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Factors Affecting Post Harvest Changes in Grain Prices Received By North Dakota Producers

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Highlights

Many factors are evaluated in a producer's decision about when to market grain. One of these is expected price changes due to a recurrent seasonal pattern. The theory of intertemporal prices suggests that intra-year changes are due to the normal seasonal pattern and unexpected changes in fundamental market variables. These patterns were identified and relationships estimated for prices received by North Dakota producers for hard red spring and durum wheat and barley. The results indicated that lows occurred during harvest and peaks were during October for barley and durum wheat and November for hard red spring wheat. Comparisons were made between the periods 1967/68 to June 1973 and 1973/74 to December 1980. The latter period differed from the former in that it was dominated by the export market. Results indicated there has been relatively more variability and less seasonality in the latter period. The relationship between variability in post harvest price appreciation and changes in estimates of market variables within the marketing year was estimated for each grain. The results indicated the extent that post harvest appreciation was affected by changes in market variables. It also allowed identification of the normal seasonal price rise. These were 5.6 percent from August to November for hard red spring wheat, 5.7 percent from August to October for durum wheat, and 12.9 percent from August to October for barley.

FACTORS AFFECTING POST HARVEST CHANGES IN GRAIN PRICES RECEIVED BY NORTH DAKOTA PRODUCERS

by

William W. Wilson*

Many factors affect timing of marketing decisions by grain producers. These include storage availability, opportunity costs of grain storage, taxes, cash-flow needs, participation in farm programs, and expectations of future trends in prices. The latter includes price changes due to both unexpected changes in fundamental market variables and the normal seasonal pattern. Similar factors also affect marketing decisions by processors. Likewise, the demand for marketing services (i.e., transportation, elevation, etc.) is derived from and responds positively to changes in grain prices. Understanding seasonal price behavior is important to each of the above participants making effective marketing decisions.

Seasonal price behavior refers to intra-year price variability which is recurrent over many years. At the beginning of the crop marketing year, supplies are abundant and generally known. There is also an array of expected demands for the remainder of the marketing year. Prices increase, or decrease, throughout the marketing year to allocate given supplies among the competing demands. Generally, the normal seasonal pattern in prices is for the low to occur at and immediately post harvest, increasing thereafter.

In several of the recent marketing years, prices have not followed their normal seasonal pattern. In the 1970's there has been tremendous growth in the demand for grain commodities. Export demand has grown much faster than domestic demand and has been more sporadic. Exports of all wheat, for example, increased from 738 million bushels in 1970/71 to an expected 1,525 million bushels to be exported in 1980/81. Growth in exports, however, has not been steady. Exports increased to 1,217 million bushels in 1973/74, decreased to 950 million bushels in 1976/77, and have since decreased. Domestic consumption has not grown as fast and has been less erratic. In the more volatile grain market of the 1970's, prices have not followed normal seasonal price patterns. Consequently, there has been more uncertainty in marketing decisions.

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Seasonal price patterns have been the subject of several previous studies. Peck analyzed seasonal patterns of prices received by producers in Indiana.[1] The seasonal low for hard red winter wheat occurred in July and the high in December. However, the seasonal pattern for wheat was relatively weak, i.e., deviations from the marketing year average price were relatively small. The period of study was 1960/61 through 1972/73 when the grain market was largely domestic and relatively stable. The study, however, was valuable because in it was developed a theory explaining intra-year price variability. It indicated that price changes in any particular year were functionally related to normal seasonal price pattern and any changes in fundamental market variables within the marketing year.[2] Trapp also evaluated seasonal price variability and estimated a relationship between returns to storage and fundamental factors at the beginning of the marketing year.[3] The results indicated that if the supply/demand ratio was greater than 1.5, returns to storage would be negative. A related study in North Dakota showed that seasonal price patterns for wheat in 1972 to 1976 differed from those in 1961 to 1972.[4] Seasonal indexes were calculated for each of the five principal classes of wheat. The results indicated there was a greater range and variation during the latter period. Secondly, seasonal highs and lows occurred earlier in the marketing year in the 1972 to 1976 time period.

The general purpose of this study is to describe seasonal behavior of wheat and barley prices received by North Dakota producers. Specific objectives are:

1) to calculate seasonal indexes of prices for hard red spring and durum wheat and barley received by North Dakota producers,

2) to examine variability in intra-year price trends,

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[1]Peck, A. N. and H. S. Baumes, Jr. Seasonal Price Behavior for Indiana Farm Commodities, Station Bulletin No. 90, Department of Agricultural Economics, Purdue University, West Lafayette, July 1975.

[2]Fundamentals used in this study refer to statistical series on supply, domestic demand, export carryover, etc.

[3]Trapp, J. N. "Guidelines for Making Commercial Wheat Storage Decisions," abstract, American Journal of Agricultural Economics: Proceedings Issue, 62 (December 1980) 5:1104.

[4]Thomson, D. E. Seasonal and Cyclical Patterns of Cash Wheat Prices for Crop Years 1961-72 and 1972-76, Agricultural Economics Miscellaneous Report No. 30, Department of Agricultural Economics, North Dakota State University, Fargo, October 1977.

3) and to evaluate the extent changes in fundamental market variables during the year cause seasonal price variations to deviate from the expected.

The study is an extension of previous studies in that seasonal indexes are calculated for recent years. Fundamental factors explaining changes in seasonal patterns in recent years also are presented.

Factors affecting seasonal price patterns and deviations from the norm are presented in the following section. Seasonal patterns and factors affecting seasonal patterns of prices are presented for hard red spring wheat, durum wheat, and barley in the remainder of the report. Results for each grain are discussed separately.

Sources of Seasonality in Grain Prices

Prices for grain commodities are typically low during and immediately post harvest and generally increase thereafter, peaking three to four months later. High prices in November, December, and January generally occur just prior to closing of the Great Lakes and Upper Mississippi Waterways. However, the rate of increase in prices from the normal low to the normal high varies from year to year. Prices have decreased throughout the marketing year in some cases. A simple theory of intertemporal price change, with applications to grains in North Dakota is developed in the present section.

A characteristic of grain commodities is that a surplus exists at harvest, which is consumed throughout the marketing year. To induce storage, prices increase and approximately cover the costs incurred in holding grain. Price appreciation throughout the market year is the return to storage. If over several years price increases are not sufficient to induce storage, there would be more harvest selling; prices would become depressed at harvest and would increase in the nonharvest period. Eventually, these price differentials would increase until they approximately covered the opportunity costs of holding the commodity. If over several years the price differential between the harvest and nonharvest periods exceeds the cost of storage, more grain would be stored at harvest for later sales. Prices would increase during the harvest period, decrease during the nonharvest period. The results would be a lower price differential. It is the potential for arbitrage which is the mechanism that ensures that over many years, intra-year price differentials are sufficient to remunerate those who store grain. In any particular year however, prices may increase more than the cost of storage, or even decrease. These anomalies are due to changes in fundamental conditions within the marketing year as demands are realized and differ from those initially expected.

There is basically one price for a crop and price differentials serve to allocate grain throughout the consumption period. These concepts are discussed below.[5] The following assumptions have been made for purposes of simplicity: two demand periods (i.e., harvest and post harvest); a supply function which is perfectly inelastic; no carryovers; and at the outset demands in both periods are the same and known with certainty. These assumptions simplify the following discussion and are by no means limiting. The concepts are discussed with reference to Figure 1.

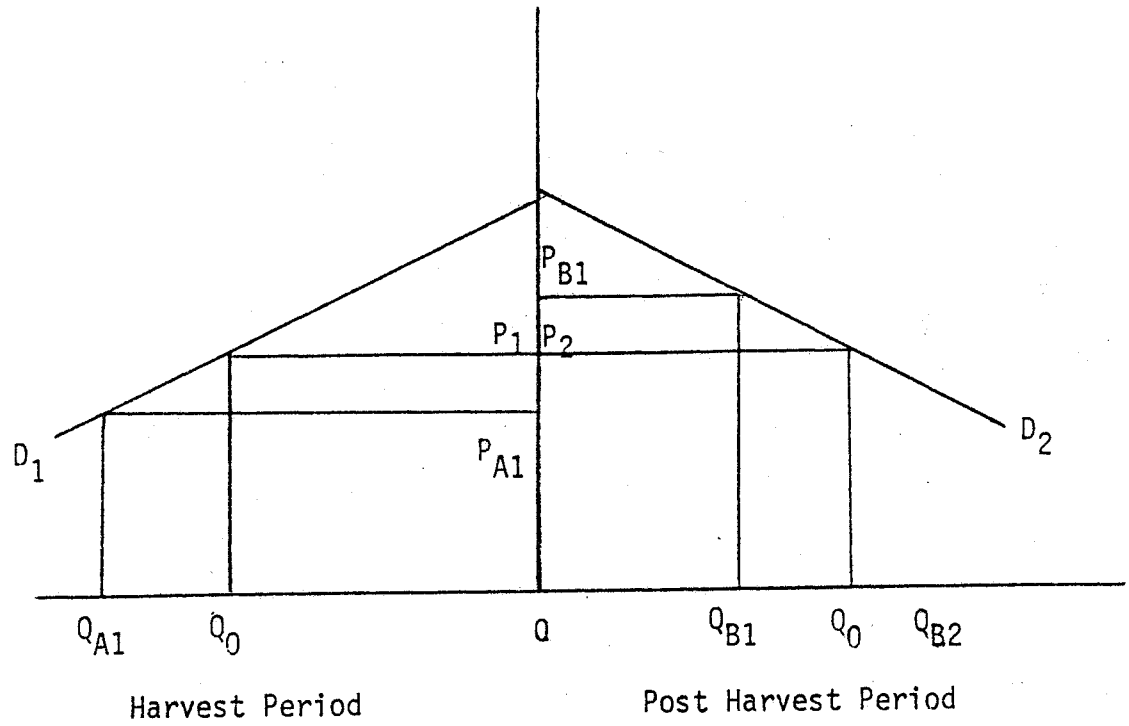

Figure 1. Two-Period Demand Case

D_1 and D_2 are expected demands in the two periods respectively and OQ_0 equals one-half of total supply. P_{01} and P_{02} are equilibrium prices in the two periods. With these initial prices, total supply is consumed in equal amounts (OQ_0) in

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[5] These concepts are credited in H. Working, "A Theory of Anticipatory Prices," American Economic Review, (May 1958), pp. 188-199; P. A. Samuelson, "Intertemporal Price Equilibrium: A Prologue to the Theory of Speculation," in J. Stiglitz (ed.) The Collected Scientific Papers of Paul A. Samuelson, Vol. 2, The MIT Press, Cambridge (1966), pp. 946-984.

each of the two periods. The resulting prices in each period are equal. Consequently, returns to storage would be nil with no market incentive to store the commodity between the two periods.

A positive price differential between the two periods is needed to induce storage. P_{A1} and P_{B1} are introduced in Figure 1 to represent a positive price differential. As a result, quantity demanded is greater in the harvest period than the post harvest period. If the price differential is sufficient to cover the cost of storage over several years, but does not exceed it, an equilibrium would evolve. The price differential would allocate consumption of given supplies throughout the two periods.

Uncertainty is introduced in the model by relaxing the assumption of known demands in the post harvest period. At the beginning of the marketing year supply estimates are fairly accurate and demands in the post harvest period are the biggest source of uncertainty. The model is demonstrated in Figure 2 with the actual post harvest demand function introduced as D_2^*. The expected demand function at the beginning of the marketing year, D_2, changed within the marketing period. In any marketing year the actual demand may increase, decrease, or stay the same relative to that initially expected. If the price differential remains at its normal seasonal level, $P_{A2} - P_{A1}$, quantity demanded in the post harvest period would be OQ_{B2}. Since in this case total demand ($OQ_{A1} + OQ_{B2}$) would exceed total supply [($OQ_0 + OQ_0$) = ($OQ_{A1} + OQ_{B1}$)], prices must increase in the nonharvest period to allocate the supply among the demands. The equilibrium price in the post harvest period would be P_{B2}. Thus, because actual demand was greater than expected in the post harvest period, the intra-year price differential ($P_{B2} - P_{A1}$) would exceed the normal seasonal price differential ($P_{B1} - P_{A1}$).

If the actual demand function in the post harvest period had evolved to be less than initially expected, the price differential would be less than normal ($P_{B1} - P_{A1}$). In fact, the post harvest demand function may decrease far enough relative to that initially expected so that a negative price differential would evolve between the two periods. Prices in the post harvest period would be less than those during the harvest period in this case. Similar conclusions can be drawn with respect to changes in total supply as projections become more precise.

Several concepts were developed in the discussion above. First, over many years there is a normal pattern of intra-year prices which increase throughout the marketing year to cover storage costs. Secondly, in any particular year intra-year price patterns deviate from the normal seasonal pattern because of

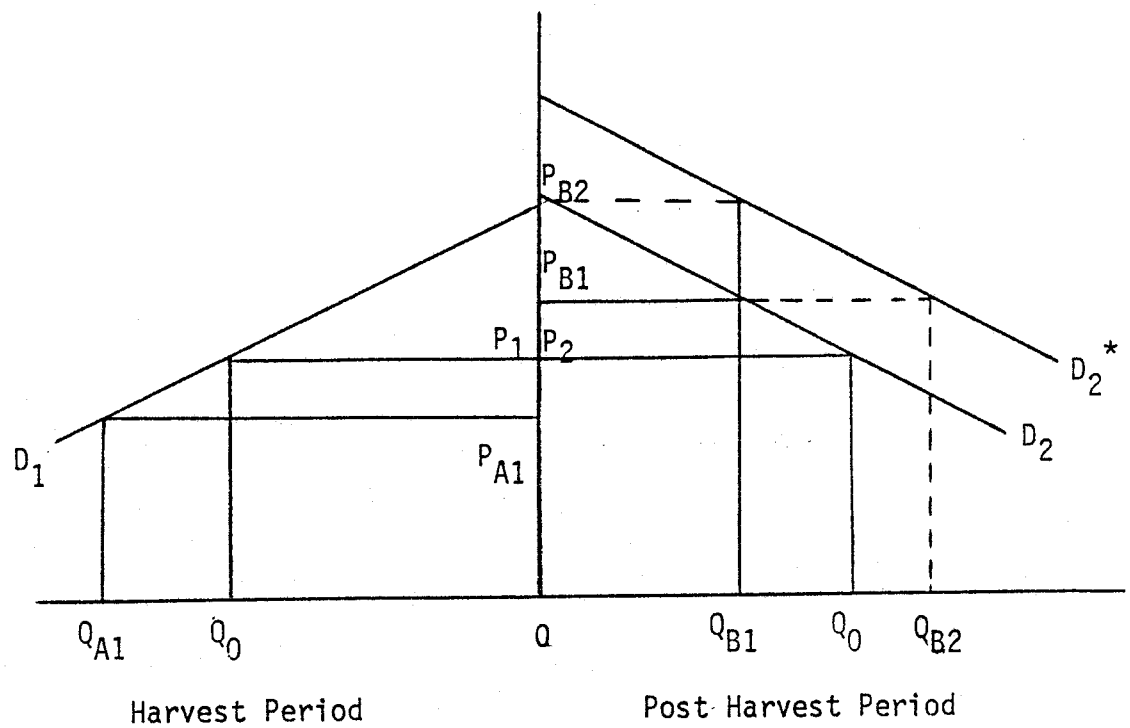

Figure 2. Two Period Demand with Unexpected Change in Demand in the Post Harvest Period

changes in fundamental supply and demand estimates as the marketing year progresses. Consequently, intra-year price variability is functionally related to normal seasonal price appreciation and changes in fundamental market variables within the marketing year.

Methodology

Two procedures were used to analyze intra-year price variability. First, seasonal and irregular variations in prices received by North Dakota producers were described using time series analyses. Normal seasonal patterns were developed using these relationships. Secondly, the relationship between variability in post harvest price appreciation and intra-year changes in supply and demand projections (i.e., changes in fundamentals) was estimated. The general methodology and data for each are discussed below.

Time Series Analysis

Generally, price movements through time are affected by four components. Trend is the long term direction of price movement and occurs over many years. It can be either increasing, decreasing, or constant. Cyclic movements are also longer term but refer to a wave-like movement which is recurrent. Cycles are

generally attributable to a response to changes in fundamentals which is lagged. Cycles are generally more common in livestock than in grains because of the implicit lagged supply response in the former. Seasonal price movements refer to intra-year price variations which occur every year in generally the same patterns. Seasonal price movements are due to events which happen annually at about the same time. Grain in the upper midwest is harvested during the late summer and early fall and much of the logistical system for export freezes soon after. The irregular component of time series data refers to variations which are unexpected and do not occur on a regular basis. These are due to unexpected events which are sporadic such as strikes, unseasonable weather, embargoes, etc. The relationship between these four components is shown in Figure 3. Price movements through time are affected by all four components. The purpose of time series analysis is to decompose a series of data so that individual components can be examined. Of particular importance in this study is the seasonal factor.

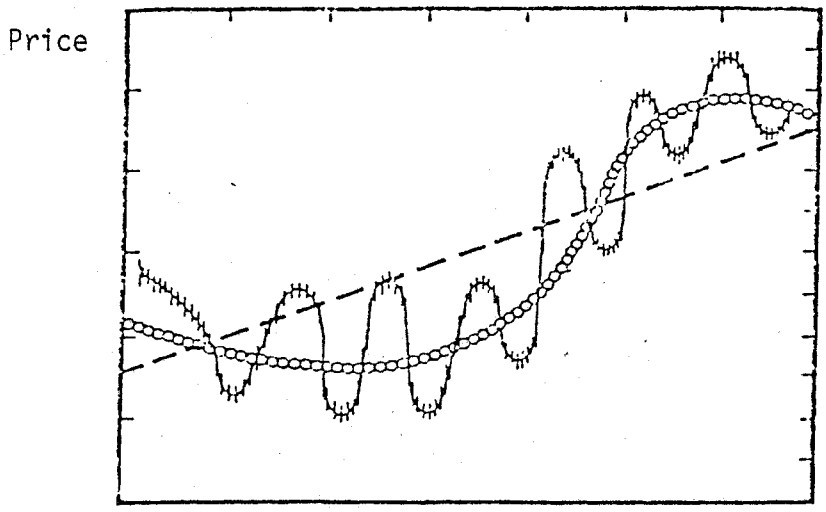

Figure 3. Four Components of Time Series Data

The general procedure for decomposition is as follows.[6] It is assumed that the four components affect each other multiplicatively. Calculation of a

[6]Readers interested in specific procedures are referred to W. W. Wilson and J. Crabtree, Seasonal Behavior of Marketing Patterns for Grain from North Dakota. Agricultural Economics Report No. 143, Department of Agricultural Economics, North Dakota State University, Fargo, March 1981.

12-term moving average approximates the trend cycle components. The original data divided by the moving average yield the seasonal-irregular ratio for each observation. To eliminate irregularity, the seasonal-irregular ratio is averaged over the series for each month. Specific procedures used in this study not only average over months but account for changes in the seasonal pattern over the time series. Thus, the irregular component and trends in seasonality were accounted for in calculating the seasonal factors.

Both the seasonal-irregular ratios (SI) and seasonal (S) factors allow for examination of recurrent intra-year price variability. Both have a base of 100 and can be interpreted as the percent of the average annual price. Thus, if S_t (or SI_t) were 95, prices in month t would be 95 percent of the marketing year average. If S_t exceeded 100, prices in that particular month t, would be greater than average. However, S_t is more refined as an indicator of seasonality than SI_t because the irregular component has been removed in the former. Examination of SI_t is important because it illustrates the relative variability in price for each month over the time series. The specific procedure used in this study was the X-11 Seasonal Adjustment Program.[7] The above procedures were applied to prices received by North Dakota producers for hard red spring wheat, durum wheat, and all barley. The study period was the 1967-68 crop year through 1980.[8]

Fundamental Analysis

Factors affecting variability in post harvest price appreciations were also analyzed. The theory of intra-year price appreciation indicated that prices increased from the normal seasonal low for two reasons. One is the opportunity cost of holding grain from harvest. The second is that changes in fundamental factors within the marketing year affect the extent of post harvest price appreciation. Fundamental factors refer to total supply, and domestic and export demand. Estimates of total supply and domestic demand are relatively accurate at the beginning of the marketing year. Projections of export demand however, are less accurate and frequently change within the marketing year.

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[7]For a detailed discussion of the X-11 procedure see United States Bureau of Census, The X-11 Variant of the Census Method II Seasonal Adjustment Program, Technical Paper No. 15, Government Printing Office, 1967 revision.

[8]Price data were taken from North Dakota Crop and Livestock Reporting Service, North Dakota State University, Agricultural Experiment Station. Various issues of Agricultural Statistics.

The model estimated for each of the three grains is as follows:

$$CHPR_t = a_0 + b_1 CHTS_t + b_2 CHTD_t + e_t$$

where $CHPR_t$ is the percentage change in price from the harvest period to the normal high in marketing year t; $CHTS_t$ and $CHTD_t$ are the percentage change in projections of total supply and total demand within the marketing year. In each case it was the third quarter projection (i.e., July or August) less the actual divided by the third quarter projection. Thus, the exogenous variables indicate the extent the projections were reflective of changes in the fundamental situation within the marketing year. e_t is the error term and is assumed normally distributed around mean zero.

The intercept term, a_0, is of particular importance. Its value represents the percentage change in prices if the values of the two exogenous variables are zero--i.e., if there were no changes in the fundamental market variables within the year. It thus represents the price rise from the harvest period to the normal high. The actual price change would be greater or less than a_0 if changes occur in one of the fundamental market variables, i.e., an unexpected change in projected exports.

Data on total demand and total supply projections and actual levels were taken from Wheat Situation and Feed Situation reports for wheat and barley, respectively. Fundamentals in all wheat were used for the analyses of both hard red spring and durum wheat. The initial projected supply and demand estimates are normally published in the July or August Situation report for that marketing year. Fundamental data used in this study are shown in the Appendix. Normal high prices for the marketing year were discerned from the time series analysis. The month with the highest seasonal index was selected as the normal high. The analysis used data from the 1962/63 to 1980/81 crop years.

Hard Red Spring Wheat

Monthly prices of hard red spring wheat received by North Dakota producers from the 1967/68 crop year to December 1980 have been plotted by crop year and are shown in Figure 4. Prices are listed in Table A1 in the appendix. Prior to the 1972/73 marketing year, intra-year prices were relatively stable. Prices were somewhat lower during harvest and increased thereafter. Beginning with the 1972/73 marketing year, prices exhibited much more intra-year variability as well as inter-year

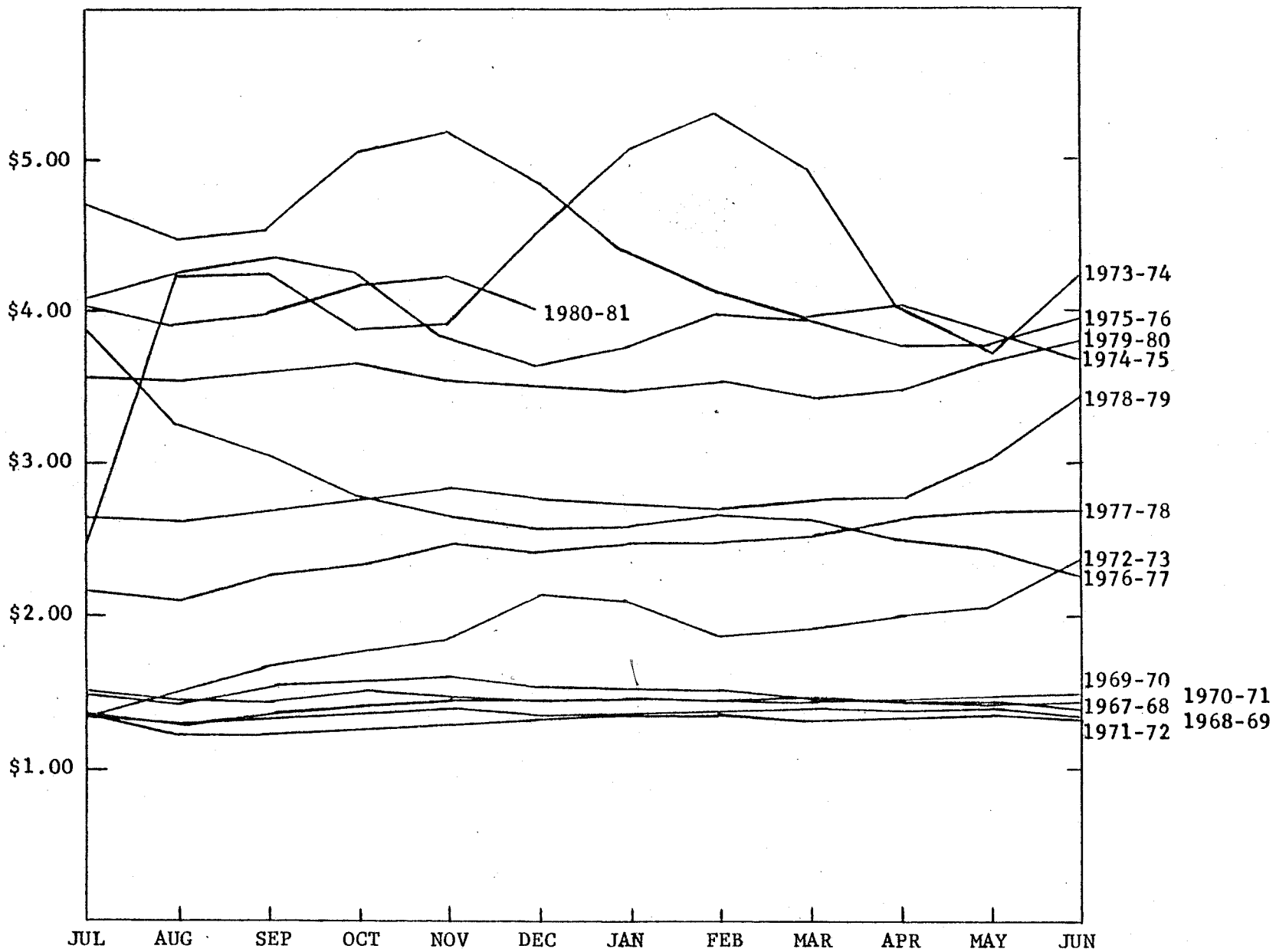

Figure 4. Hard Red Spring Wheat Prices Received by North Dakota Producers by Crop, 1967/68 to December 1980.

variability. Prices increased after harvest in each of the years through 1972/73 and in 1974/75, 1977/78, 1978/79, 1979/80, and 1980/81. Post harvest price decreases occurred in 1976/77 and to some extent in 1973/74. Mixed price changes occurred in the remaining years.

The purpose of time series analysis is to assess variability in data and isolate that which is recurrent from year to year. Seasonal-irregular ratios were calculated for hard red spring wheat prices and the monthly averages are graphed in Figure 5. The average seasonal-irregular ratio for each month over the time series is a general indicator of seasonality. Seasonal-irregular ratios for each month of each year are listed in Table A2 in the appendix. The low price, on average, occurred in May, at 96.9 percent of the marketing year average, and increased thereafter. Prices in August were 99.1 percent of the marketing year average and those in October and November were 103.0 and 102.9 percent of the marketing year average, respectively. Prices remained above the marketing year average from September through February. Analysis of variance was used to test whether these differences were statistically significant, and they were. Consequently, the observed seasonality was significant. Standard deviations were calculated for each month and were used to derive confidence intervals. These are also shown in Figure 5. The results indicate that prices are relatively more irregular during May, June, July, and August. Irregularity in prices during the remaining months was relatively less, especially in October and March.

Seasonal indexes were calculated from the seasonal-irregular ratios by removing the irregular component. Implicit trends in the seasonal indexes for each month also were computed and used to calculate indexes one year ahead. Irregular observations were removed or weighted and trends were incorporated to calculate the seasonal index for each month.[9] For example, observations such as January to September of 1973 were replaced by an average because they were under the influence of large export sales and thus, were irregular. The results are shown in Table 1. Prices increase after harvest and reach a peak in October and November. Seasonal indexes for October and November are expected to be 103.0 and 103.1, respectively, during the 1981/82 marketing year. Prices in January through May are less than the crop year average with March expected to be the least. A comparison of seasonal

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[9]Specific procedures are discussed in United States Bureau of Census, op. cit.; and W. W. Wilson and J. Crabtree, op. cit.

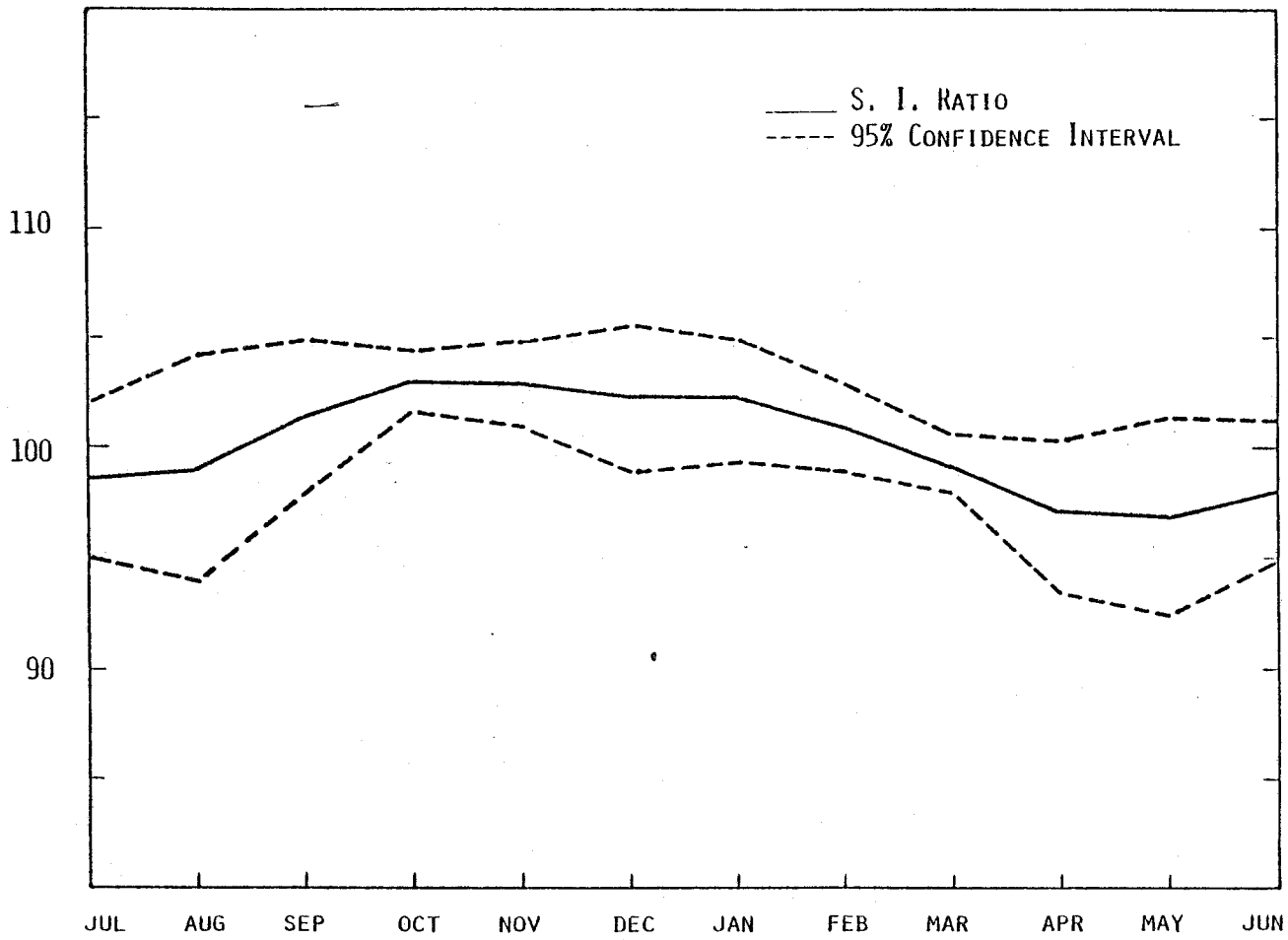

Figure 5. Seasonal-Irregular Ratios for Hard Red Spring Wheat Prices Received by North Dakota Producers 1967/68-1980.

TABLE 1. SEASONAL INDEXES FOR HARD RED SPRING WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	98.1	93.9	97.8	101.9	103.0	101.5	102.2	101.1	100.8	100.2	100.3	99.0
1968/69	98.1	93.8	97.8	101.9	103.2	101.8	102.4	101.3	100.6	99.9	99.9	98.7
1969/70	97.7	93.8	98.2	102.1	103.6	102.4	103.3	101.5	100.1	99.2	99.0	97.9
1970/71	97.5	94.2	98.9	102.5	103.5	103.3	104.7	101.4	99.5	98.2	97.5	96.3
1971/72	97.6	95.2	99.8	103.4	103.4	104.2	105.7	101.1	98.8	97.4	96.0	94.7
1972/73	98.3	96.7	100.7	104.3	102.5	104.4	105.7	100.8	98.7	96.9	95.4	93.7
1973/74	99.2	98.1	101.4	104.8	101.6	103.6	104.8	100.6	98.9	97.1	95.6	93.7
1974/75	100.3	99.1	101.9	104.4	100.6	102.1	103.2	100.5	99.4	97.9	96.8	94.9
1975/76	101.1	99.3	101.7	103.7	100.4	100.7	101.2	100.1	99.6	98.6	98.1	97.1
1976/77	101.4	99.2	101.5	102.9	100.6	99.5	99.5	99.8	99.4	98.8	99.3	99.4
1977/78	101.6	98.8	101.0	102.3	101.3	99.0	98.6	99.4	98.9	98.5	99.9	101.1
1978/79	101.6	98.8	101.0	102.3	102.1	99.0	98.4	98.7	98.1	98.0	100.0	101.9
1979/80	101.8	98.7	100.7	102.5	102.8	99.4	98.3	98.1	97.5	97.8	99.9	102.1
1980/81	101.7	98.9	100.7	102.8	103.0	99.5	--	--	--	--	--	--
Seasonal Indexes One Year Ahead	July	August	September	October	November	December	January	February	March	April	May	June
1981/82	101.7	99.0	100.7	103.0	103.1	99.6	98.3	97.8	97.1	97.6	99.9	102.2

indexes for several months over the time series indicates that seasonal behavior of prices has changed slightly. Generally, there is less seasonality and the peaks have shifted in more recent crop years relative to earlier periods. For example, the seasonal index for August increased from 93.9 in 1967 to 98.9 in 1980. Similar increases occurred in June, July, and September. Seasonal indexes in January decreased from 102.2 in 1968 to 98.3 in 1980. Similar decreases occurred in February, March, April, and December in recent years. Consequently, there appears to be less seasonal price variability in recent marketing years relative to the earlier years.

Time series analyses were also applied separately for the first half and second half of the series. The results indicate there was less seasonality and more variability during the later period relative to the former. Differences between months were significant in the 1967/68 to 1972/73 period. The seasonal-irregular ratio averaged for August was 93.7 and subsequently increased to a peak of 103.8 in December and 103.4 in January. During the period containing the most recent six years, the seasonal-irregular ratio averaged in August was 102.1. It increased slightly in September and October to 102.8 and 102.6, respectively, and then decreased. These ratios were not statistically different than each other during the latter period.

Post harvest price appreciation for each year since 1962/63 was analyzed further. Prices decreased between August and November in 1973/74 and 1976/77 and in each year were associated with bearish changes in fundamental market variables. For example, ending stocks in 1973/74 were originally projected at 298 million bushels but actually evolved to be 339 million bushels. Similarly, ending stocks at the outset of the 1976/77 marketing year were projected to be 760 million bushels but actual ending stocks turned out to be 1,112 million bushels. Normally prices increase from August to November but larger than normal increases occurred in 1970/71, 1972/73, 1974/75, and 1977/78. In each of these years there were bullish changes in fundamentals within the crop year. For example, exports were originally projected to be 675 million bushels in 1970 but were actually greater at 738 million bushels. Prices increased by 12.5 percent from August to November in that year. Prices appreciated by 22.67 percent between August and November in the 1972/73 market year. Projected supplies were relatively accurate in that marketing year but export demand increased from a projected 800 million bushels to 1,186 million bushels. Prices increased 17 percent between August and November in the 1977/78 marketing year and there were corresponding bullish changes in fundamentals.

Post harvest price appreciation averaged over several years, approximates the opportunity cost of holding grain. However, in any particular year, changes in fundamental market variables from those originally projected also affect the extent prices rise or fall after harvest. The following statistical model was estimated to explain variability in post harvest price changes for hard red spring wheat:

$$CHPR_t = \underset{(2.86)}{5.609} - \underset{(2.98)}{2.226}\ (\overline{CHTS}) + \underset{(2.72)}{0.565}\ (CHTD)$$

$R^2 = .55$
$F = 9.83$
D.W. = 1.95

t statistics are in parentheses. $CHPR_t$ is the percentage change in hard red spring wheat prices between August and November (i.e., the normal low and normal high), and $CHTS_t$ and $CHTD_t$ are the percentage that supply and demand projections for all wheat changed during the marketing year. All coefficients are significant at the 5 percent level or greater and the overall equation is significant. Signs of the coefficients are as expected.

The intercept term indicates the extent prices change after harvest assuming the fundamental market variables do not (i.e., if supply and demand estimates remain as those projected at the beginning of the marketing year). It indicates that average price increases were 5.6 percent between August and November assuming that the fundamental market variables remain as initially projected. It therefore approximates normal returns to storage. However, the extent prices appreciate would be different if changes in fundamental market variables occur after the beginning of the marketing year. Specifically, if total supply projections decreased by 1 percent, prices would appreciate 2.2 percent more than normal (i.e., 7.8 percent). Similarly, if demand projections increased by 1 percent, the post harvest price appreciation would increase by 0.56 percent greater than normal (i.e., 6.16 percent).

Actual and estimated values of post harvest price appreciation are shown in Figure 6. Change in prices between August and November ranged from negative values to +23 percent. Values estimated from the equation all indicate the correct direction. Explanatory power of the equation seems relatively good considering other random influences also affect post harvest price changes. Factors such as government programs and constraints in the logistic and transportation system were excluded but appear to be individually relatively unimportant.

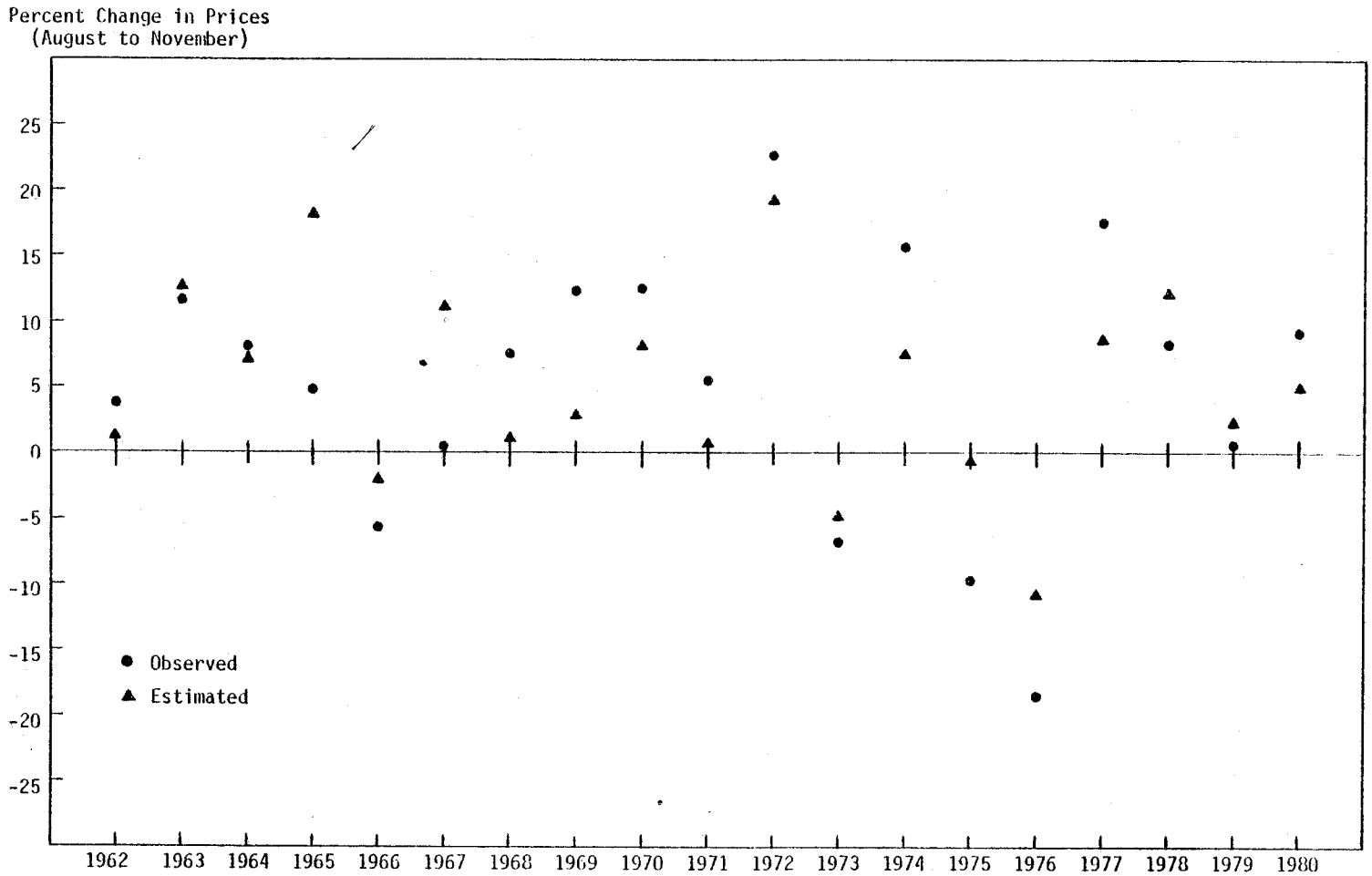

Figure 6. Actual and Estimated Values of Post Harvest Changes in Hard Red Spring Wheat Prices Received by North Dakota Producers, 1962-1980.

Models were also estimated using fundamental data specific to hard red spring wheat, world wheat data, and various combinations thereof. The results presented above were the most consistent. The model also was estimated using changes in carryovers as the fundamental statistic instead of changes in total supply and total demand. Generally, the results were similar to those above and the size of this intercept term was similar. The estimated equation was:

$$CHPR_t = \underset{(3.01)}{4.89} - \underset{(4.47)}{0.3302}\ (CHCA_t)$$

$R^2 = .54$
$F = 9.83$
D.W. = 1.95

Where $CHCA_t$ is the percentage change in carryover from those originally projected.

Durum Wheat

Monthly prices received by North Dakota producers for durum wheat are plotted by crop year in Figure 7 from 1967/68 through December 1980. These prices are listed in Table A3 in the Appendix. Prices have normally been at a marketing year low in August and increase thereafter. Post harvest price increases occurred in 1967/68, 1968/69, 1970/71, 1971/72, 1973/74, 1974/75, 1977/78, 1978/79, and 1979/80. The actual high however, varied across the years, occurring sometime between October and the spring months.

Time Series analysis was used to assess intra-year price behavior. Monthly average irregular ratios for durum wheat prices are shown in Figure 8. Ratios for individual months of each year are listed in Table A4 in the appendix. The monthly average seasonal-irregular ratio is an indicator of relative prices within a year. If the ratio is less than 100, prices in that month are less than the marketing year average, and vice-versa. Prices are lowest during June and increase after that, peaking in October. Prices in August were greater than the marketing year average. Analysis of variance was used to test whether the monthly seasonal-irregular ratios were statistically different or due to chance. The analysis indicated that these differences were not significant at the 1 percent level. Despite the means being different, irregularity in monthly prices is great enough that no evidence of stable seasonality was found. Standard deviations were calculated for each month as a measure of variability and used to calculate 95 percent confidence intervals. The results are also shown in Figure 8. Variability in prices was large during the May through September period and relatively less in the remaining months. The confidence intervals ranged from 89 to 153 in August but only from 96 to 104 in February. An

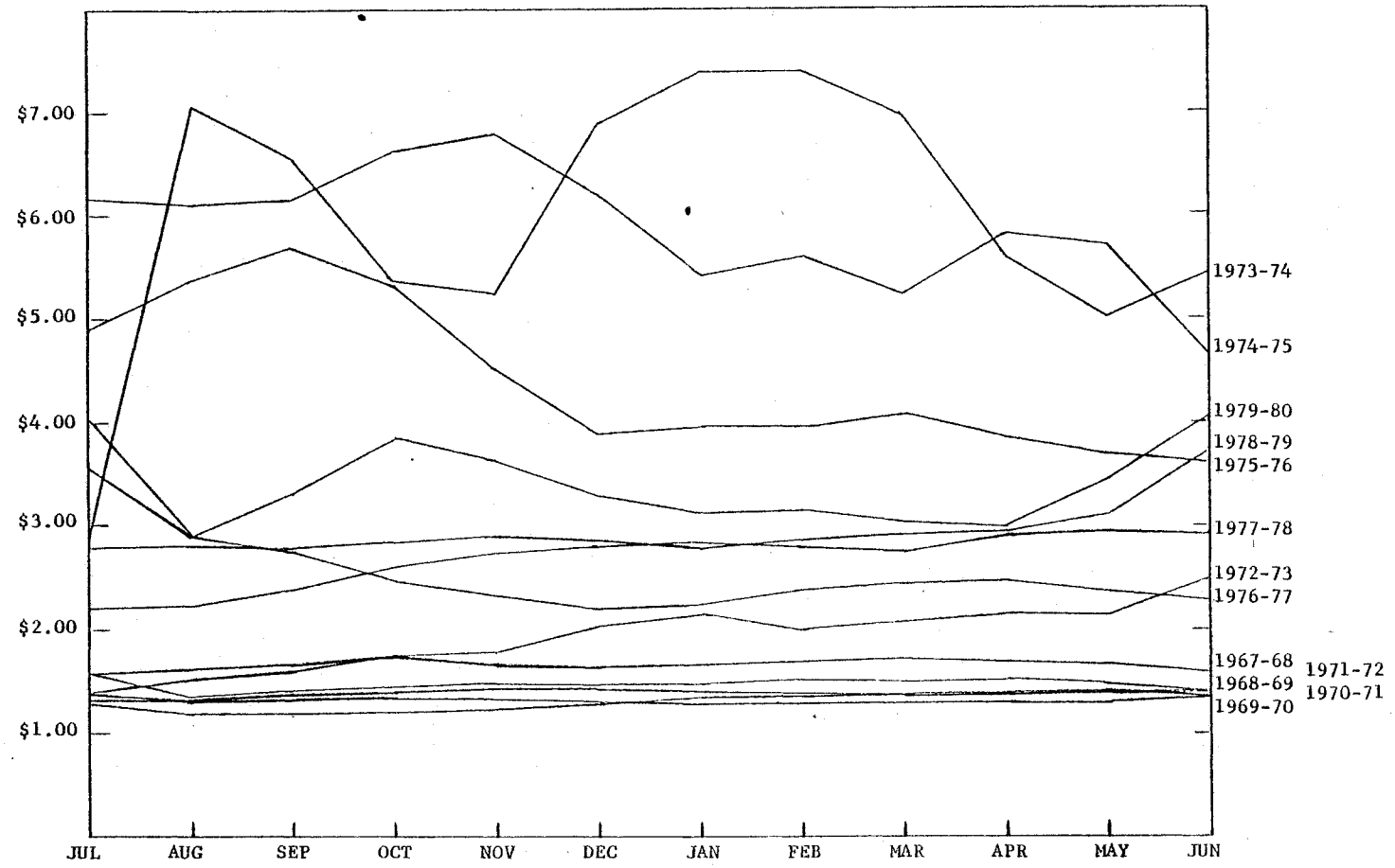

Figure 7. Durum Wheat Prices Received by North Dakota Producers by Crop Year, 1967/68 to December 1980

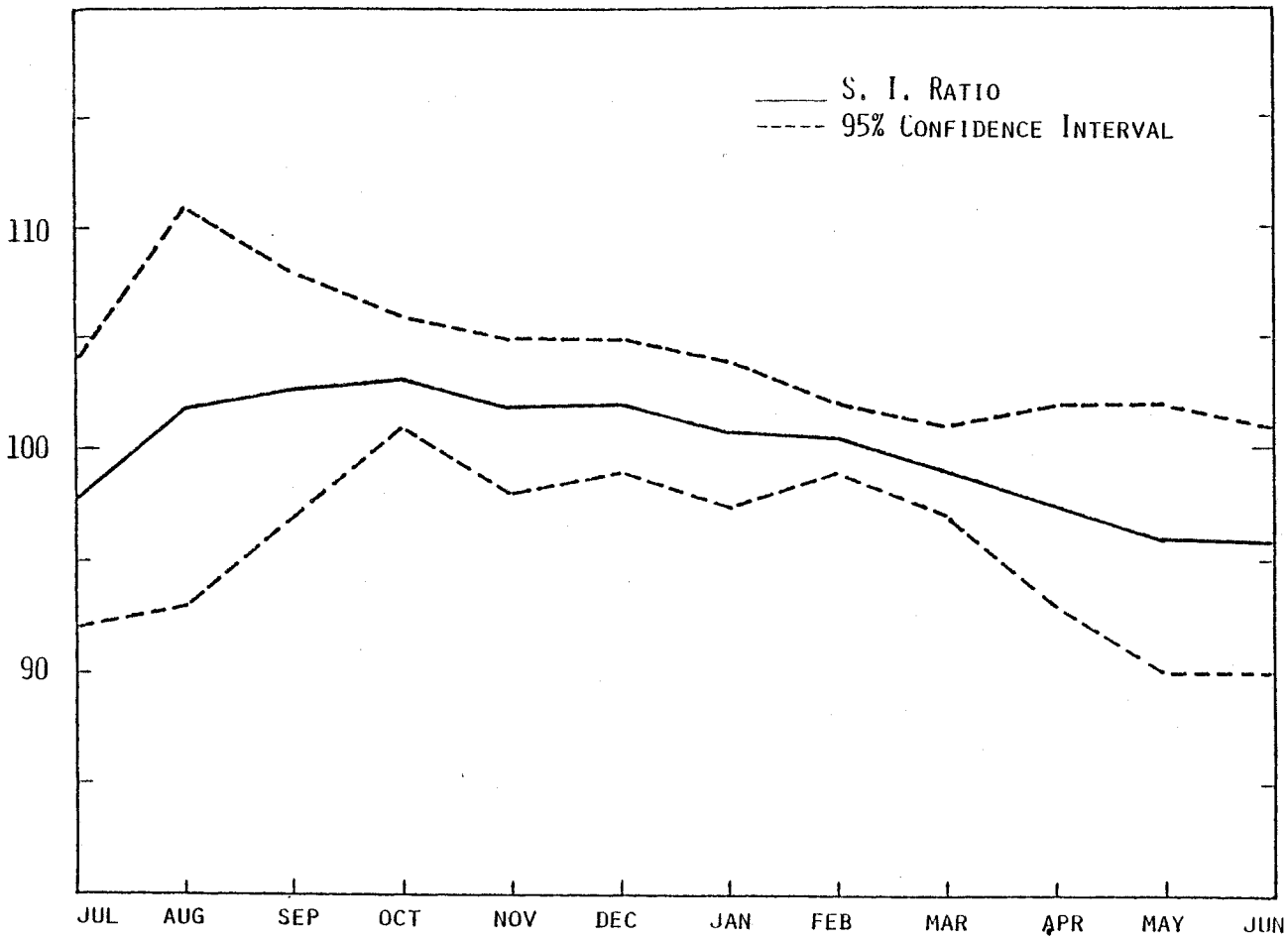

Figure 8. Seasonal-Irregular Ratios for Durum Wheat Prices Received by North Dakota Producers, 1967/68-1980.

important point is that 100 is included in the confidence intervals for each month, thereby reinforcing the absence of significant seasonality. Consequently, in light of the irregularity in durum prices, seasonal price movements have not been significant over the time series.

Seasonal indexes were calculated by removing the irregular component and are better indicators of seasonal price behavior. The results are shown in Table 2. In the recent marketing year, prices in August were 98.2 percent of the average and increased to 105.4 percent in November. In other words, prices appreciated 7.2 percent during the immediate post harvest period. The results indicate that the seasonal pattern has been changing. Indexes for August increased in the latter 1970's relative to the 1960's. Similar increases occurred in September and November. Indexes for January, February, and March have tended to decrease in the 1970's relative to the 1960's. Generally, the seasonal low in recent years has not been as low as it was in the late 1960's and early 1970's. Seasonal highs are slightly higher than during the earlier period, but they occur earlier in the marketing year. In recent years they have occurred in October or November vis-a-vis later months. Based on the trends in monthly indexes, those for August and November of 1981 are expected to be 98.3 and 105.6, respectively.

Seasonal-irregular ratios were calculated separately for the periods July 1967 to June 1973 and July 1973 to December 1980 to demonstrate changes which have taken place in intra-year durum prices. Ratios in the earlier period were at a low in August at 94, increased thereafter, and peaked at 103.2 in January. The seasonal pattern was stable and significant during that period. In the latter period ratios for August and January were 105.5 and 97.2, respectively. There was more irregularity in the latter period and the differences were not statistically different.

Fundamental market variables affect intra-year durum price changes similar to those discussed regarding hard red spring wheat prices. Generally, durum prices increase from August to October, but changes in fundamental market variables affect the direction and extent of these changes. The estimated model explaining intra-year durum price changes is as follows:

$$\underset{}{CHPR_t} = \underset{}{5.68} - \underset{(3.42)}{2.69}\ (CHTS_t) + \underset{(-2.84)}{0.1618}\ (CHTD_t) \qquad \underset{(0.82)}{} \qquad R^2 = .35,\ F = 4.62$$

t statistics are shown in parentheses. $CHPR_t$ is the percent change in durum prices from August to October, $CHTS_t$ and $CHTD_t$ are percent changes in total supply and total demand, respectively, of all wheat from the beginning of the marketing year to the end.

TABLE 2. SEASONAL INDEXES FOR DURUM WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	98.7	94.0	97.3	100.2	101.5	100.5	101.1	102.3	102.1	102.2	101.1	98.8
1968/69	98.6	94.0	97.4	100.3	101.6	100.9	101.5	102.3	101.7	101.7	100.7	98.5
1969/70	98.1	94.4	97.7	100.5	101.8	102.1	102.8	102.2	101.0	100.1	99.8	97.9
1970/71	97.5	95.4	98.5	100.9	101.5	103.8	104.5	102.2	100.2	97.9	98.3	96.4
1971/72	97.2	96.8	99.6	101.8	101.5	105.8	105.3	102.0	99.0	96.1	97.3	94.4
1972/73	97.1	98.6	101.3	102.8	101.0	106.7	104.9	101.6	98.6	95.5	96.9	93.1
1973/74	97.5	99.8	102.5	103.6	100.8	106.4	103.2	101.0	98.5	96.2	97.5	92.9
1974/75	97.9	100.3	103.4	103.8	100.3	104.8	101.2	100.5	99.0	97.7	98.4	94.0
1975/76	98.5	99.9	103.1	103.8	100.8	103.0	98.9	99.8	99.0	99.4	99.4	96.1
1976/77	99.0	99.1	102.8	103.5	101.7	101.2	97.5	99.0	98.8	100.4	99.4	98.8
1977/78	99.8	98.3	102.1	103.1	102.9	100.3	97.0	98.3	98.1	100.5	98.7	100.9
1978/79	100.4	97.9	101.9	102.9	104.0	100.4	97.2	97.8	97.2	99.8	97.7	102.0
1979/80	101.1	97.9	101.7	102.8	105.0	101.0	97.3	97.6	96.3	99.4	97.2	102.1
1980/81	101.1	98.2	101.8	102.8	105.4	101.3	--	--	--	--	--	--
Seasonal Indexes One Year Ahead 1981/82	101.2	98.3	101.9	102.9	105.6	101.4	97.3	97.4	95.9	99.2	97.0	102.2

The equation was adjusted for first-order autocorrelation using 0.5124 which was the estimated coefficient. All the coefficients have the expected sign and are significant except for $CHTD_t$ and the overall regression is significant at the 5 percent level.

The intercept term indicates the percentage change in durum prices from August to October if changes in the other variables are zero. Thus, it indicates that durum prices would increase 5.68 percent between August and October as long as fundamental market variables do not change. Post harvest price appreciation would be greater than or less than 5.68 percent if a change occurs in the market variables. If total supply increases from that initially projected, price appreciation would be less. For every 1 percent that actual total supply deviates from that initially projected, intra-year price appreciation would change by 2.69 percent. The estimated coefficient for $CHTD_t$ was not significantly different than zero. It indicates that changes in demand projections for all wheat have little effect on durum price appreciation in the fall of the marketing year.

Actual versus estimated post harvest price changes are shown in Figure 9. Actual post harvest price changes ranged from -18.4 percent in 1976 to 22.7 percent in 1972. Estimated price changes, while not precise, do not have the correct sign in all years except 1971. In that year prices increased 5.69 percent between August and October, but the model estimated a decrease of 2.05 percent.

Attempts to use durum-specific fundamental data yielded insignificant results. Further, some of the data were not published for some of the variables. Of particular importance were projections for the demand for durum at the beginning of the marketing year which were not made in the 1967/68 to 1976/77 marketing years.

All Barley

Barley is interesting because it exhibits less irregularity and more seasonality; consequently, returns to storage are greater and risks are less relative to those in wheat. Barley prices received by North Dakota producers from 1967/68 to December 1980 are graphed in Figure 10. The prices are listed in Table A5 in the appendix. Prices are normally at a marketing year low at harvest, subsequently increase, and peak sometime between October and February. Prices were lowest during harvest for all marketing years except for 1967/68, 1975/76, and 1976/77. Months in which the highs occurred varied from year to year but normally occurred during or after October.

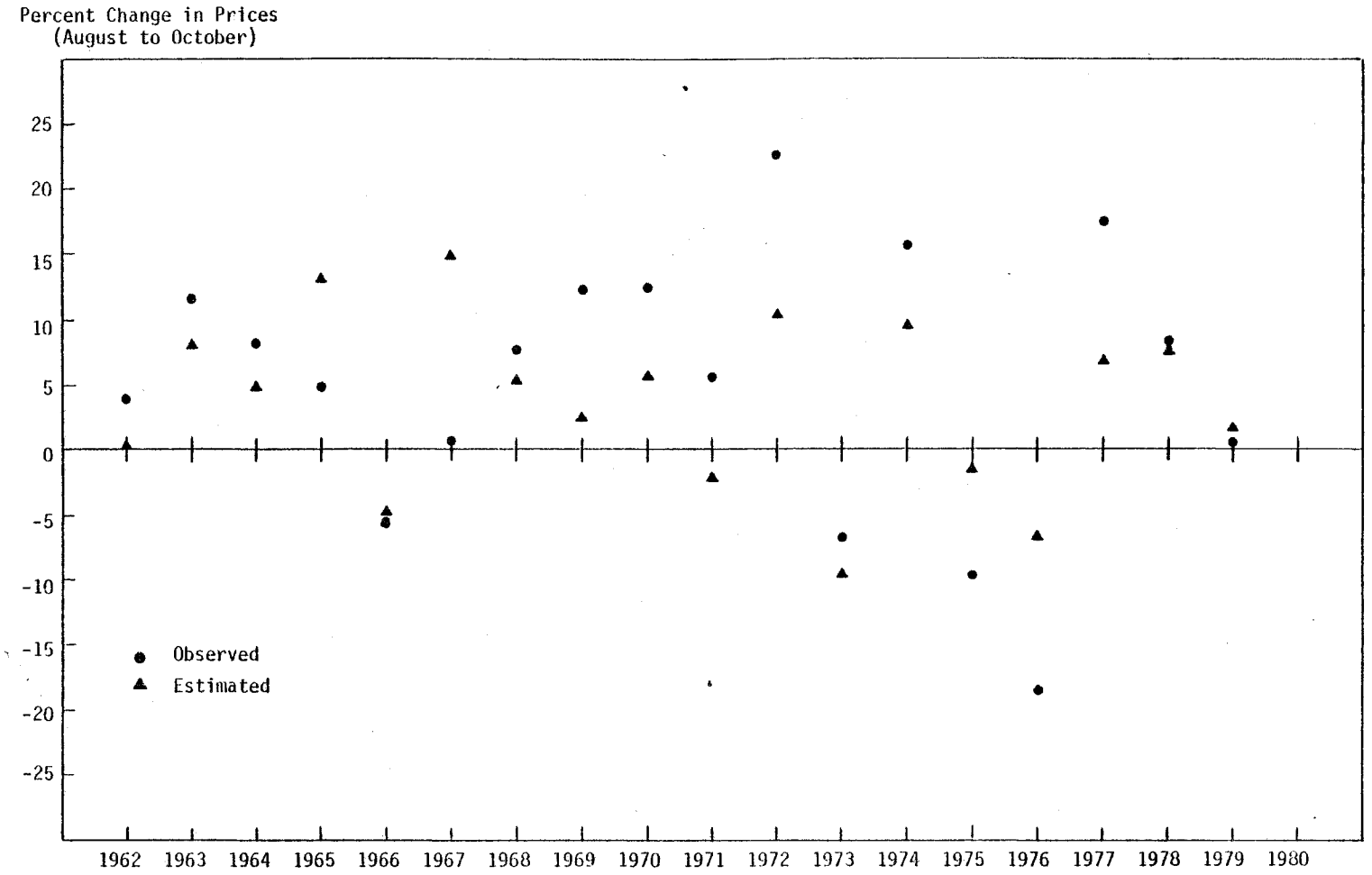

Figure 9. Actual and Estimated Values of Post Harvest Changes in Durum Wheat Prices Received by North Dakota Producers, 1962-1980

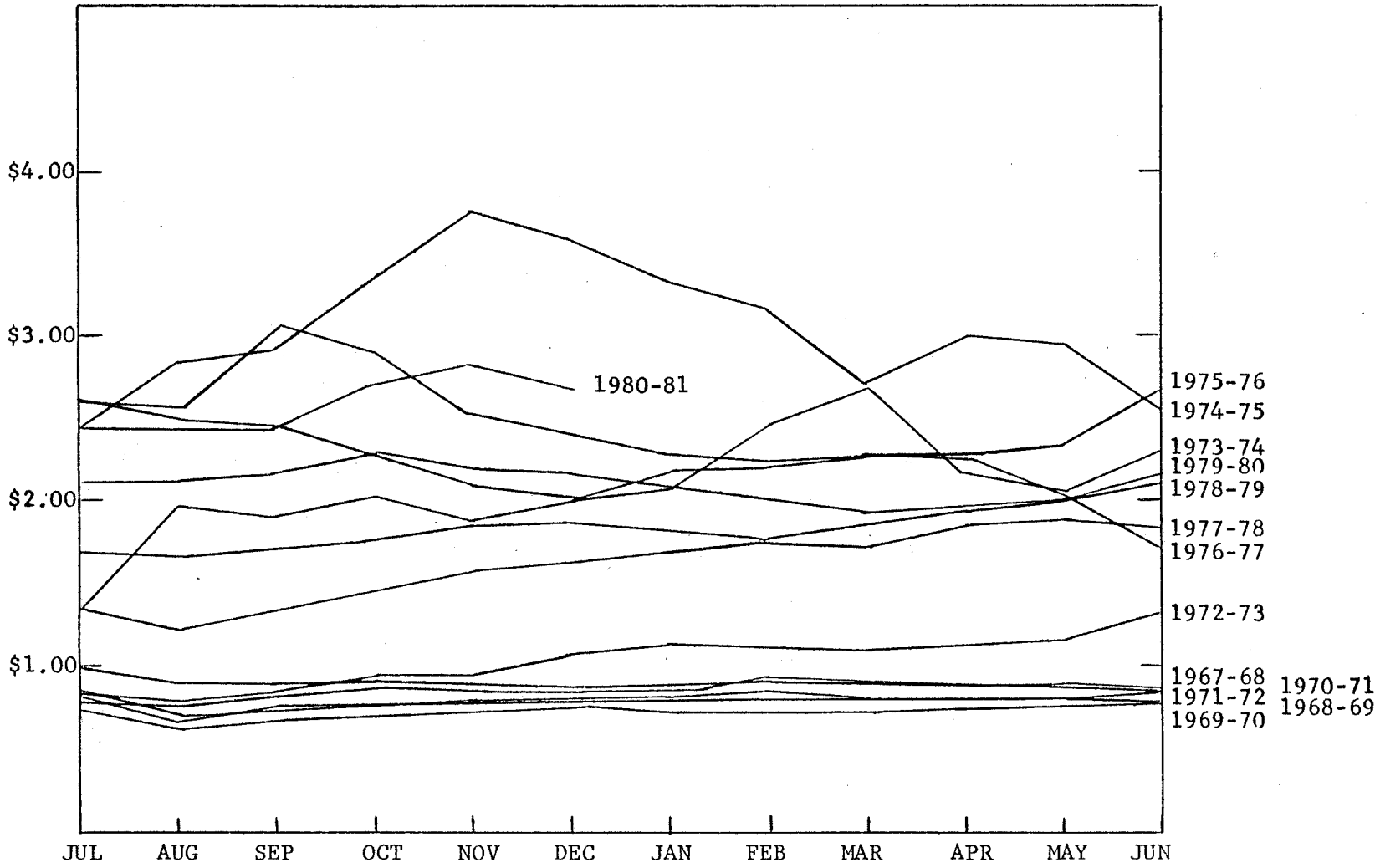

Figure 10. All Barley Prices Received by North Dakota Producer by Crop Year, 1967/68 to December 1980.

Time series analysis was used to assess irregular and seasonal behavior in barley prices. Monthly average seasonal-irregular ratios for all barley are shown in Figure 11. Ratios for individual months are listed in Table A6 in the appendix. The monthly average seasonal-irregular ratio is a good approximation of the relative intra-year variability in prices. Lows occurred in August at 94.1 and later increased. Peaks occurred in October and again in Feburary at 102.4 and 102.8, respectively. Analysis of variance was used to test whether these differences were statistically significant, and they were. Standard deviations were calculated for each month and used to calculate confidence intervals. The results are also shown in Figure 11. Variability was greatest during August with a range of 81.6 to 114.9. Large increases in prices occurred after August and generally stayed about the same between October and February.

Seasonal indexes are a more refined indicator of seasonality because the ratios are averaged and extreme values have been replaced. Seasonal indexes for barley prices are shown in Table 3. In the 1980/81 marketing year, seasonal index was 95.6 in August and peaked at 103.8 in November. Similar patterns occurred in other years except the peaks may have been in later months. Barley prices have become somewhat less seasonal in recent years. Indexes for August, November, and December have increased since the earlier years of the time series. Likewise, indexes for January, February, and March have decreased in recent years. Thus, months with low indexes are not quite as low as in the late 1960's and early 1970's. Also, the seasonal high occurs in November, as opposed to January, February, and March which were traditionally the months with high prices.

Seasonal-irregular ratios were also calculated separately for the two periods July 1967 to June 1973, and July 1973 to December 1980. Seasonal-irregular ratios in the former period ranged from a low in August of 88.4 to a high in February of 104.7. Irregularity was minimal and seasonality was significant. Seasonal-irregular ratios for the 1973-1980 period indicated the low occurred in July at 93.7 and increased to 104.3 in October. In the latter period the observed monthly difference was not statistically significant.

For purposes of analysis, the normal low and normal high for barley prices were August and October, respectively. Barley prices increased every year between August and October except for 1962/63 and 1976/77. In 1962/63 prices decreased from $.79 to $.78/bushel and in 1976/77 prices decreased from $2.50 to $2.29/bushel. Increases occurred in the remaining years and the average rate of increase was 9.2 percent. Statistical analysis was used to estimate the relationship between

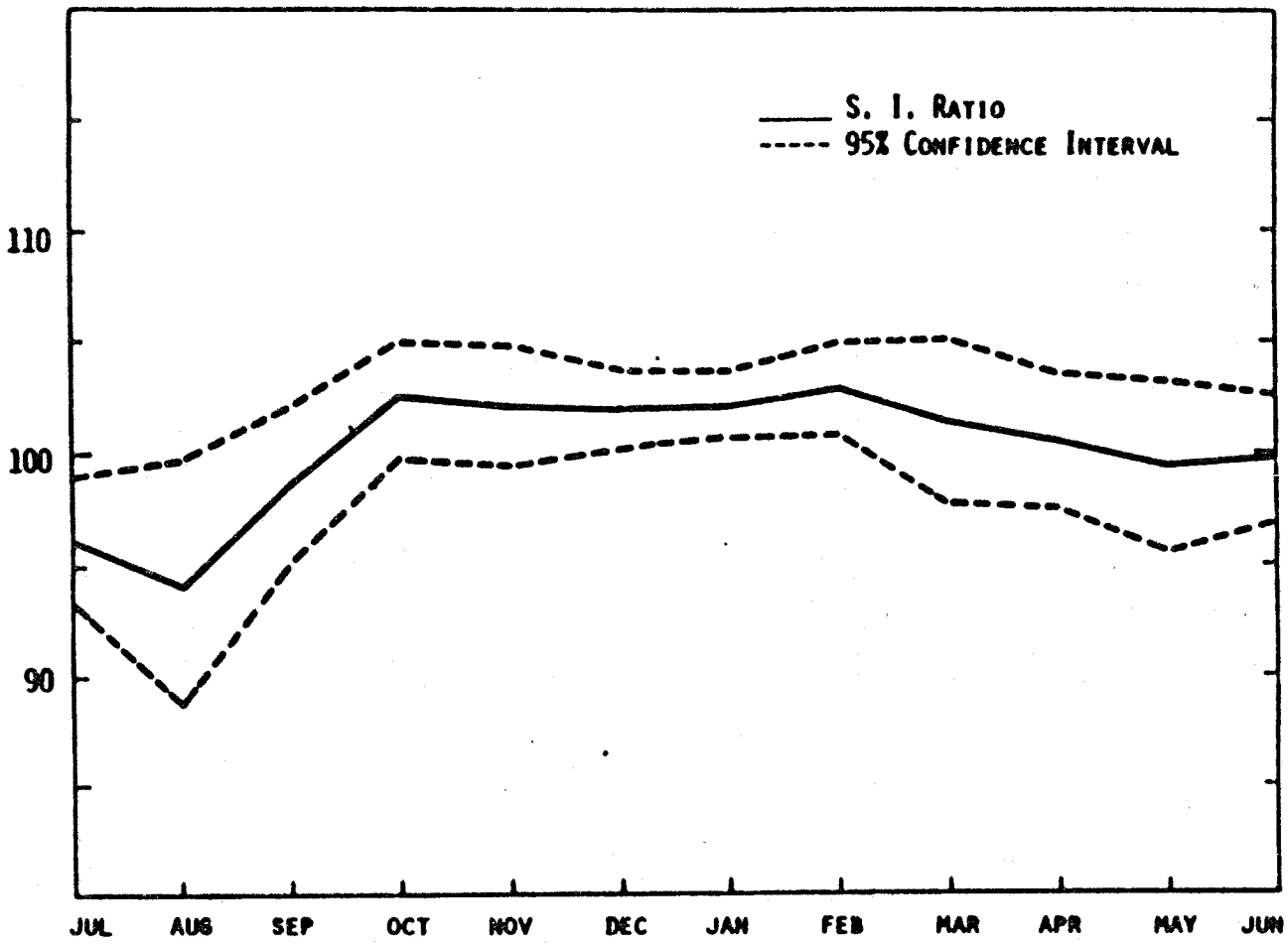

Figure 11. Seasonal-Irregular Ratios for All Barley Prices Received by North Dakota Farmers, 1967/68-1980.

TABLE 3. SEASONAL INDEXES FOR ALL BARLEY PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	97.7	90.5	95.3	98.7	101.1	100.7	102.0	103.6	102.8	102.3	103.2	102.7
1968/69	97.8	90.5	95.2	98.8	100.3	100.9	102.1	103.9	102.7	101.9	102.7	102.3
1969/70	97.9	90.6	95.4	99.2	100.3	101.6	102.7	104.4	102.4	101.2	101.3	101.3
1970/71	97.8	90.9	96.1	100.4	100.5	102.4	103.1	105.1	101.8	100.0	99.5	99.5
1971/72	97.3	92.2	97.3	102.2	100.4	103.5	103.3	105.3	101.2	98.7	97.9	97.4
1972/73	96.9	93.7	98.8	104.5	100.5	103.9	102.9	105.1	100.8	97.7	97.0	96.1
1973/74	96.4	95.3	100.1	106.0	100.2	103.7	102.9	104.0	100.8	97.7	97.2	95.9
1974/75	96.1	96.2	100.7	106.4	100.0	102.6	102.4	103.0	101.0	98.4	98.5	97.0
1975/76	95.7	96.6	100.3	105.4	100.0	101.7	101.5	101.7	101.3	99.8	100.3	98.6
1976/77	95.7	96.1	99.1	104.1	100.6	101.0	101.0	100.8	101.1	100.8	101.6	100.4
1977/78	95.9	95.7	97.7	102.5	101.3	100.8	100.7	100.1	100.8	101.5	102.4	101.2
1978/79	96.0	95.4	96.6	101.8	102.4	101.1	101.2	101.1	99.9	101.4	102.7	101.4
1979/80	95.8	95.5	95.9	101.5	103.3	101.7	101.3	99.9	99.3	101.4	102.9	101.1
1980/81	95.7	95.6	95.6	101.6	103.8	102.1	---	---	---	---	---	---
Seasonal Factors, One Year Ahead, 1981/82	95.6	95.6	95.5	101.7	104.0	102.3	101.5	99.9	99.1	101.4	103.0	100.9

price changes from August to October and changes in barley fundamental market variables. The estimated model is as follows:

$$CHPR_t = \underset{(3.30)}{12.96} - \underset{(-1.08)}{0.743}\ (CHTS_t) + \underset{(0.01)}{0.00402}\ (CHTD_t)$$

$R^2 = .07$
$F = 0.59$
D.W. = 2.60

t statistics are shown in parentheses. $CHPR_t$ is the percentage change in price between August and October, $CHTS_t$ and $CHTD_t$ are the percentage deviations from the original estimates of total supply and total demand, respectively. The regression equation was insignificant as indicated by the low R^2 and F statistic. All the coefficients were insignificant except the intercept term. Interpretation of the intercept term indicates that prices increase 12.96 percent assuming changes in the fundamental marketing variables are nil. Coefficients for $CHTS_t$ and $CHTD_t$ are both insignificant, implying that changes in the dependent variable are not affected by changes in these variables.

Other forms of the equation were also experimented with unsuccessfully. The model was also estimated using fundamental corn data and combinations thereof. Again, the results were insignificant. Insignificance of the barley model is likely due to the specialty nature of that crop grown in North Dakota. Ninety percent of the barley acreage in North Dakota is planted in malting barley, and it is changes in these fundamentals which are important. Changes in all barley fundamentals are all that is available and they do not necessarily reflect the malting barley situation. Secondly, the barley market is largely a domestic market in which production is used in malting and feeding in about equal proportions. Exports are very small relative to total use. Consequently, exports and volatility in the international market play less important roles in variability in the barley market.

Conclusions

Marketing decisions by agricultural producers are affected by many factors. Storage costs and availability, tax situations, and expectations of future price movements all affect marketing decisions. A factor of particular importance which affects expected future price movements is the seasonal pattern of prices. Seasonal price patterns are those which are recurrent year after year. During harvest, prices are depressed because of the surplus during that period. As the marketing year

progresses, prices generally increase reflecting positive returns to storage. Prices for hard red spring wheat are at a low in August and peak in October and November. The seasonal-irregular ratio calculated for August was 99.1 and those for October and November were 103.0 and 102.9, respectively. Thus, post harvest price appreciation has been about 4 percent. Seasonal-irregular ratios for durum wheat prices are similar. That for August was 101.8 and increases occurred thereafter with a peak at 103.2 in October. However, irregularity (not accounted by recurrent seasonal patterns) was more important in durum wheat prices, and monthly differences were not significant. All barley prices are at a low in August with a seasonal-irregular ratio of 94.1 and increase to a peak in October at 102.4, an increase of 8.8 percent.

Each of the three grains experienced a slightly different seasonal price between the periods 1967/68 to June 1973 and 1973/74 to December 1980. The latter period differed from the former in the case of wheat because it was dominated by the international market more so than by the domestic market. Seasonal-irregular ratios for hard red spring wheat in the former period increased from 93.7 in August to 103.8 in December. In the latter period the ratio for August exceeded 100 and the monthly differences were not significant. The results indicate there was relatively more variability and less seasonality in the latter period. Similar conclusions were made for durum prices. Generally, the seasonal low has not been as low in recent years as in the earlier period and the seasonal high is slightly higher and occurs sooner in the marketing year. In recent years it has been occurring in October and November. Similar changes in intra-year barley prices were observed.

Post harvest price changes are related to 1) the normal seasonal price change, and 2) changes in fundamental market variables within the marketing year. A model was specified and estimated to examine this relationship. The results indicated how changes in supply and demand estimates affect post harvest price changes and allowed for identification of the normal seasonal price rise. The latter occurs when changes in fundamentals were assumed nil. The results indicated that the normal seasonal price rise was 5.6 percent from August to November for hard red spring wheat, 5.7 percent from August to October for durum wheat, and 12.9 percent from August to October for barley. A revealing conclusion from these results is that returns to barley storage are greater than returns to wheat storage. Thus, if cash is needed or storage space is limited, storage of barley would be preferable to

wheat. In any particular year, these may not evolve because of changes in fundamental market variables. Results presented in this study approximate the returns to storage or the appreciation in revenues which accrue from storage. These must be balanced against individual situations regarding taxes, storage costs, etc. in making storage decisions.

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APPENDIX

TABLE A1. HARD RED SPRING WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS 1967-68 TO DECEMBER 1980 (¢/BUSHEL)

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	156	149	148	154	150	148	149	147	149	145	145	140
1968/69	136	130	134	138	140	136	139	139	140	139	140	136
1969/70	138	130	138	143	146	147	147	145	144	147	148	150
1970/71	150	144	155	159	162	154	153	152	147	146	143	144
1971/72	135	123	123	128	130	133	135	135	133	133	135	133
1972/73	134	150	168	179	184	214	210	189	193	201	206	238
1973/74	249	424	427	391	395	453	507	532	495	403	375	427
1974/75	469	448	454	504	519	487	439	412	397	403	387	369
1975/76	410	425	436	427	384	366	377	399	394	378	378	395
1976/77	388	326	303	279	266	257	259	265	262	249	242	225
1977/78	214	210	227	234	247	241	248	248	252	265	269	269
1978/79	264	263	269	278	285	279	274	272	278	278	305	347
1979/80	356	354	361	367	356	353	347	352	342	347	366	379
1980/81	402	390	398	416	422	402	---	---	---	---	---	---
Average	257	262	267	271	270	269	260	261	256	249	249	258

SOURCE: North Dakota Crop and Livestock Reporting Service.

TABLE A2. SEASONAL-IRREGULAR RATIOS FOR HARD RED SPRING WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	97.5	95.1	96.5	102.7	101.7	101.1	101.9	100.6	102.3	100.3	101.4	99.1
1968/69	97.4	94.0	97.8	101.5	103.4	100.3	101.9	101.1	101.4	100.6	101.3	98.2
1969/70	99.2	93.0	98.2	101.1	102.5	102.7	102.4	100.9	99.7	100.7	99.8	99.4
1970/71	97.9	92.8	99.2	102.1	105.3	101.7	102.3	102.2	99.0	98.4	97.4	100.6
1971/72	98.2	93.8	97.3	102.9	104.2	105.2	104.9	102.7	98.6	96.7	97.0	93.8
1972/73	91.2	97.0	102.9	104.7	104.2	118.4	113.6	99.4	97.3	94.3	87.0	88.7
1973/74	82.5	128.3	121.3	105.0	99.4	105.5	109.8	109.3	99.6	81.4	77.2	90.5
1974/75	102.1	98.8	99.4	108.4	111.1	106.6	100.5	98.6	97.5	100.2	96.7	92.0
1975/76	100.6	102.3	104.4	104.5	97.5	95.3	98.6	103.7	102.2	98.3	99.0	105.3
1976/77	107.9	97.5	99.3	98.9	98.9	97.2	98.4	101.4	102.3	100.9	103.1	100.7
1977/78	98.7	96.6	101.3	100.2	102.1	97.7	99.5	98.3	98.2	101.6	102.0	101.7
1978/79	99.8	98.9	99.9	101.8	103.3	100.4	98.2	97.1	97.6	94.1	97.7	104.9
1979/80	102.8	99.9	101.8	104.5	101.8	100.5	97.7	97.8	94.4	95.4	99.5	101.1
1980/81	105.0	99.9	100.5	104.2	105.0	99.2	--	--	--	--	--	--
Average	98.6	99.1	101.4	103.0	102.9	102.3	102.3	101.0	99.2	97.1	96.9	98.1

TABLE A3. DURUM WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980 (¢/BUSHEL)

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	159	165	170	177	168	168	170	173	174	172	169	160
1968/69	159	138	146	148	152	150	150	154	153	154	149	143
1969/70	141	132	135	136	136	133	132	131	131	131	130	132
1970/71	133	133	144	147	149	147	145	144	140	140	141	135
1971/72	130	122	122	124	127	131	138	138	139	139	141	142
1972/73	142	156	162	179	181	207	217	202	211	217	216	249
1973/74	293	706	658	537	524	688	740	741	699	561	504	545
1974/75	617	611	617	664	680	682	542	560	524	581	572	463
1975/76	493	539	569	533	453	392	398	397	410	387	370	361
1976/77	357	293	279	253	238	226	229	242	247	249	239	230
1977/78	222	224	240	263	276	282	285	283	279	292	296	295
1978/79	282	283	282	288	293	288	281	289	296	297	313	372
1979/80	402	390	432	485	464	431	414	418	405	400	445	507
1980/81	604	600	548	541	545	526	---	---	---	---	---	---
Average	295	321	322	320	313	318	295	298	293	286	283	287

TABLE A4. SEASONAL IRREGULAR RATIOS FOR DURUM WHEAT PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	90.7	93.8	96.8	101.6	97.7	98.9	100.7	102.6	103.4	103.1	102.4	98.5
1968/69	100.0	88.9	96.1	98.7	101.9	100.4	100.1	102.6	102.2	103.6	101.4	98.8
1969/70	98.9	93.9	97.5	99.8	101.6	100.9	101.5	101.7	102.1	101.8	99.9	99.3
1970/71	97.1	94.2	99.7	100.9	102.7	102.5	102.1	101.8	98.8	98.8	100.4	98.4
1971/72	98.1	95.5	98.1	100.8	102.8	104.2	106.4	102.3	99.0	96.2	96.1	95.8
1972/73	93.9	99.9	99.4	104.4	100.6	110.4	111.8	100.1	97.3	88.2	74.0	71.0
1973/74	71.1	153.3	133.4	102.6	92.6	110.2	108.8	104.3	99.5	83.5	78.5	87.7
1974/75	101.4	100.9	100.2	105.3	107.0	110.3	92.5	99.5	93.6	103.4	103.4	86.3
1975/76	93.7	102.8	109.1	106.2	97.3	90.7	96.5	98.8	104.3	100.8	99.2	100.7
1976/77	106.2	95.3	101.0	100.7	99.9	96.1	96.4	100.2	101.8	103.9	102.3	100.8
1977/78	97.9	96.8	99.1	102.4	101.6	99.9	99.3	98.3	96.8	101.1	102.1	101.9
1978/79	98.1	99.5	99.9	102.5	104.3	101.5	97.0	97.6	97.6	94.0	93.4	103.5
1979/80	104.8	96.7	104.0	115.0	109.1	100.9	96.4	95.9	91.0	87.4	93.9	102.6
1980/81	117.5	114.0	103.9	103.7	105.7	103.1	--	--	--	--	--	--
Average	97.8	101.8	102.7	103.2	101.8	102.1	100.7	100.5	99.0	97.4	95.9	95.8

TABLE A5. ALL BARLEY PRICES RECEIVED BY NORTH DAKOTA PRODUCERS, 1967/68 TO DECEMBER 1980 (¢/BUSHEL)

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	100	93	91	93	91	89	92	93	93	91	91	88
1968/69	81	67	78	78	79	79	80	81	80	80	80	79
1969/70	75	64	70	73	75	76	75	75	76	76	78	80
1970/71	78	77	83	86	85	86	87	92	90	88	88	87
1971/72	83	70	73	77	80	80	81	84	81	81	81	83
1972/73	83	80	86	95	94	107	114	112	111	114	116	131
1973/74	134	197	190	203	189	201	208	246	268	216	207	230
1974/75	242	284	293	335	376	360	334	318	272	300	296	258
1975/76	260	257	308	291	252	240	228	224	228	228	234	268
1976/77	261	250	248	229	211	203	218	220	227	225	202	172
1977/78	134	123	134	147	159	163	170	174	172	184	187	185
1978/79	168	166	170	176	185	186	183	177	185	193	199	210
1979/80	211	212	218	230	221	217	209	202	192	197	199	214
1980/81	242	243	243	271	283	268	---	---	---	---	---	---
Average	154	156	163	170	170	168	160	161	160	159	158	160

TABLE A6. SEASONAL IRREGULAR RATIOS FOR ALL BARLEY PRICES RECEIVED BY NORTH DAKOTA PRODUCERS 1967/68 TO DECEMBER 1980

Marketing Year	July	August	September	October	November	December	January	February	March	April	May	June
1967/68	97.7	93.4	94.2	99.3	99.7	98.8	102.4	103.5	103.7	102.6	104.6	103.3
1968/69	97.0	81.6	96.4	97.7	99.8	100.4	102.0	103.4	102.5	103.0	103.5	103.0
1969/70	98.9	85.5	94.2	98.3	100.8	102.3	101.7	102.5	102.3	102.4	103.0	102.5
1970/71	96.3	91.7	96.6	99.8	99.5	101.2	101.6	105.9	102.5	99.8	100.6	101.7
1971/72	100.7	88.2	94.4	100.1	103.2	102.4	103.2	106.3	100.9	98.8	97.1	98.3
1972/73	97.4	92.9	98.1	104.4	98.3	106.8	109.5	104.3	100.0	97.4	91.4	93.1
1973/74	85.5	114.9	104.7	109.4	100.3	102.7	100.0	110.5	114.1	89.4	84.3	91.6
1974/75	92.9	104.1	101.3	108.5	115.9	108.5	101.3	98.7	86.7	98.3	100.3	91.4
1975/76	95.8	96.5	116.3	111.3	99.8	99.6	98.9	100.1	102.3	99.6	97.1	105.2
1976/77	99.2	96.0	100.4	99.7	97.1	95.4	101.7	101.7	106.7	111.5	108.9	102.4
1977/78	87.5	85.1	93.5	99.1	101.8	99.9	101.4	102.1	99.2	104.4	105.0	103.6
1978/79	94.6	94.1	96.1	98.7	103.0	103.5	101.6	97.6	100.4	101.6	100.4	101.3
1979/80	97.5	95.2	97.4	104.4	102.8	103.4	101.7	99.5	95.2	97.7	96.1	98.2
1980/81	104.4	98.8	94.9	103.7	107.1	101.2	---	---	---	---	---	---
Average	96.1	94.1	98.5	102.4	102.1	101.9	102.1	102.8	101.3	100.5	99.4	99.7

TABLE A7. PROJECTED[1] AND ACTUAL FUNDAMENTAL DATA FOR ALL WHEAT, 1962/63 TO 1980/81

Marketing Year	Projected Total Supply	Actual Total Supply	Projected Total Demand	Actual Total Demand	Projected Export Demand	Actual Export Demand
	Million Bushels					
1962/63	2,373	2,421	1,223	1,226	622	642
1963/64	2,345	2,341	1,290	1,440	675	849
1964/65	2,180	2,193	1,310	1,375	675	725
1965/66	2,175	2,134	1,395	1,599	725	867
1966/67	1,777	1,849	1,389	1,424	732	744
1967/68	2,023	1,948	1,478	1,409	750	761
1968/69	2,126	2,117	1,437	1,298	750	544
1969/70	2,237	2,263	1,380	1,378	575	606
1970/71	2,230	2,237	1,420	1,506	675	738
1971/72	2,279	2,350	1,430	1,487	650	632
1972/73	2,417	2,409	1,605	1,971	800	1,186
1973/74	2,178	2,307	1,880	1,968	1,100	1,217
1974/75	2,175	2,139	1,758	1,704	1,000	1,018
1975/76	2,507	2,572	1,921	1,908	1,125	1,173
1976/77	2,707	2,810	1,947	1,698	1,050	950
1977/78	3,155	3,150	1,878	1,973	1,000	1,124
1978/79	2,978	2,976	1,845	2,051	1,100	1,194
1979/80	3,025	3,069	2,165	2,168	1,300	1,375
1980/81	3,220	---	2,255	---	1,450	---

[1]Projections as estimated in the third quarter Wheat Situation report of each year. Actual fundamental data were taken from subsequent Wheat Situation reports. Total demand is the summation of export and domestic demands.

TABLE A8. PROJECTED[1] AND ACTUAL FUNDAMENTAL DATA FOR ALL BARLEY, 1962/63 TO 1980/81

Marketing Year	Projected Total Supply	Actual Total Supply	Projected Total Demand	Actual Total Demand
	million bushels			
1962/63	534	583	399	363
1963/64	544	577	412	389
1964/65	536	560	411	461
1965/66	515	534	425	393
1966/67	506	532	417	377
1967/68	488	531	391	418
1968/69	569	597	410	370
1969/70	613	665	413	398
1970/71	652	695	454	463
1971/72	629	660	436	459
1972/73	593	648	427	464
1973/74	609	623	464	443
1974/75	468	470	410	404
1975/76	484	492	400	412
1976/77	478	511	359	385
1977/78	543	555	384	383
1978/79	622	632	382	403
1979/80	594	619	425	426
1980/81	541	---	422	---

[1]Projections as estimated in the third quarter Feed Situation report of each year. Actual fundamental data were taken from subsequent Feed Situation reports. Total demand is the summation of export and domestic demands.

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