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[1] 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.[2] 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.[3]

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.[4] 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

3/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).

4/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

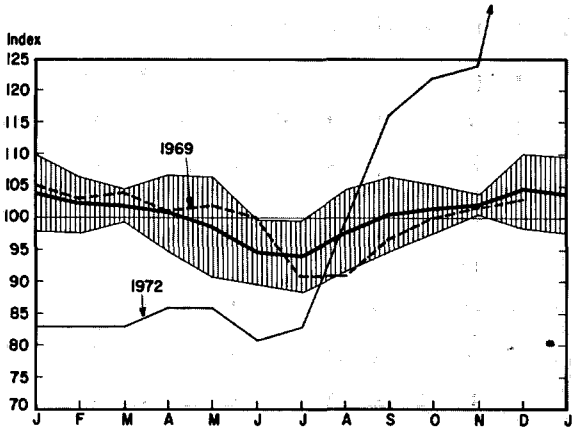


Chart 2
Soybeans-Missouri

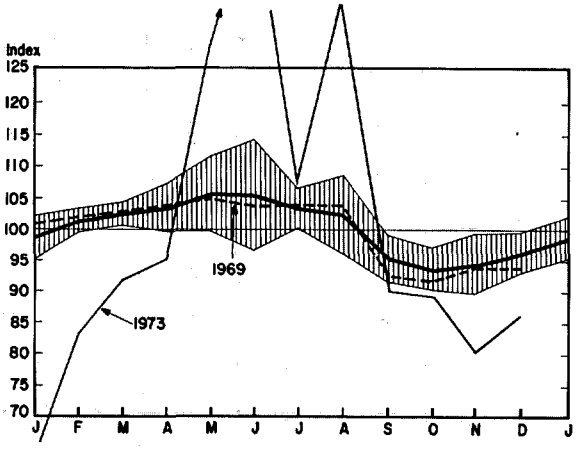


Chart 3
Corn-Nebraska

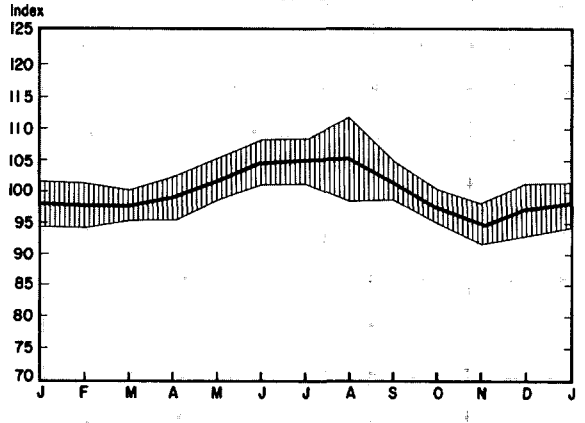


Chart 4
Slaughter Hogs-Omaha

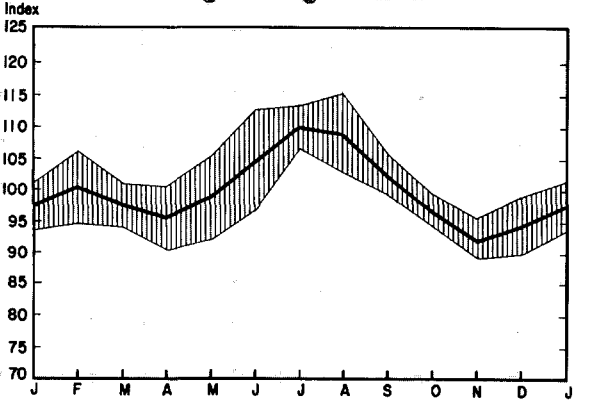


Chart 5
Feeder Cattle-Kansas City

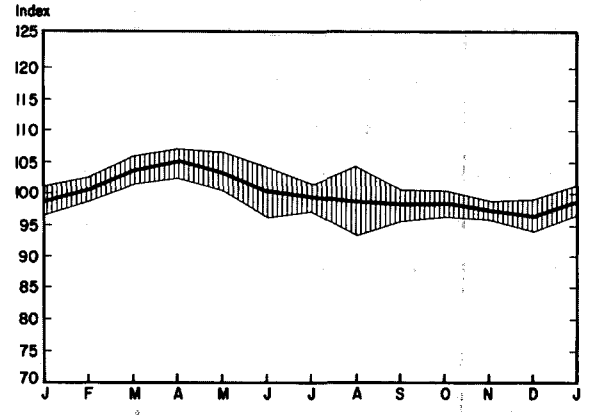
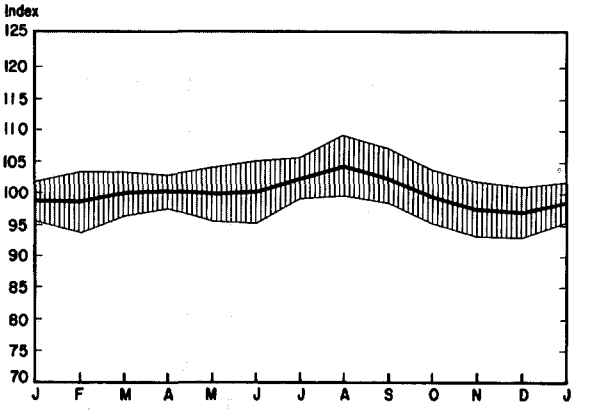


Chart 6
Slaughter Steers-Omaha



NOTE: The heavy black 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.

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.

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 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.

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

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.