severe impact on certain groups of agricultural producers than on others. For example, cattlemen have generally been experiencing losses for up to three years during the liquidation phase of the present cattle cycle. A recent survey of Tenth District agricultural bankers revealed that 50 per cent of District cattlemen probably suffered decreases in net worth during 1976.⁶ Furthermore, among those operations experiencing gains in equity, farm real estate value increases were the sole reason in over 80 per cent of the cases. Higher than normal cattle **marketings** this year—induced by drought—would place a severe financial burden on **U.S.** cattlemen.

Despite a generally favorable aggregate balance sheet for agriculture, it is clear that some producers are quite vulnerable to

serious—and in some cases **irreparable**—damage to their financial structure as a result of sharp reductions in production or forced livestock sales at unusually depressed market prices. In the Tenth District, for example, over half of the bankers responding to a recent survey said at least half of their farm customers presently have serious cash flow problems and would need renewals, extensions, or restructured loans to solve those problems.⁷ Consequently, many bankers are presently reviewing farm loan applications even more carefully than usual—and are frequently requiring additional collateral. There is concern that the quality of many agricultural loans may have deteriorated over the last six months, even though this is not yet clear from available aggregate data.

POLICY ALTERNATIVES

A frequent and almost reflexive response to troubles on the farm is to suggest the problems would largely be resolved if prices were only better—and hence the desire to raise support prices for major affected crops to "fair" levels.⁸ This approach, though well intentioned, has several flaws. Most obviously, neither higher support prices nor higher market prices provide much benefit to the farmer whose crop has been lost to drought. Higher support prices benefit the large, efficient producers most and likely hasten the demise of small farms, since land resources are bid away from them and they are unable to afford new cost-reducing technology available to the larger operator. To

⁴ *Characteristics of Federal Land Bank Loans, 1975*, Farm Credit Administration, Washington, D.C., December 1976, pp. 6-7.

⁵ This figure reflects nonfarm income being earned at the time the loan is closed, and is the level of nonfarm income reasonably expected during at least the first year after closing the loan.

⁶ *Financial Letter*. Federal Reserve Bank of Kansas City, November 10, 1976.

⁷ *Financial Letter*, Federal Reserve Bank of Kansas City, February 9, 1977.

⁸ The Commodity Credit Corporation (CCC) makes loans to farmers, giving them additional flexibility in marketing their crops. The farmers' grain is collateral for the loan. The support price is the value placed on the grain for loan purposes by the CCC. Bushels of grain placed under CCC loan times support price determines the amount of money loaned to a farmer. Since these are nonrecourse loans, the farmer has the option of turning over to CCC—as full settlement of the loan—the grain used as loan collateral.

the extent that support prices exceed market prices, significant long-term economic disruptions can occur. Demand for farm commodities is reduced and, at the same time, excess supplies are accumulated. Artificially high feed grain prices are damaging to the livestock industry at all levels. Hard-won export markets are jeopardized, and production controls usually become necessary to limit accumulation of excess supplies. But perhaps most serious, less-than-optimal resource allocations occur and, as a result, consumers and producers may be less well off than might otherwise be the case. Both in terms of economic impact and timeliness of relief, a much stronger case can be made for specific kinds of aid tailored to needs of distressed operators.

Assistance to Lenders

When an area is seriously affected by drought, deposit growth in local banks frequently slows. Decreases in deposit growth more seriously impair local country banks than either large city banks or Farm Credit Banks with access to national money markets. Requests for loan renewals and extensions increase. Local banks may not be able to make all the loans they would like because of limited funds. The nation's 12 Federal Reserve Banks have unique capabilities to augment the banking industry's loanable funds through the availability of a seasonal borrowing privilege for member banks. Those member banks that experience recurring patterns of movement in their loans and deposits may qualify for this seasonal borrowing privilege, whereby loans from the Federal Reserve are made available to them during their entire identifiable season each year. The requirements for eligibility typify conditions encountered by banks serving smaller communities in which the local economy is heavily dependent upon one **industry—such** as agriculture or tourism. More than 400 banks in the Tenth District are eligible for this seasonal credit service from the

Federal Reserve Bank of Kansas City. Furthermore, in the event of severe economic dislocations that may result from regional or local difficulties, such as those associated with protracted drought, Federal Reserve Banks may make loans over more extended periods to affected member banks. With the approval of the Board of Governors, Federal Reserve Banks also may extend credit in such situations to nonmember banks, other corporations, partnerships, or individuals.

Assistance to Individuals

Federally guaranteed loans to individual farmers can often serve both the needs of the farmers and those of the local lender. Loans that examiners might classify as **substandard—**causing a lender to call—may be repaid by a new loan that carries a Government guarantee of total or partial repayment. Thus, the lender can continue to extend funds **to** the farmer borrower. Such guaranteed loans are made by Farmers Home Administration (**FmHA**) and the Small Business Administration (**SBA**). The SBA is primarily involved in lending to small business, though recent authority enables them to engage in certain types of farm lending as well—for purchase of land, equipment, and for operating expenses.

In the event an area is declared a disaster area by the Secretary of **Agriculture—as** a result of natural forces such as drought, flood, or plant disease, **etc.—certain** emergency programs to provide financial assistance are activated. For example, FmHA makes loans bearing a 5 per cent interest rate available to those farmers living within the disaster area who cannot obtain credit from normal commercial sources. In addition, the SBA can make loans to qualifying farmers to replace physical loss as a result of a designated disaster, such as flood, earthquakes, and tornadoes. Under special circumstances, SBA loans are also available to restore the cash flow of the business. These loans are available up to

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a **\$500,000** limit if normal credit sources are unavailable.

Emergency livestock loans are presently available (until September 30, 1978) to all established U.S. livestock producers unable to obtain credit through normal commercial credit sources. The Government guarantees 90 per cent of a **\$350,000** maximum line of credit extended to a borrower by a commercial credit source. Furthermore, the current farm program contains provisions for low-yield payments to producers of all crops with acreage allotments in the event of a natural disaster, disease, or **insect** damage—providing that these factors are beyond the control of the producer.

A number of other programs can be utilized to provide financial relief to distressed farmers. The Agricultural Stabilization and Conservation Service, for example, offers assistance in defraying the costs of transporting hay to livestock producers in dry areas so that herds can be maintained. The Government, through a cost-sharing arrangement, regularly helps farmers make investments in various soil and water conservation practices throughout the country. And the Federal Crop Insurance Corporation—a Government **corporation**—offers all-risk crop insurance on 25 different crops in different parts of the United States (essentially in commercial-producing areas for each crop). In this program, the producer can designate the extent to which he wants protection, and the premium is set accordingly. However, Federal crop insurance can be cancelled or denied to individual producers with a high-loss history. Nevertheless, it is very apparent from the above discussion that farmers have access to several programs that help cushion the blow when adversity strikes.

A FINAL NOTE

There is no way of knowing whether the drought problems of the **past** 2 years will continue in 1977. A surprisingly small amount

of moisture, if available at the proper time, will permit crops to grow and reach maturity. However, the fact is that moisture supplies in many regions are low, and the probability of receiving adequate rainfall in the coming months for normal production is not favorable. If the drought should continue in 1977, the Tenth District's farmers and ranchers would likely encounter very serious financial difficulties.

During the 1973-75 period, net income in the District averaged about \$9,000 per farm (ranging from \$4,600 in Missouri and Oklahoma to **\$17,000** in Colorado). Furthermore, as of January 1, 1975, the average debt per farm in the District was slightly more than \$33,000. This means that for every dollar of net income, the District's farmers and ranchers had approximately \$3.65 of debt. Omitting the debt-free operators from the calculations would have increased this figure even more. If, for some reason, serious problems occur and net farm income in 1977 falls sharply, say one-third below the 1973-75 average, or down to about **\$6,000** per farm, the debt-to-net income ratio in the District would rise to 5.5. While a ratio of 5.5 is not necessarily a danger point, it is clear that in this kind of environment many farmers and ranchers would not be able to repay mortgages and meet normal living expenses without some form of outside assistance.

Fortunately, a wide range of **disaster-assistance** programs is in place and ready for use when circumstances warrant. And it seems that additional programs are proposed each time a new disaster **strikes**.⁹ Although more programs

⁹ The Federal Government has made available, during fiscal 1977, \$1.2 billion in drought assistance programs. This will provide funding for grants, loans, and cost-sharing programs. The Administration has called for \$844 million in additional aid this year. Most of this aid is available through the Farmers Home Administration, the Small Business Administration, and the Agricultural Stabilization and Conservation Service. However, some of the proposed additional funding for drought relief

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are available for the agricultural producer than for the small businessman serving the producer, the disaster assistance that producers receive, to continue near-normal production practices, partly protects small businessmen in rural communities from disastrous declines in business volume and excessively high levels of delinquent accounts. A present shortcoming in

purposes would be available through the Economic Development Administration, the Interior Department, the Bureau of Reclamation, and the Southwestern Power Administration.

such programs, however, is the time lag from when the need for disaster aid becomes apparent until benefits become available. Unnecessary delays result in needless hardships and anguish to agricultural producers, to small businessmen who service their needs, and to the affected commercial bankers. Therefore, rather than devising new drought-relief programs, policymakers should devote their efforts to adequately funding existing programs as well as to refining and integrating present disaster programs and procedures so that the assistance machinery runs more efficiently.

The Federal Reserve's Impact On Several Reserve Aggregates

By Jack L. Rutner

A number of economists posit that "reserve aggregates," such as the monetary base, are crucial to the determination of the money supply.² A previous article in this Review, which examined the relationship between one reserve aggregate—the monetary base—and two money supply measures, did indeed find that the base played an important role in the determination of the money supply.¹ Findings such as these have led some economists to argue that the Federal Reserve can control the money supply by controlling reserve aggregates. These arguments typically assume that the Federal Reserve can easily control reserve aggregates, and, while they recognize that the Federal Reserve does not have direct control over reserve aggregates, they nonetheless

assume that open market operations can be used to effectively control the behavior of these variables. Empirical verification of this assumption, however, has received only scant attention in the professional literature, although the technical or analytical relationship has received thorough treatment.⁴

This article examines the relationship between Federal Reserve open market operations and reserve aggregates such as the monetary base. The first section briefly treats the analytical relationships, while the next section contains the results of an empirical analysis of these relationships. The article concludes with a discussion of the study's implication for the Federal Reserve's ability to control reserve aggregates.

¹ The items which constitute the reserve aggregates are in the modern world liabilities of the central bank and/or the Treasury. Historically, gold and silver were used as reserves in addition to central bank and Treasury liabilities.

² See, for instance, Fred J. Levin, "Examination of the Money Stock Control Approach of Burger, Kalish, and Babb," and Michael J. Hamburger, "Indications of Monetary Policy: The Arguments and the Evidence," both in *Monetary Aggregates and Monetary Policy* (Federal Reserve Bank of New York, 1974).

³ Jack L. Rutner, "A Time Series Analysis of the Control of Money," Federal Reserve Bank of Kansas City *Monthly Review*, January 1975.

⁴ The effect of open market operations on reserves was examined by John H. Wood, "A Model of Federal Reserve Behavior," *Staff Economic Studies*, No. 17, Board of Governors of the Federal Reserve System, mimeographed (no date); and by Vittorio Bonomo and Charles Schotta, "Federal Open Market Operations and Variations in the Reserve Base," *Journal of Finance*, Vol. 25, No. 3 (June 1970).

The omission of free reserves from the items examined in this article was based on free reserves having been extensively explored in the Wood and in the Bonomo and Schotta studies.

DETERMINANTS OF RESERVE AGGREGATES

The Monetary Base

The monetary base consists mainly of those liabilities of the Federal Reserve that are either a part of the nation's money supply or that may be used as bank reserves to support deposits that are a part of the money supply. Specifically, the base consists of two components: member bank deposits at the Federal Reserve and **currency and coin**—mainly Federal Reserve notes—held by commercial banks and the nonbank **public**.⁵

Many factors affect the monetary base, with an important one being the Federal Reserve's open market operations in U.S. Government securities. Suppose, for example, that the Federal Reserve buys some securities from bond dealers and pays for them with checks drawn on the Federal Reserve. Suppose further that the bond dealers deposit the checks in their bank accounts and the banks forward the checks to the Federal Reserve to be added to their reserve **accounts**.⁶ The open market operation would then result in an increase in member bank reserves and therefore an increase in the monetary base. The example, however, ignores the impact of other factors which may also affect the base and either offset or augment the impact of open market operations. Movements in the base therefore may not necessarily correspond on a one-to-one basis with movements in open market operations.

Factors other than open market operations that affect the base may themselves be affected—perhaps indirectly—by open market operations, so that some of the impact of

operations on the base may be automatically offset. An example of this type of factor is member bank borrowing from Federal Reserve Banks. The purchase of Government securities by the Federal Reserve and the corresponding rise in reserves may produce a decline in interest rates. The decline in interest rates and the increase in bank reserves may cause banks to reduce their borrowing from the Federal Reserve, which in turn would tend to reduce bank reserves and the monetary base. This reduction in the base, then, would offset some or all of the initial increase in the base produced by the open market operation.

Other factors, however, may interact coincidentally with open market operations: Thus, for example, an increase in Federal Reserve float due to inclement weather or other reasons may result in the increase in the base in the absence of open market operations. The Federal Reserve, however, may employ open market operations to offset the impact of other factors that are expected to affect bank reserves and the base. Suppose, for example, that the Federal Reserve wishes to maintain bank reserves at a constant level but anticipates that changes in float or in some other factor could potentially reduce reserves. The Federal Reserve, in this case, would purchase securities in order to offset the impact of the other factors, but the open market operations would not result in a rise in bank reserves or the base.

Factors that affect the monetary base other than open market operations may be conveniently grouped together and referred to as "other factors." Using this terminology, it may be said that changes in the base are determined by two variables—open market operations and other factors. The relationship between the monetary base, open market operations, and other factors may be further clarified by reference to the balance sheet of the Federal Reserve System (Table 1). This balance sheet shows that the base consists mainly of certain of the liabilities of the Federal Reserve

⁵ The monetary base includes currency and coin issued by the U.S. Treasury, which is not a liability of the Federal Reserve.

⁶ In actual practice, no checks would be written. Both the dealers' and the banks' accounts would be credited directly.

Table 1
THE FEDERAL RESERVE BALANCE SHEET
(In billions of dollars)
August 11, 1976

| ASSETS | | LIABILITIES | |
|--------------------------|--------------|-------------------------|--------------|
| U.S. Treasury securities | 93.1 | Liabilities included in | |
| All other assets: | 20.5 | monetary base: | 104.6 |
| Member bank borrowing | 6 | Member bank deposits | 24.7 |
| Float | 3.4 | F.R. notes outstanding | 79.9 |
| Gold and SDR's | 12.3 | All other liabilities: | 9.0 |
| Other assets | 4.2 | U.S. Treasury deposits | 4.7 |
| | | Other deposits | 1.2 |
| | | Other liabilities | |
| | | and capital | 3.1 |
| Total | 113.6 | Total | 113.6 |

NOTE: In addition to the Federal Reserve liabilities included in the monetary base, the base includes U.S. Treasury currency **outstanding**, that is, currency and coin issued by the U.S. Treasury. As of August 11, 1976, Treasury **currency** was \$10.7 billion, so that the monetary base was \$115.3 billion (\$104.6 billion of Federal Reserve liabilities included in the base plus the \$10.7 billion in Treasury currency). Note that the sum of the factors affecting the base add up to the base. Thus, the base equals U.S. Treasury securities held by the Federal Reserve, \$93.1 billion, plus other factors affecting the base, \$22.2 billion. The other factors are **all** other assets from the balance sheet, \$20.5 billion, **less** all other liabilities, \$9.0 billion, plus Treasury currency, \$10.7 billion.

The specific components of other factors are: gold and **SDR's** plus member bank borrowings plus float plus other assets, including bank premises, plus U.S. Treasury currency outstanding less U.S. Treasury deposits less other deposits, including foreign deposits, less other liabilities and capital.

System, that is, deposits of member banks and Federal Reserve notes held by commercial banks and the nonbank public. Since the Federal Reserve's assets must equal its liabilities—the balance sheet must balance—a change in any of the Federal Reserve's asset items or in any of the liability items other than items included in the base could potentially result in a change in the base. Thus, these asset and liability items are the determinants of the base. Following **the previous discussion, these factors may be placed into two groups. One group consists** of changes in the Federal

Reserve's portfolio of U.S. Government securities—open market operations—while the second group consists of the other factors referred to earlier. In summary, the following relationship may be stated between the monetary base, open market operations, and other factors.⁷

⁷ The actual definitions of the reserve aggregates and the Treasury portfolio employed here differ somewhat from the general description of the text. The Treasury portfolio as found in official publications is valued at par. (See the Federal Reserve Bank of New York's publication, *Glossary*:

Changes in the monetary base
 = open market operations
 + other factors affecting the base.

Other Reserve Aggregates

Reserve aggregates treated in this article, in addition to the monetary base, are the unborrowed monetary base, member bank reserves, and unborrowed member bank

Weekly Federal Reserve Statements, New York (September 1972), p. 8, item 7 and 7a*). The desired variable, however, is the cash purchase (and sale) value of the portfolio because it reflects more accurately actual changes in reserves due to open market operations. The premiums and discounts are embedded in other assets and liabilities and capital accounts, which, according to the terms used here, are part of other factors. Allowing these premiums and discounts to remain in other factors could overstate the effect other factors have on the reserve aggregate. Unfortunately, these premiums and discounts are not readily available so an adjustment was made to approximate them by adding to the portfolio the items other assets less premises less foreign currency less other liabilities and capital plus capital and surplus less Franklin National borrowings (beginning in October 1974 when it was moved from borrowings to other assets—note that the other factors employed here include Franklin National borrowings). The reason the item "other capital accounts," the difference between capital and capital paid in plus surplus, was not used directly stems from its not being available on a weekly average basis. Capital paid plus surplus, however, even though also not available on a weekly average basis, changes only infrequently. Thus, subtracting these items from other liabilities and capital on a weekly average basis leaves other liabilities and other capital accounts approximately on a weekly average basis. The source for other assets and liabilities and capital was from *Federal Reserve Bulletins* from the table on Member Bank Reserves, while the remaining were from the table on Consolidated Statement of Condition of all Federal Reserve Banks.

Aside from these changes, the monetary base was changed in two ways. The first involved adding "other deposits" at the Federal Reserve to it because some of these deposits are held by nonmember banks and certainly must contribute to their reserves. Secondly, but for reasons not directly applicable to this paper, the monetary base (as well as member bank reserves) was adjusted for reserve requirement changes. To maintain comparability, the same adjustment was performed on the Treasury portfolio. Inasmuch as examination here is on a log linear basis, the effects of this adjustment on the relationships being examined should be small.

reserves. The unborrowed monetary base is the monetary base less member bank borrowings from the Federal Reserve. This aggregate was developed because some economists argue that changes in member bank borrowings prevent the Federal Reserve from controlling the total monetary base. Changes in borrowing, according to this argument, tend to **offset** the impact on the total base of open market operations. Since changes in borrowings do not affect the unborrowed base, it is argued that the Federal Reserve can control the unborrowed base better than the total base.

The relationship between the unborrowed monetary base, open market operations, and other factors is equivalent to that for the total monetary base, except that member bank borrowings are not included in the other factors that affect the unborrowed base.

Member bank reserves is an important reserve aggregate because reserves provide the support for deposits which are an important component of the nation's money supply. The relationship between member bank reserves, open market operations, and other factors is similar to that for the monetary base, except that other factors affecting member bank reserves include currency and coin held by nonmember banks and the nonbank public. Such currency and coin is included because changes in it affect member bank reserves but do not affect the monetary base. Unborrowed member bank reserves was developed as a reserve aggregate for the same reason that the unborrowed monetary base was developed. Member bank borrowings are not included in the other factors that affect unborrowed reserves, but, as is the case with the total member bank reserves, currency held by the public and by nonmember banks is included.

EMPIRICAL EXAMINATION

As discussed in the previous section, open market operations and "other factors" jointly determine the behavior of each reserve

The Federal Reserve's Impact

aggregate. This section examines the relative importance of the two determinants by first estimating the correlation between each reserve aggregate and its determinants as well as the correlation between the determinants. Then, these correlations—which are examined for weekly, monthly, and quarterly observations for the period from **January** 1959 through December 1974—are used to draw conclusions about the extent to which open market operations or other **factors** determine reserve aggregates.⁸

Two types of correlations are **examined**—simple and partial. In both types, the correlation coefficient, which may vary in value from -1.0 to +1.0, measures the degree of association between two variables. A high positive value indicates that movements are highly and positively associated, while a high negative value means that movements are highly and negatively associated. Simple correlations show the degree of association

⁸ The intent of examining the three correlations associated with each reserve aggregate for time periods of differing durations is to attempt to infer which, if either, of the reserve aggregate's two components are determining it. Other factors on a weekly basis, for example, may be highly associated with reserve aggregates, but on a quarterly basis may not be related at all. This could suggest that over the longer run open market operations are offsetting the effect of other factors on reserves, although other evidence needs to be present for this interpretation to be valid.

The data employed for assessing the weekly interaction of each of the four reserve aggregates with their components are not seasonally adjusted figures beginning in the **first** week of **January 1959** and ending in the last week of December 1974. The weekly data were then grouped into 208 4-week averages, **termed** monthly here, and 64 13-week or quarterly averages. This article's monthly figures differ from officially published figures because the official figures are actually for a period longer than 4 weeks. The quarterly figures differ as well because the official quarterly figures are averages of official monthly data. The choice of computing quarterly averages from the weekly figures rather than employing official figures was determined by the necessity of making certain adjustments to open market operations, which could more accurately be accomplished with the original weekly data. This adjustment was also the determining factor in employing 4-week averages. (For adjustments, see footnote 7.)

between any two variables without taking account of the possible association of either of the two variables with any other variables. Partial correlations, which are derived from regression analysis, show the degree of association of two variables after taking account of association with other variables. Two sets of partial correlations were derived. One set—called Type I—takes account of the impact of past movements in both the dependent and the independent variables in each regression. The other set—Type II—takes account only of past movements in the dependent variable.'

⁹ The regressions are of the form:

$$Y = f(\text{past } Y, \text{ current } X, \text{ past } X, \text{ error term}) \quad (\text{Type I})$$

$$Y = f(\text{past } Y, \text{ current } X, \text{ error term}) \quad (\text{Type II})$$

The dependent variable in one set of regressions was the change in the natural logarithm of the reserve aggregate, while the independent variable was either the change in the natural logarithm of open market operations or the change in the natural logarithm of other factors, as measured by the ratio of the reserve aggregate to open market operations. The choice of using the change in these logarithms rather than changes in levels was determined by the ability of logarithms to remove some heteroscedasticity of the regression residuals. A second set of regressions for the interaction between open market operations and other factors estimated the partial correlation between the two, first using one and then the other as dependent variables. The reason for reversing dependent and independent variables in the second set of regressions was a consequence of other inconclusive evidence concerning the direction of causality between these two variables. Estimating the partial correlations both ways, which as it turned out makes virtually no difference to the conclusions, does not presuppose any *priori* assumptions about causality. The independent variables are not reversed when the reserve aggregate is the dependent variable because the reserve aggregate is the determined and not the determining factor.

The lags for the regressions were the following: 57 weekly, 13 monthly, and 5 quarterly.

The Box-Pierce Chi-square test on the residuals when lagged dependent variables are present was used. See G.E.P. Box and David A. Pierce, "Distribution of Residual Auto-correlation in Auto-regressive Integrated Moving Average Time Series Models," *Journal of the American Statistical Association*, Vol. 65, December 1970, p. 1509.

In all but one of the regressions, significant autocorrelation was present in the residuals. Thus, it was necessary to filter the original variables in the several regressions so as to make the residuals as nearly white noise as practicably possible. Two techniques were used in

The Monetary Base and Unborrowed Monetary Base

The correlation results summarized in Table 2 show that during the 1959-74 period the monetary base was more highly correlated with open market operations than with other factors, especially for monthly and quarterly movements. The simple correlation, for example, between the base and open market operations for weekly movements in the variables was .51, while the correlation between the base and other factors was only .25. The simple correlation between quarterly movements in the base and open market operations increased to .66, while the correlation between the base and other factors declined to .11, with the latter too small to be statistically significant. The two types of partial correlations derived from regression analysis have a pattern similar to the simple correlations.¹⁰

The correlation results also indicate that movements in open market operations and other factors were fairly highly and negatively correlated during the 1959-74 period, suggesting that simultaneous but opposite movements in the base's two determinants offset some of the potential impact of each determinant. The extent of these offsetting movements generally tended to increase as the length of the time period increased.

Several conclusions may be drawn from these correlation results. One is that open market operations during the 1959-74 period offset the impact of other factors on the monetary base, although by itself the high negative correlation between open market operations and other factors shows only that one offset the other." It is the finding that the correlation between the

base and open market operations increased while the correlation between the base and other factors declined as the length of the time period increased that suggests that it was open market operations which offset other factors, rather than the other way around.

A second conclusion suggested by the correlation results is that open market operations during the 1959-74 period were the dominant factor determining movements in the base and not merely offsetting movements in other factors. This conclusion is supported by the finding that the correlation between the base and open market operations was fairly high—considerably higher than that between the base and other factors—and that this correlation did not decline as the length of the time span increased. If open market operations had merely offset movements in other factors, either open market operations would have been highly and negatively correlated with other factors but not with the base, or the correlation

¹⁰ The partial correlations, however, differ from the simple correlation in that the partial correlations indicate that on a weekly basis open market operations and other factors, while still having a very high negative correlation, are about equally correlated with the base. This, suggests that, although both components of the base are offsetting one another, they both play about an equal role in weekly determination of the base. It also suggests that the simple correlations are affected by some third set of variables to which the base and open market operations are responding. When this response is held constant, especially in the Type I regression, open market operations are less highly associated with the base while other factors are more highly related.

¹¹ The finding that the association between the monetary base and its other factors is declining must mean that something is offsetting other factors so that they have no effect on the base. Since the base is composed of only two determinants and since its association with open market operations was not declining, indicating that these operations are not being offset, it must be open market operations which are offsetting other factors. The high negative correlation between open market operations and other factors which is either stable, as in the simple correlations, or increasingly negative, as in the partial correlations, indicates that other factors and open market operations are indeed offsetting one another rather than, say, other factors having self-canceling movements over time so that it has no effect on the base.

determining the filter. One was from a regression of the residuals on themselves, while the second was to treat the residuals as moving averages and follow the technique described in T. W. Anderson, *The Statistical Analysis of Time Series* (New York: John Wiley and Sons, Inc., 1971), pp. 223-35.

Table 2
CORRELATION OF OPEN MARKET OPERATIONS, RESERVE AGGREGATES, AND OTHER FACTORS

| Correlation of | Partial Correlations* | | | | | | |
|---|--|---------|-----------|---------|---------|-----------|-----------|
| | Simple Correlations | | | Type I | | Type II | |
| | Weekly | Monthly | Quarterly | Weekly | Monthly | Quarterly | |
| Monetary base with: | <u>Monetary Base</u> | | | | | | |
| OMO | .51 | .62 | .66 | .40 | .42 | .49 | |
| Other factors | .25 | .19 | .11s | .40 | -.08s | -.04s | |
| OMO with other factors† | .71 | -.65 | .68 | A. -.78 | -.89 | -.92 | |
| | | | | B. -.78 | -.90 | -.90 | |
| Unborrowed base with: | <u>Unborrowed Monetary Base</u> | | | | | | |
| OMO | .33 | .61 | .67 | .22 | .46 | .68 | |
| Other factors | .46 | .26 | .11s | .58 | .17 | -.11s | |
| OMO with other factors† | -.68 | -.61 | -.67 | A. -.66 | -.84 | -.90 | |
| | | | | B. -.67 | -.84 | -.88 | |
| Member bank reserves with: | <u>Member Bank Reserves</u> | | | | | | |
| OMO | .38 | .54 | .47 | .42 | .50 | .59 | |
| Other factors | .74 | .73 | .49 | .72 | .49 | .63 | |
| OMO with other factors† | -.34 | -.18 | -.54 | A. -.32 | -.57 | -.53 | |
| | | | | B. -.32 | -.55 | -.49 | |
| Unborrowed reserves with: | <u>Unborrowed Member Bank Reserves</u> | | | | | | |
| OMO | .13 | .50 | .40 | .16 | .48 | .54 | |
| Other factors | .89 | .81 | .67 | .92 | .78 | .77 | |
| OMO with other factors† | -.34 | -.11s | -.42 | A. -.24 | -.28 | -.37 | |
| | | | | B. -.24 | -.28 | -.33 | |
| Account Taken of Past Movements in Dependent Variable | | | | | Weekly | Monthly | Quarterly |
| Account Taken of Past Movements in Independent Variable | | | | | Weekly | Monthly | Quarterly |
| | | | | | .34 | .40 | .52 |
| | | | | | .23 | .10 | .15s |
| | | | | | -.50 | .86 | .83 |
| | | | | | .73 | -.88 | -.94 |
| | | | | | .17 | .41 | .59 |
| | | | | | .60 | .23 | -.06 |
| | | | | | -.57 | -.79 | -.81 |
| | | | | | -.61 | -.74 | -.85 |
| | | | | | -.29 | .50 | .36 |
| | | | | | .72 | .62 | .68 |
| | | | | | -.25 | -.53 | -.50 |
| | | | | | -.04 | -.53 | -.48 |
| | | | | | .12 | .43 | .44 |
| | | | | | .92 | .79 | .77 |
| | | | | | -.20 | -.18 | -.29s |
| | | | | | -.20 | -.13s | -.35 |

* See footnote 9 for discussion of regressions from which the partial correlations were derived. Also, see footnote 7 for description of data used in regressions.

† OMO refers to open market operations.

‡ In the case of the partial correlations between open market operations and other factors, the value of the correlation coefficient was estimated in two ways. The first correlation given in the table, and denoted by A, was derived under the assumption that other factors determine open market operations. The second, denoted by B, assumes that open market operations determine other factors. As the table shows, the results were quite similar. See footnote 9 for a more complete discussion of this matter.

§ Indicates correlation is not significantly different than zero in a statistical sense (5 per cent level).

between open market operations and the base would have declined as the time span of the observations lengthened. It should be added that, since only a part of the movements in open market operations could directly affect movements in the base (because the rest of the movement in open market operations was offsetting the other factors), the base was not perfectly correlated with open market operations even for the longer time spans.

The correlation results for the unborrowed monetary base are generally similar to results for the total monetary base. The unborrowed base was more highly correlated with open market operations than with other factors that affect the unborrowed base. Also, the unborrowed base became more highly correlated with open market operations and less highly correlated with its other factors as the length of the time span increased. Another result was that open market operations and other factors affecting the unborrowed base were highly and negatively correlated.

The only important difference between the unborrowed base and the total base is that for the weekly time span the unborrowed base was more highly correlated with its other factors than with open market operations. This suggests that for weekly periods the **impact** of other factors was offset by open market operations to a greater extent for the total base than for the unborrowed base.

Member Bank Reserves and Unborrowed Reserves

The correlation results for member bank reserves and for unborrowed member bank reserves differ considerably from the results for the base and the unborrowed base. Both total and unborrowed member bank reserves were less highly correlated with open market operations than with other factors. This is true for the simple correlations as well as for both sets of partial correlations. Also, unlike the results for the base concepts, there was no

systematic tendency for member bank reserves to become more highly correlated with open market operations and less highly correlated with other factors as the length of the time span **increased**.¹² This was especially true for the partial correlation results. Thus, for example, the Type **II** partial correlation between member bank reserves and open market operations was higher for the monthly than for the quarterly time span (.50 compared to .36, see Table 2), **while** the correlation between reserves and other factors was lower for the monthly than for the quarterly time span (.68 compared to .62).

These correlation results for member bank reserves and unborrowed member bank reserves suggest that during the **1959-74** period factors other than open market operations were considerably more important in determining these aggregates than was the case for the monetary base and the unborrowed base. The results also suggest that open market operations did not tend to offset the impact of other factors on reserves and unborrowed reserves as much as was the case for the base and the unborrowed base.¹³

Summary of Empirical Examination

In summary, two broad conclusions may be drawn from the empirical examination. One is that open market operations during the **1959-74** period appear to have been considerably more important than other factors in determining the monetary base and the unborrowed base, but for member bank reserves and unborrowed reserves, the correlation results do not provide any evidence that open market operations were a more important determinant than other factors. It

¹² The partial correlations also indicate that open market operations were more highly correlated with member bank reserves and unborrowed reserves than with the monetary base and the unborrowed base. It may be that, for the base concepts, a relatively large portion of the variation in open market operations offset variations in other factors, leaving a relatively small portion of the variation in open market operations to affect the base concepts.

The Federal Reserve's Impact on Several Reserve Aggregates

appears that for the base concepts, open market operations offset much of the impact of other factors on these reserve aggregates as well as having had a direct impact on these aggregates.

A second conclusion is that, **in** general, open market operations were as important in determining the unborrowed base as in determining the total base, and the same conclusion holds when comparing the impact of open market operations on unborrowed and total member bank reserves. An exception is that, over weekly time spans, other factors appear to have been more important than open market operations in determining the unborrowed base than in determining the base.

IMPLICATIONS FOR CONTROLLING RESERVE AGGREGATES

The results of this analysis may be

¹³ One interesting question that emerges from this study concerns unborrowed reserves. This reserve aggregate is closest to one variable on which the Federal Reserve actually focuses, which is free reserves. **Unborrowed** reserves differ from free reserves by the item required reserves. Yet, unborrowed reserves is more highly associated with other factors than any other reserve aggregate irrespective of the time period, and similarly it has the lowest negative association existing between other factors and open market operations. These results would seem to contradict the **Wood** study and the Bonomo and Schotta study cited earlier because they suggest that the impact of the other factors on unborrowed reserves is offset. A possible explanation is that the manager in the period covered by the data has changed his modw *operandi* and so focuses on other targets which have the net effect of resulting in the other factors of the broader reserve aggregates being offset. Clearly, however, this conundrum needs further examination.

interpreted to suggest that the Federal Reserve can use open market operations to control the monetary-base and the unborrowed base. The evidence presented in this article does not indicate whether or not the Federal Reserve can control the two base concepts better than member bank reserves and unborrowed reserves. During the period studied—1959-74—the Federal Reserve did not necessarily attempt to control reserve aggregates. Thus, even though the findings indicate that factors other than open market operations affected the reserve concepts more than the base concepts, it may, nevertheless, be true that the **Federal Reserve** could if it so desired offset the effect of these other factors with open market operations. Thus, while the article could be used to infer which reserve aggregates the Federal Reserve can control—and these appear to be the monetary base and, for monthly and quarterly time periods, the unborrowed base—no conclusion can be drawn as to which aggregates the Federal Reserve cannot control.¹⁴

¹⁴ The criterion used here for controllability is the ability of the Federal Reserve to offset most or all of the impact of factors other than open market operations on reserve aggregates. Under certain circumstances, other measures of controllability may be important as, for example, the standard error of estimate from a linear regression with a reserve aggregate as a dependent variable and open market operations as an independent variable. Because the **Federal Reserve** uses open market operations as a control variable to both offset the effect of other factors and to affect reserves directly, the standard error criterion is not applicable, except possibly in a regression from a larger model which takes into account the offsetting effects of open market operations on other factors.

