



# *monthly review*

JUNE 1975

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FEDERAL RESERVE BANK OF KANSAS CITY



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# Budget Deficits and The Money Supply

By J. A. Cacy

The nation's money supply is closely linked to deficit spending by the Federal government, many analysts contend. Due to the way monetary policy is conducted, these observers argue, money grows rapidly when the deficit in the Federal budget is large and grows slowly when the deficit is small or when surpluses occur. This article undertakes an analytical and empirical examination of these propositions. The first section of the article reviews the analytical relationship between budget deficits and surpluses and money, while the second section presents results of the empirical examination.

## RELATIONSHIP BETWEEN DEFICITS AND SURPLUSES AND THE MONEY SUPPLY

In analyzing the relationship between Federal budget deficits and surpluses and the money supply, it is useful to distinguish direct effects from indirect effects. Budget deficits occur when government expenditures exceed revenues. A deficit will lead to a direct rise in the money supply if the U.S. Treasury finances the deficit not by borrowing but by drawing down balances it holds at commercial banks or Federal Reserve Banks. That is because government expenditures result in a shift of funds into money balances held by the public, and out of deposit balances held by the U.S. Treasury, which are not a part of the money

supply. The government revenues, though, result in a shift out of the public's money balances and into Treasury deposits. Therefore, when expenditures exceed revenues, money balances will increase and Treasury deposits will fall.<sup>1</sup> Similarly, when revenues exceed expenditures and the Treasury does not use the resulting surplus to repay debt held by the public, money balances will decline and Treasury deposits will rise. In practice, changes in Treasury deposits arising from deficits and surpluses may importantly affect the money supply over short periods, but are quantitatively unimportant for longer periods.

If deficits and surpluses are not accompanied by changes in Treasury deposits, they will not directly alter money balances. When a deficit is accompanied by borrowing, the increase in money due to expenditures exceeding revenues is offset by a decline in the money balances of those who purchase the obligations issued by the Treasury. When a surplus is accompanied by debt repay-

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<sup>1</sup>The financing of a deficit by drawing down Treasury balances may affect commercial bank reserves as well as the money supply. If Treasury deposits at Federal Reserve Banks rather than at commercial banks are drawn down, reserves will increase. Unless the increase is offset by the Federal Reserve System, commercial banks may use the reserves to acquire earning assets. This may lead to a rise in the money supply beyond the direct increase caused by the financing of the deficit. The Federal Reserve may, of course, offset the increase in both reserves and the money supply arising from a deficit financed by drawing down Treasury deposits.

## Budget Deficits and The Money Supply

ment, the decline in money due to revenues exceeding expenditures is offset by an **increase** in the money balances of those who were holding redeemed securities.

Deficits and surpluses unaccompanied by changes in Treasury deposits may indirectly affect money. These indirect effects may be both quantitatively significant and long-lived and may result in a correlation between deficits and surpluses and money. To facilitate exposition, in the analysis of indirect effects and in the remainder of the article, the term "deficits and surpluses" is not used. Instead, the term "deficit," which may be positive or negative, is employed and is defined as Federal government expenditures minus revenues. In this terminology, a surplus or an excess of revenues over expenditures is referred to as a negative deficit.

A deficit not accompanied by a change in Treasury deposits may indirectly affect money because it may lead to changes in interest rates. The public, commercial banks, and the Federal Reserve System may then respond to these interest rate changes in ways that affect money. A positive deficit (expenditures exceed revenues) financed by borrowing will tend to cause interest rates to increase. The rise in interest rates will tend to reduce the demand for **M1** balances, which consists of currency plus demand deposits held by the public. When the public shifts out of **M1** and into other assets, **M1** will tend to decline.

As offering rates on time deposits increase along with other interest rates, part of the balances moving out of **M1** may be placed in time deposits. To the extent that **M1** balances are drawn down and transferred to time deposits, the required reserves of the banking system will decline and excess reserves will increase. This, along with the rise in interest rates, will encourage banks to acquire earning assets, which will tend to offset some of the initial drop in **M1** and add to the initial increase in time deposits. The net impact on money resulting from these responses by the public and commercial banks cannot be determined analytically. **M1** would probably decline but,

because **M2** consists of **M1** plus time deposits other than large negotiable **CD's**, **M2** might decline or increase. Similarly, responses by the public and commercial banks to a decline in interest rates associated with a negative deficit (that is, a surplus with revenues exceeding expenditures) accompanied by debt repayment would tend to indirectly cause **M1** to increase and the effect on **M2** would be uncertain.

In terms of responses by the Federal Reserve System, it is often argued that the Federal Reserve conducts monetary policy in a way that results in a correlation between the deficit and money. Some observers hold that the correlation occurs because the Federal Reserve tries to stabilize interest rates. They contend that the Federal Reserve responds to the deficit-induced upward pressure on interest rates by acquiring U.S. Government securities **and/or** providing banks with reserves in other ways, thereby encouraging commercial banks to augment their holdings of earning assets. These increases in the earning assets of the banking system are accompanied by increases in money balances, thereby resulting in a correspondence between the deficit and the behavior of money. The argument would be similar for a negative **deficit**, **which** would place downward pressure on interest rates. In trying to stabilize interest rates, the Federal Reserve would reduce bank reserves and the money supply would decline. While the Federal Reserve may at times attempt to stabilize interest rates, however, it often allows interest rates to move up or down. Thus, any argument that the conduct of policy results in a correspondence between the deficit and money should not be based on the assumption that the Federal Reserve attempts to stabilize interest rates.

An alternative hypothesis about the Federal Reserve's approach to policymaking is that it sets out to influence interest rates, but does not necessarily seek to stabilize them. The alternative would postulate that the Federal Reserve determines its interest rate policy in light of economic conditions such as unemployment and inflation. If followed, this approach to **policymaking** may tend to pro-

duce a correspondence between the deficit and the money supply.

In the latter part of a recession and the early part of an economic recovery, for example, when unemployment is high and the inflation rate is low, the Federal Reserve may allow interest rates to decline or, at least, resist upward movements in rates. At the same time, due to the sluggishness of the economy, Federal revenues are declining and transfer-payment expenditures are rising so that the deficit is large. The consequent heavy Treasury borrowing is placing upward pressure on interest rates. To prevent rates from rising, the Federal Reserve would purchase U.S. Government securities in volume and/or undertake other reserve-supplying actions, which would lead to large money supply increases. Thus, large money supply increases would accompany the large deficit and would result, in part, from the combination of the large deficit and the Federal Reserve's policy of minimizing upward movements in interest rates.

As the economy moves into the middle stage of an economic expansion, when inflationary pressures develop and unemployment falls, the Federal Reserve may allow interest rates to rise. At the same time, due to the economic recovery, the deficit is small. The consequent reduction in Treasury borrowing alleviates some of the upward pressure on interest rates. In allowing interest rates to rise, the Federal Reserve would be forced to moderate the increases in the money supply. Thus, the small increases in money would accompany the small deficit and would be brought about, in part, by the combination of the small deficit and the Federal Reserve's policy of allowing interest rates to rise.

In the latter part of a recovery and the early part of a recession, when inflationary pressures are strong and unemployment is low, the Federal Reserve may be pushing interest rates up or, at least, resisting downward movements. At the same time, due to the inflation, the deficit is negative, i.e., a surplus occurs. Consequently, the Treasury is repaying debt, and this places

strong downward pressure on interest rates. The Federal Reserve, in order to resist downward interest rate movements, would reduce the money supply. Thus, the decline in the money supply would accompany the negative deficit and would be brought about, in part, by the combination of the negative deficit in the budget and the Federal Reserve's policy of resisting downward movements in interest rates.

In summary, it is sometimes contended that the Federal Reserve may respond to deficit-induced alterations in interest rates in a way that results in large money supply increases when the deficit is large, small money supply increases when the deficit is small, and declines in money when the deficit is negative. That is, Federal Reserve responses may produce a correlation between the deficit and the money supply. It was earlier shown that responses by the public and commercial banks may also result in correspondence between the deficit and money. The remainder of the article empirically examines these propositions.

## **EMPIRICAL EXAMINATION**

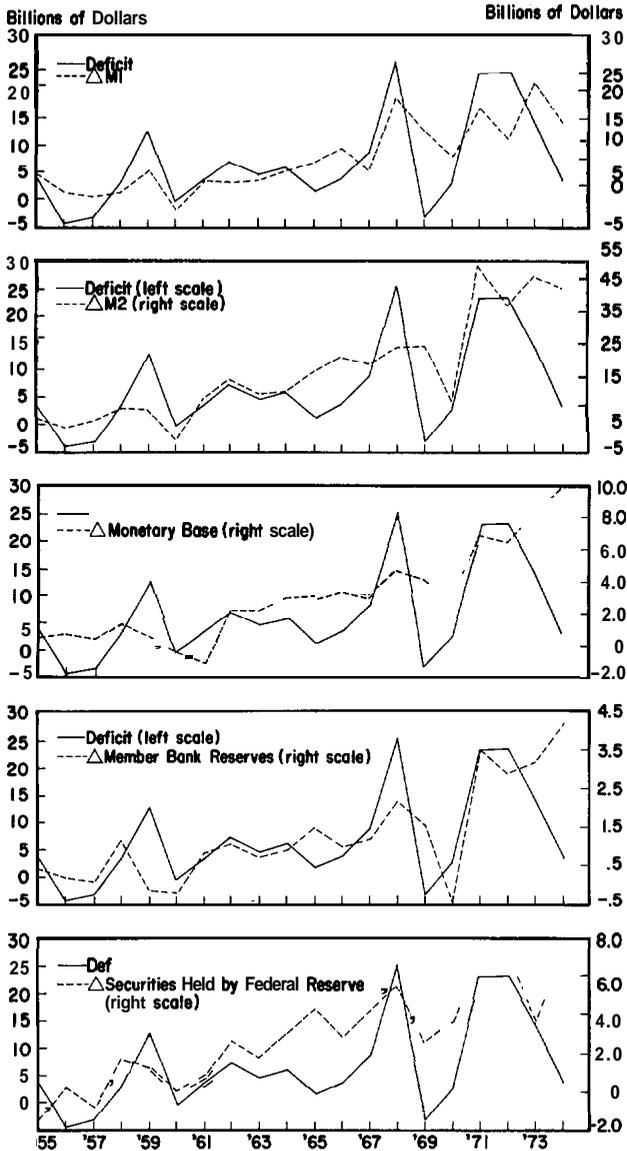
### **1955-74 Period**

This section examines the relationship between the deficit and the money supply and certain other variables during the 1955-74 period. Yearly data on the deficit along with changes in M1 and M2 are shown in Chart 1. Also, to examine the extent to which Federal Reserve operations may be related to the deficit, Chart 1 contains yearly data on member bank reserves, U.S. Government securities held by the Federal Reserve System, and the monetary base, which consists of member bank reserves plus currency held by the public and non-member banks.

Chart 1 indicates there is very little year-to-year correspondence between movements in the deficit and movements in any of the other variables, although the other variables trended upward with the deficit in the 1955-74 period. For example, in 9 of the 20 years in the period, the change in M1 moved in the opposite direction from

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**Chart 1  
THE DEFICIT, MONEY SUPPLY,  
AND OTHER VARIABLES  
1955-74**



the deficit. The same is true to a slightly lesser extent for M2, reserves, and the monetary base. Movements in Federal Reserve holdings of U.S.

Government securities corresponded somewhat more closely with the deficit, especially for the 1967-73 period. Also, it is true that in those years in which very sharp increases in the deficit occurred—1959, 1968, and 1971—M1 increased considerably more than in the immediately preceding years.

The absence of a year-to-year correspondence does not necessarily mean that the behavior of the money supply and other variables was unrelated to the behavior of the deficit during the 1955-74 period. For example, a deficit in any one period may have affected money not only in that period but also in one or more succeeding periods. The exploration of this possibility requires statistical analysis. However, due to the few years for which consistent data on the deficit are available, yearly data are not well suited for the type of statistical analysis required.

**1970-74 Period**

Monthly data for the 1970-74 period are available and provide a more fruitful subject for a statistical examination of the relationship between the deficit and the money supply. In the examination of the 1970-74 period, regression analysis was applied to monthly data to try to discover statistically significant relationships between the deficit and M1, M2, the monetary base, member bank reserves, and U.S. Government securities held by the Federal Reserve System.

The analysis hypothesized that the behavior of each variable in any month was affected by the behavior of the deficit in that month and in certain preceding months. For example, it was hypothesized that the behavior of M1 in any month, say December 1974, was affected by the behavior of the deficit in December 1974 and in certain months preceding December, say in each month from July 1973 through November 1974. The hypothesis that the behavior of money and the other variables in any month was affected by the behavior of the deficit in past months is based on the notion that time lags exist in economic behavior. Because time is required to adjust to changing conditions,

for example, a deficit may place upward pressure on interest rates for a number of months after it occurs. In addition, the public, commercial banks, and the Federal Reserve System may not respond immediately to a change in interest rates but may respond over a period of time.

The regression analysis indicates that during the 1970-74 period, M2 was related to and affected by the deficit in a statistically significant way. As shown in Table 1, for the regression measuring the impact of the deficit on M2 over a 24-month period, the adjusted R<sup>2</sup> was statistically significant and was .46. This may be interpreted to mean that on average 46 per cent of the behavior of M2 was accounted for by the behavior of the deficit. A significant relationship was also found between the deficit and M1, but it was weaker than for M2. For M1, only the 18-month regression produced a statistically significant R<sup>2</sup>, and it indicates that only 28 per cent of the behavior of M1 was accounted for by the behavior of the deficit.<sup>2</sup>

While money was found to be related to the deficit, the regression analysis does not support the proposition that the Federal Reserve responded to the deficit by taking actions that affected

2/Data on the deficit were taken from the *Treasury Bulletin and Monthly Treasury Statement of Receipts and Outlays of the United States Government*. The latter publication contains information on liabilities owed and assets held by the Federal government. Liabilities minus assets, or net liabilities, may be symbolized by NL. The deficit is equal to the change in NL, that is,  $D = \Delta NL$ . In the statistical analysis, it was convenient to employ levels rather than changes, so that NL rather than  $\Delta NL$  or D was used. Thus, the analysis examined the relationship between NL and the level of money balances rather than between D and changes in money balances. Monthly data on NL are available beginning in July 1967, so that the period from July 1967 through November 1974 was involved in the statistical analysis.

Monthly seasonally adjusted series on NL, M1, and the other variables were detrended using the autoregressive technique. (For a discussion of this technique, see Robert D. Auerbach and Jack L. Rutner, "Money and Income: Is There a Simple Relationship?" in the *Monthly Review*, Federal Reserve Bank of Kansas City, May 1975. See especially footnote 11.) Detrended values of M1 and the other variables were regressed on detrended values of NL. Using M1 to illustrate, the regression equations took the form:

$$M1_t = a + b_0 NL_t + b_1 NL_{t-1} + \dots + b_n NL_{t-n} + u_t$$

To test for the possibility that NL is affected by, as well as affects, money, NL was regressed on M1 and each of the other variables. These regressions took the form:

$$NL_t = a + b_0 M1_t + b_1 M1_{t-1} + \dots + b_n M1_{t-n} + u_t$$

In these regressions, none of the R<sup>2</sup>'s were statistically significant. It may be tentatively concluded, therefore, that the dominant direction of causation is from the deficit to money and that there is little or no feedback from money to the deficit.

**Table 1**  
**ADJUSTED R<sup>2</sup>S FOR REGRESSIONS**  
**HAVING THE DEFICIT AS THE**  
**INDEPENDENT VARIABLE**

| Dependent Variable  | Regressions Involving: |           |
|---|------------------------|-----------|
|   | 18 Months              | 24 Months |
| M1  | .28*                   | .31       |
| M2  | .40†                   | .46‡      |
| Monetary base   | .21                    | .58‡      |
| Member bank reserves                                      | .00                    | .00       |
| U.S. Government securities held by Federal Reserve System | .01                    | .02       |
| Commercial paper rate                                     | .47†                   | .49‡      |
| Federal funds rate  | .00                    | .34       |

\*Statistical significance at 90 per cent level of confidence.  
†Statistical significance at 95 per cent level of confidence.  
‡R<sup>2</sup> is significant but statistically unreliable because Durbin-Watson test indicates the existence of serial correlation.

money. The analysis indicates that, while M2 was positively related to the deficit during the 1970-74 period, M1 was negatively related.<sup>3</sup> Prior to undertaking the analysis, it was expected that, if money was found to be significantly related to the deficit, a positive relationship would be indicated. That is, the regression analysis was expected to show that an increase in the deficit tended to result in an increase in money and a decrease in the deficit tended to result in a decrease in money. Such a relationship would exist if the Federal Reserve responded to large (small) deficits by buying large (small) quantities of U.S. Government securities and taking other actions that led to large (small) increases in the money supply.

However, since M1 was negatively related to the deficit, the Federal Reserve apparently did not respond to the deficit by taking actions that affected money. Rather, it appears that the Federal Reserve allowed the deficit to change interest rates. Instead of arising from Federal Reserve responses, the relationship between money and the deficit was due to responses by the public and

3/In addition to M1 and M2, the time deposit component of M2 was regressed on the deficit, but the R<sup>2</sup>'s were not significant. For the three variables, the sum of the regression coefficients is as follows:

|               | Regressions Involving: |           |
|---------------|------------------------|-----------|
|               | 18 Months              | 24 Months |
| M1            | -1.847                 | -1.151    |
| M2            | -.193                  | +.749     |
| Time deposits | +.620                  | +3.846    |

commercial banks to the interest rate changes.<sup>4</sup> For example, a deficit-induced increase in interest rates, along with the accompanying rise in offering rates on time deposits, tended to reduce the demand for M1 balances. The public, therefore, tended to shift out of M1 balances and into other assets, including time deposits. This shift tended to reduce the required reserves and increase the excess reserves of commercial banks, encouraging them to acquire earning assets. The rise in earning assets tended to offset part of the initial decline in M1 balances and add to the initial increase in time deposits. On balance, these responses by the public and commercial banks to the increase in interest rates accompanying the rise in the deficit tended to result in a decline in M1 and an increase in M2. Similarly, a deficit-induced drop in interest rates tended to lead to an increase in M1 and a decline in M2.

The conclusion that the Federal Reserve responded to the deficit by allowing it to result in interest rate changes is further supported by the results of regression analysis directly testing the relationship between the deficit and interest rates. This analysis provides some evidence that, during the 1970-74 period, interest rates were related to and affected by the deficit in a statistically significant way. To illustrate, for the regression measuring the impact of the deficit on the commercial paper rate over an 18-month period, the adjusted R<sup>2</sup> was statistically significant and was .47. In addition, the relationship was positive, indicating that a large (small) deficit led to a large (small) increase in the commercial paper rate.<sup>5</sup>

The analysis did not uncover any statistically significant relationships between the deficit and the monetary base, member bank reserves, or U.S. Government securities held by the Federal Re-

<sup>4</sup>The conclusion that public and commercial bank responses produced the relationship between money and the deficit is based on the finding that the sums of the coefficients are negative in the two M1 regressions (see footnote 3). The conclusion that M2 is positively related to the deficit is based on the finding that, in the M2 regression having the largest number of lags (24), the sum of the coefficient is positive. Note that the sums of the coefficients in the time deposits regressions are positive. This is consistent with the conclusion that a deficit-induced increase in interest rates, accompanied by a rise in offering rates on time deposits, resulted in a shift out of M1 balances and into time deposits.

serve. Table 1 shows that, for regressions involving these variables, the R<sup>2</sup>'s were either not significant or significant but not statistically reliable.<sup>6</sup> Thus, the evidence does not support the proposition that the Federal Reserve tends to respond to deficit spending in a systematic way by acquiring U.S. Government securities or by supplying reserves or by expanding the monetary base so that commercial banks can buy U.S. Government securities. These results are consistent with the finding that the relationship between the deficit and money in the 1970-74 period was due to responses by the public and commercial banks rather than to Federal Reserve responses.

**SUMMARY**

The nation's money supply is closely linked to deficit spending by the Federal government, many analysts contend. According to these observers, the association is due to efforts by the Federal Reserve System to stabilize interest rates. This leads the System to respond to deficits by buying U.S. Government securities and/or taking other actions that result in increases in the money supply. However, the deficit and money may be related for reasons other than or in addition to the behavior of the Federal Reserve. The public and commercial banks, as well as the Federal Reserve System, may respond to deficit-induced alterations in interest rates in ways that affect money.

Empirical analysis undertaken in this article suggests that the deficit and money are related. While an examination of yearly data for the 1955-74 period reveals little or no year-to-year association, regression analysis applied to monthly data

<sup>5</sup>For the commercial paper and Federal funds regressions, the sums of the coefficients are as follows:

|                  | Regressions<br>18 Months | Involving:<br>24 Months |
|------------------|--------------------------|-------------------------|
| Commercial paper | + .405                   | + 2.776                 |
| Federal fund;    | + .803                   | +22.106                 |

<sup>6</sup>For the 24-month monetary base regression, the significant R<sup>2</sup> may indicate some relationship, even though the R<sup>2</sup> is not reliable due to the existence of serial correlation. For this regression, the sum of the coefficients is -2.673, indicating a negative relationship between the monetary base and the deficit. It may be that a deficit-induced rise in interest rates reduces the public's demand for currency, which is a large portion of the base. If this occurs, and if the Federal Reserve does not respond to the deficit by increasing the base, a negative relationship between the base and the deficit would be expected.

for the 1970-74 period indicates that both **M1** and **M2** were related to and affected by the deficit in a statistically significant way. However, the analysis does not support the proposition that the Federal Reserve responded to the deficit by taking actions that affected money. Rather, it appears that the Federal Reserve allowed the deficit to affect interest rates. Instead of arising from Federal Reserve responses, the relationship between the deficit and money was due to responses on the part of the public and commercial banks.

These conclusions are supported by several findings. One is that, while **M2** was positively related to the deficit, **M1** was negatively related. That is, a deficit was associated with an increase in **M2** and a decline in **M1**. It appears therefore that a deficit led to a rise in interest rates, causing the public to shift out of **M1** balances into other assets. As the offering rates on time deposits increased along with the increase in interest rates, part of the balances moving out of **M1** were transferred into the time deposit component of **M2**, offsetting part of the effect on **M2** of the drop in **M1**. The decline in **M1** and the rise in time deposits increased the excess reserves of banks which, along with the

increases in interest rates, led banks to acquire assets. Some of the prior decline in **M1** was thereby offset and the rise in time deposits was augmented. On balance, these responses by the public and commercial banks to a deficit-induced rise in interest rates resulted in a decline in **M1** and an increase in **M2**.

The conclusion that the Federal Reserve responded to the deficit by allowing it to result in interest rate changes is further supported by the results of regression analysis testing the relationship between the deficit and interest rates. These results provided some direct evidence that, during the 1970-74 period, interest rates were related to and affected by the deficit. Finally, the empirical investigation undertaken in this article did not uncover any statistically significant relationships during the 1970-74 period between the deficit and Federal Reserve operations, as measured by the monetary base, member bank reserves, and U.S. Government securities held by the System. This is consistent with the conclusion that the relationships between the deficit and money were due to responses by the public and commercial banks rather than to Federal Reserve responses.

# Seasonality of Agricultural Prices

By Blaine W. Bickel

History shows that prices of many agricultural products exhibit definite seasonal patterns which reflect the various marketing practices of farmers as well as the natural biological processes that govern production. For example, the movement of grain to market usually increases rather significantly during the harvest period, pushing prices down. Likewise, the bulk of the beef calf crop is produced in the spring, so that many calves reach market size at about the same time each year. This uneven flow in the supply of most farm commodities, coupled with changes in demand, produce seasonal price movements that should be considered when formulating a market strategy.

Agriculture has been, at least until recent years, an industry bound by tradition. Little effort was devoted to developing a marketing strategy, as many farmers sold their crops right out of the field. A great deal of on-farm storage capacity has been added in recent years, however, as farmers have attempted to increase their returns by waiting for a post-harvest rebound in prices. The success of this delayed-marketing strategy depends on both the magnitude of the price recovery and the degree of confidence that can be placed in the regularity of the seasonal pattern. If a price increase that exceeds storage and other holding costs is highly probable each year, the decision to postpone marketing would obviously be wise. To provide a framework for the decision-making process, the seasonal price patterns of several commodities

important to Tenth Federal Reserve District<sup>1</sup> agriculture are examined in this article.

## THE ANALYSIS

The changes in any price series over a long period of time can be attributed to secular, cyclical, seasonal, and irregular factors. Secular changes occur gradually over a long period of time. Cyclical fluctuations take place at somewhat shorter intervals and may be associated with alternating periods of expansion and contraction in the industry or with fundamental changes in market demand. Seasonal patterns tend to recur year after year, and are of prime importance to most agricultural producers. Irregular price movements cannot be predicted, and due to their random nature are quite often offset by another random movement within a relatively short period.

To analyze the seasonal pattern in a price series, it is first necessary to eliminate the secular and cyclical movements from the data. This analysis employs a statistical technique known as the **ratio-to-moving average** method to isolate and measure the seasonal movement.<sup>2</sup> Briefly, the first step is to compute a 12-month moving average from the original data to obtain the cyclical component. The original series is then divided by the 12-month moving average, which removes the long-term in-

1/Colorado, Kansas, Nebraska, Wyoming, 43 western Missouri counties, northern New Mexico, and most of Oklahoma.

2/Taro Yamane, *Statistics, An Introductory Analysis* (New York: Harper and Row, 1964), p. 357.

fluences and leaves a series that contains only seasonal and irregular components. This series is further modified by computing a 5-year moving average which minimizes the effects of the irregular factors. The result is, an index that provides a quantitative measure of the amount of seasonal price fluctuation that recurs on a regular **basis**.<sup>3</sup>

Data for the analysis consist of monthly prices received by farmers for selected commodities over the 20-year period, 1955-74. The seasonal patterns of these commodities are depicted in Charts 1-6. In each of the charts, the heavy black line shows the means of the seasonal indexes for each month of the year and represents the typical seasonal price pattern for the commodity being studied. The vertical distance between this line and the index base of 100 represents the percentage that monthly prices typically vary from the average annual price, regardless of the absolute price level. The shaded area on either side of this line includes approximately two-thirds of all the monthly observations, and is referred to as the **variability range**.<sup>4</sup> When the variability range is narrow, most of the observations lie close to the average, indicating a seasonal pattern that occurs on a regular basis. As the variability range widens, a less regular seasonal pattern is indicated.

These graphic results should not be interpreted too literally. Since 20 years of data have been averaged to produce these results, the chances are relatively minor that any particular year closely follows the observed seasonal pattern. Yet, these seasonal price movements can be used as a general guide in making marketing decisions, thereby improving the chances of realizing better-than-average results over the longer run.

## **Wheat**

Wheat is the most important cash crop in the Tenth District. In recent years, Kansas production

has accounted for about half of the District's cash receipts from wheat, while much of the remainder has been contributed by Colorado and Oklahoma. The analysis deals with Kansas wheat prices only, although price patterns in the other states appear to be similar. One minor difference was observed. Because of the earlier harvest, Oklahoma prices typically reached their lowest level in June, as opposed to July in Kansas.

Chart 1 shows that the price of wheat in Kansas generally follows a predictable pattern. From a harvest low in July, prices increase steadily through December, then decline until the next harvest. A grower who sells his wheat in December can expect to receive about 4 per cent more than the annual average price, and about 11 per cent more than the July price. However, December prices exhibit considerable variation, particularly when compared to prices in November. Therefore, even though prices traditionally peak near the end of the year, one could more confidently predict **above-average** prices for November than for December.

The seasonal movement of Kansas wheat prices is somewhat irregular in July, August, and September as evidenced by the relatively large amount of price variability during this period. This reflects uncertainty about requirements and usage during the marketing year. Wheat is a good livestock feed, so there may be considerable substitution of wheat for corn or grain sorghum prior to the fall harvest of the latter two crops. Any change in expected production of these feed grains would therefore be reflected in wheat prices. In addition, wheat production in other parts of the world directly affects the export situation in this country, which adds to the sensitivity of Kansas wheat prices in the months immediately following harvest.

The variability range begins to narrow in October and continues this trend through November as supply and demand conditions for the marketing year become better defined. In addition, feed grain production is a known quantity by November, and the irregularity of wheat prices reaches its lowest point. As the average price moves to its December high, the variability range widens dramatically, and remains much the same

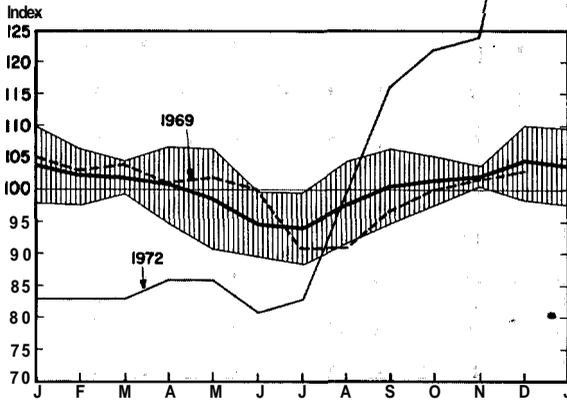
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<sup>3</sup>For a detailed description of the steps used in this analysis, see "The X-11 Variant of the Census Method II Seasonal Adjustment Program," U.S. Department of Commerce, Bureau of the Census, Technical Paper, No. 15 (Washington: U.S. Government Printing Office, 1965).

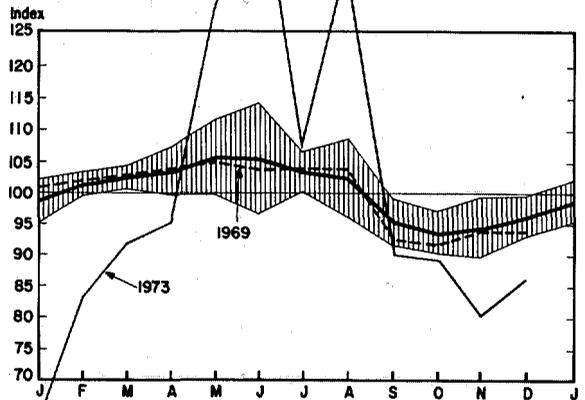
<sup>4</sup>The vertical distance on either side of the seasonal index is  $\pm 1$  standard deviation from the mean for each month.

# SEASONAL PATTERNS OF AGRICULTURAL PRICES

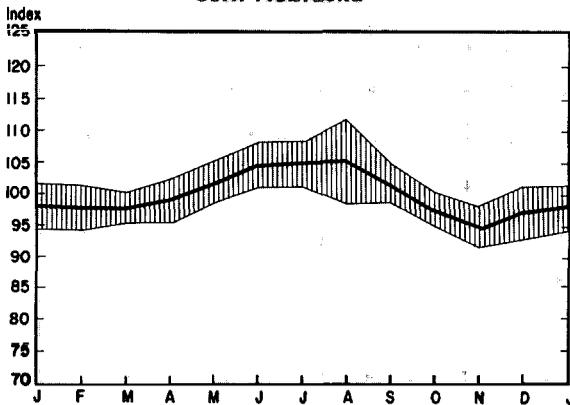
**Chart 1**  
Wheat-Kansas



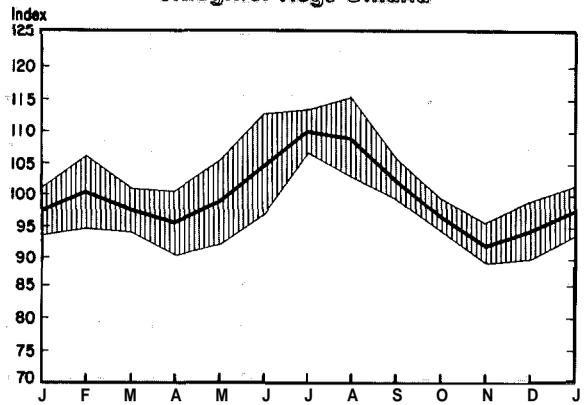
**Chart 2**  
Soybeans-Missouri



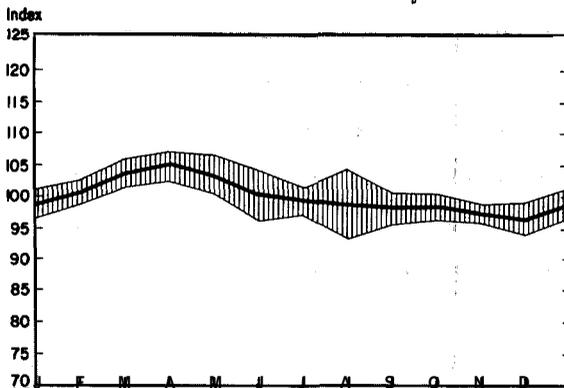
**Chart 3**  
Corn-Nebraska



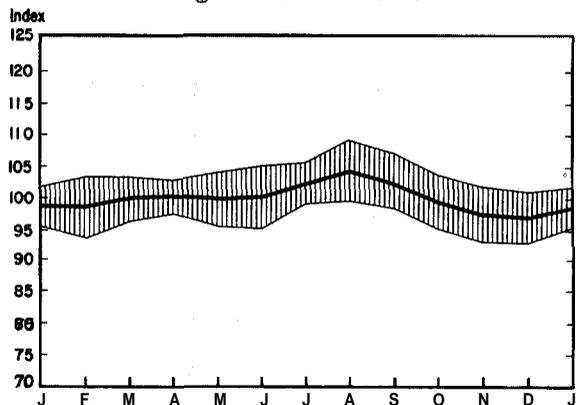
**Chart 4**  
Slaughter Hogs-Omaha



**Chart 5**  
Feeder Cattle-Kansas City



**Chart 6**  
Slaughter Steers-Omaha



NOTE: The heavy block line in each of the accompanying charts shows the seasonal price index for that commodity. The shaded area around the index is  $\pm 1$  standard deviation from the index.

through January. The decision on whether to sell stored wheat in December, or hold it until after the first of the year because of income tax considerations, is probably a major influence on the market during these 2 months. Weather extremes would also contribute to price variability at this time of year. The band continues to narrow through February and March as the relationship between supply and demand becomes well established, and weather is not usually a critical factor. But with the coming of spring, weather is of prime importance. Prices generally overreact as each new production forecast is made—whether good or bad—adding to the variability of wheat prices during this period.

If a producer elects to sell his wheat at some time other than harvest, the analysis shows that it would not normally pay to hold beyond December unless some highly unusual circumstances prevailed. Although wheat prices usually rise after harvest, this increase must be weighed against storage costs. Assuming that storage costs are **1.5** cents per bushel per month, and handling charges are **3** cents per bushel for receiving the grain and **4** cents per bushel for shipping, the breakeven price for holding wheat for the first month of the marketing year is **8.5** cents above the July price. Another **1.5** cents would be added for each additional month the grain is stored. (On-farm storage costs would differ from this example, but some costs would still be encountered.)

For a practical application of this relationship, Chart 1 shows the monthly prices received for wheat by Kansas farmers in **1969** and **1972**. To facilitate comparison, these prices have been converted to an index by setting the annual average equal to 100. The year **1969** exhibited a very typical price pattern, yet storage costs would have offset the increase in wheat prices that occurred between harvest and the end of the year. Delayed marketing in **1969** would have resulted in a lower net return than marketing at harvest, for all months except November.

Chart 1 also illustrates the hazard of relying too heavily on averages. Price movements in **1972** were very unorthodox due to the unexpected and

unusually large purchase of wheat by Russia. Before the extent of this transaction became known, wheat prices followed a normal seasonal pattern, but the picture changed dramatically during the second half of the year as prices exploded in response to the large export commitment.

### Soybeans

Chart 2 shows the seasonal price pattern for soybeans based on Missouri prices. From a harvest low in October, soybean prices typically climb at a fairly steady pace to a May high. The total price increase over this period averages **13** per cent. The seasonal index also shows that prices remain above average through August, then drop sharply toward the October low.

Soybean prices exhibit an unusual amount of variability during the spring and summer months. Speculation about whether the supply will last until the new crop is harvested has frequently produced major price swings during this period. Weather also becomes a major factor in the summer months as changes in production estimates for the new crop can influence price behavior.

The best strategy appears to be to delay soybean marketings for at least 4 months after harvest. From February through May, and again in July, there is a good chance of receiving an above-average price. The chart shows that soybean prices have usually reached their highest level in May and June, but not with any consistency. The extremely wide confidence band shows that prices may also fall below the yearly average in June.

The wide variability of soybean prices is also illustrated in Chart 2 by superimposing two selected years on the seasonal pattern. As with wheat, the monthly prices are expressed as a percentage of the annual average. Very little deviation from the typical seasonal pattern occurred in **1969**. Applying the same storage and handling costs used in the wheat example to **1969** soybean prices (October **1968** crop), the optimum selling month was May. Net returns in May were **9.5** cents per bushel more than would have been realized by selling in October.

## Seasonality of Agricultural Prices

In 1973, however, month-to-month price changes ranged from a 35 per cent increase to a 30 per cent decline in reaction to a variety of stimuli. A shortfall in Peruvian fish meal production, strong worldwide demand for high-protein feeds, and the emergence of the Soviet Union as a major soybean buyer sent prices skyrocketing early in the year. Then farmers planted the largest acreage on record and prices fell sharply in July, staged a short-lived rally, then fell again as it became apparent that supplies would exceed usage through the approaching market year. Because of this unusual price behavior, any soybean producer who held his crop beyond harvest enjoyed a tremendous increase in net returns. From an average price of \$3.15 per bushel in October 1972, soybean prices peaked at \$9.80 per bushel in June 1973, producing a potential net gain of \$6.46 per bushel for the 8 months storage.

The evidence suggests that net returns from soybeans can usually be increased by delaying marketings for at least 4 months, but the exact timing is quite dependent on current conditions.

### **Corn**

The seasonal pattern of Nebraska corn prices is illustrated in Chart 3. Compared with wheat and soybeans, corn prices generally display a more regular seasonal pattern as evidenced by the narrower range or variability. However, there is a longer time lag between the harvest low and the point at which corn prices move above the annual average. The lag is 6 months for corn, compared with 4 months for soybeans and only 2 months for wheat. Therefore, corn prices normally exceed the annual average only 5 months of the year, from May through September.

Nebraska corn prices usually reach their low in November and exhibit a rather quick recovery in December. Prices are very stable from January through March, then an upward movement carries corn prices to an August level that is slightly more than 5 per cent above the annual average and almost 11 per cent above the November low. Except for a bulge in August, the variability range maintains a relatively stable width. August is a critical month

in the development of corn. Extremely hot or dry weather in late July or August, as in 1974, can have a devastating effect on corn production. If silk development is retarded, pollination will be hindered, and the ear will not fill properly.

In general, it appears that returns could be maximized over time by holding corn until June, July, or possibly August. Again, however, the potential increase in price must be weighed against storage costs.

### **Hogs**

Chart 4 shows the seasonal price pattern for slaughter hogs at Omaha. The average price for all barrows and gilts sold for slaughter was used for this analysis, which undoubtedly resulted in a smoothing of the month-to-month price changes. Yet, compared with the crop prices examined, Chart 4 shows a much greater price range between the summer high and winter low.

Most hog producers strive for two pig crops each year. Hog prices are therefore unique in that they move through two corresponding up-and-down cycles each year. A major upward price movement reaches its peak in the late summer, while a secondary movement peaks in late winter. The fall pig crop is the smaller of the two, and when these pigs are marketed 6 months later, the price depressing effect is not as great as when the larger spring pig crop is marketed in the fall.

The seasonal price line reaches lows that are 4 per cent and 8 per cent below the annual average in April and November, respectively. The February peak is only slightly above the annual average, while July prices can be expected to top the yearly average by 10 per cent. The summer prices would probably be even higher except for the substantial number of sows sold for slaughter at that time of year.

If hog producers aim for July or August sales and avoid the month of November, they could expect above-average returns in most years. However, this would require shifting farrowings to January and July, when weather extremes become a critical factor unless the hog producer is equipped to furnish adequate shelter.

### **Feeder Cattle**

The analysis of feeder cattle prices at Kansas City is depicted in Chart 5. The range through which feeder cattle prices fluctuate each year is rather limited relative to the price movements for commodities previously discussed. From the December low to the April high, the usual price increase is only 9 per cent. Considering the natural pattern of birth in the spring and marketing in the fall, it is somewhat surprising that prices vary so little. A radical departure from the usual pattern occurred in 1974, when a year-long price decline left December feeder cattle prices at approximately one-half the January level.

The apparent discrepancy in variation between prices and marketings of feeder cattle can be at least partly explained by the change in demand during the course of the year. The demand for feeder cattle to be placed in feedlots is very high in the fall of the year, so prices are only slightly below the annual average in spite of the large number of animals placed on the market at that time. Conversely, when the supply of feeder cattle falls off in the spring, prices move only 5 per cent above the annual average because a fairly sharp decline in demand also occurs at that time of year.

There is probably little the average rancher can do to alter the marketing schedule of feeder cattle. Spring calving is not a chance occurrence. It is planned to avoid weather extremes—particularly cold—which would cause undue stress on, or even loss of, new-born calves. In addition, the annual production cycle is closely associated with the grazing season. Hence, feeder cattle prices are related to the grazing season. Prices are high in the spring when cattle are needed to utilize the abundant supply of grass. As fall approaches and herds must be removed from the range as the grazing season ends, prices tend to slump below the yearly average.

The relatively narrow band around the seasonal index indicates that the price pattern is a regular one, having a high probability of recurring each year. The only exception seems to be the month of August, generally the hottest and often the driest

month. The effect of weather on range conditions, and ranchers' responses to these conditions, probably explain most of the increased price variability in August.

### **Slaughter Steers**

The average monthly prices of all grades of steers sold for slaughter in Omaha was also analyzed. As shown in Chart 6, slaughter steer prices—like those for feeder cattle—tend to move through a rather narrow range in most years, although 1974 was an exception. Average prices change less than 8 per cent from the August high to the December low. Furthermore, the seasonal pattern is not very regular as judged by the width of the variability range.

The growth of the cattle feeding industry has undoubtedly played a major role in smoothing the line representing the seasonal index in Chart 6. Feedlots generally strive for consistency—not only in the quality of the product but also in the quantity. Some delay in marketing can occur, but once an animal reaches a certain stage of "finish," additional feeding becomes progressively more expensive and wasteful. Anything more than short-term changes in normal marketing patterns are therefore effectively eliminated.

The seasonal pattern of slaughter steer prices is especially important to the producer who markets on an irregular basis or only a few times each year. In most years, this individual should attempt to concentrate marketings in late summer and avoid the winter months when prices are usually at their low point. But this schedule may present a conflict for the feeder who purchases animals to place on feed. Assuming the typical feeding period is 140 days to 150 days, slaughter cattle that would be ready for market in late summer must be placed in the feedlot in the spring. Unfortunately, this is when feeder cattle prices are at their highest.

### **STATISTICAL SUMMARY**

With any analysis of historical data, there is no guarantee that the observed relationships and patterns of the past will remain valid in future years.

## Seasonality of Agricultural Prices

Seasonal highs and lows may shift over time as a result of the development of new crop varieties that mature at different times of the year or as a result of new marketing practices. Although the evidence is still inconclusive, the data suggest that the low point for both wheat and soybean prices may now be occurring slightly earlier than at the beginning of the period included in the study. Earlier maturing varieties may be partly responsible for such a shift, and other technological improvements have probably contributed to this development as well. The ability to harvest and transport the crop more rapidly could result in an earlier and more concentrated marketing of the commodity.

The very fact that producers are becoming more sophisticated and market oriented in their planning can also produce changes in seasonal price patterns. If production cycles are altered to take advantage of seasonal price movements, the highs and lows may be shifted to different months. Furthermore, if marketing programs are also changed, marketings may be less concentrated and the seasonal price pattern would be smoothed as a result.

While some shifting and smoothing can be expected over a long period of time, the seasonal indexes presented in this study were found to be statistically valid. It was determined that the means of the seasonal indexes for individual months were significantly different from each other, indicating that the observed month-to-month changes were not just random movements.

As previously mentioned, price changes over time can be classified as secular, cyclical, seasonal, and irregular. The amount of price variation attributable to the seasonal component for each of the six commodities analyzed in this study is shown in Table 1. Using wheat as an example, slightly more than one-fourth of the variation from one month to the next was due to the seasonal influence. (The remainder was distributed between cyclical and irregular influences.) Expanding the

**Table 1**  
**AMOUNT OF VARIATION EXPLAINED BY**  
**SEASONAL COMPONENT**

| Commodity        | Time Span in Months |      |      |      |      |      |
|------------------|---------------------|------|------|------|------|------|
|                  | 1                   | 2    | 3    | 4    | 5    | 6    |
|                  | Per Cent            |      |      |      |      |      |
| Wheat            | 26.1                | 30.8 | 34.5 | 33.4 | 30.5 | 25.8 |
| Corn             | 42.0                | 50.3 | 52.0 | 49.8 | 45.6 | 40.8 |
| Soybeans         | 28.5                | 36.7 | 37.6 | 37.2 | 35.6 | 32.4 |
| Slaughter Hogs   | 53.2                | 54.3 | 50.9 | 41.6 | 32.9 | 28.6 |
| Feeder Cattle    | 27.6                | 34.9 | 36.1 | 33.1 | 28.9 | 24.5 |
| Slaughter Cattle | 34.3                | 36.8 | 37.5 | 34.9 | 32.0 | 29.4 |

time span to 3 months, more than one-third of the variation in wheat prices was due to seasonal factors. In fact, the seasonal component achieves its greatest importance during the 3-month time span in all cases except hogs. Since hog prices move through two cycles each year, it is not surprising to find the seasonal influence dominating the 1- and 2-month periods.

Beyond the sixth month, the seasonal influence declines rapidly for most commodities as the cyclical component begins to dominate the series.

### **CONCLUDING COMMENT**

Seasonal indexes can be useful management tools for anticipating the short-run movement of commodity prices. But the average will seldom be followed exactly in any given year, so the producer needs to add his own judgment to the current situation and outlook. An understanding of seasonal price patterns can sometimes be used to schedule production to avoid low price months or to concentrate marketings in the period that offers above-average prices. This may not be the best strategy in any given year, but over time the producer should enjoy above-average results. In an industry that is frequently confronted with narrow, if not negative, profit margins, good marketing strategies are essential for the long-run survival of the firm.