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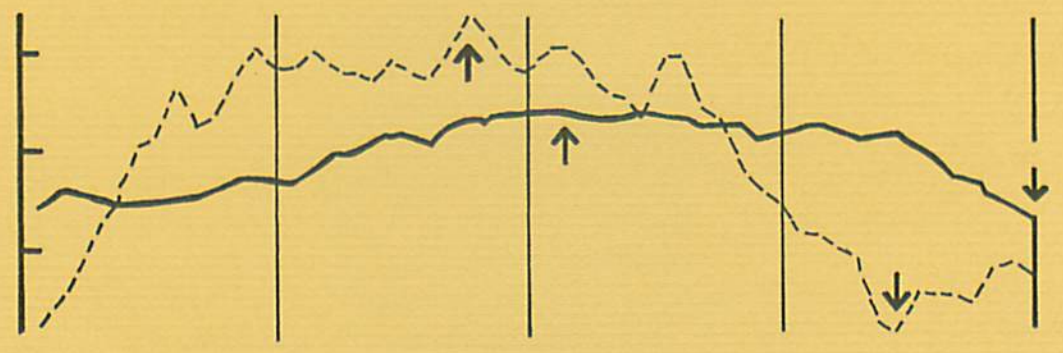
Seasonal and Cyclical Patterns of Cash Wheat Prices For Crop Years 1961-72 and 1972-76

Donald E. Thomson



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FOREWORD

This research was undertaken pursuant to a grant from the Chicago Board of Trade Foundation. The period of investigation was October 1, 1976, to June 30, 1977.

The principal investigator was Donald E. Thomson, Instructor, Department of Agricultural Economics, North Dakota State University. Dr. Donald E. Anderson, Dr. Gordon W. Erlandson, Professors, Department of Agricultural Economics, North Dakota State University; and Dr. Doris Hertsgaard, Associate Professor, Department of Mathematics, North Dakota State University, provided assistance in concept and conduct of the investigation. Mr. James E. Nelson, Research Analyst, University Computer Center, North Dakota State University, assisted in computer programming.

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HIGHLIGHTS

Seasonal, trend, and cyclical influences in cash wheat prices for the five principal classes of wheat at major markets were analyzed for crop years 1961-72 and 1972-76. Seasonal indexes were found to be different in the two periods. Trend was horizontal in crop years 1961-64 and 1964-72. It was a mound-shaped curve in crop years 1972-76. A four and one-half year cycle persisted throughout the 1961-76 period. Information in the study may be used to assist in estimating the course of cash wheat prices.

SEASONAL AND CYCLICAL PATTERNS OF CASH WHEAT PRICES FOR CROP YEARS 1961-72 AND 1972-76

Donald E. Thomson*

The Soviet Union in the summer of 1972 purchased 400 million bushels of wheat and large quantities of other grains from the United States due to a poor domestic grain crop and an apparent decision to improve the food standard of its people. This huge sale, along with increased exports of grain to other countries, exhausted government-held stocks of grain in the United States. These stocks had been built up under the program of controlled production with prices dominated by a loan level floor and a Commodity Credit Corporation sales price ceiling.

The exhaustion of the government-held stocks and the increase in export sales caused a rapid escalation in grain prices and an apparent change in their seasonal pattern. In the years 1972 to 1976, under a free market and with exports continuing much larger than previously, prices fluctuated more and remained at higher levels than pre-1972.

The objectives of this investigation were:

1. To determine seasonal and cyclical price patterns in the five principal classes of wheat prior to and after July, 1972;

2. To determine if these patterns were different; and

3. To suggest possible uses of this information in commodity futures trading and the grain trade.

DATA

Cash wheat prices were obtained for each Thursday (or Wednesday if Thursday was a holiday) from January, 1961, through December, 1976.[1] The prices were for number 1 hard red winter wheat, 13 percent protein, at Kansas City; number 2 soft red winter wheat at Chicago; number 1 dark northern spring wheat, 13 percent protein, at Minneapolis; number 1 hard amber durum, medium, at Minneapolis; and number 1 soft white wheat at Portland. Prices were deleted for the last week of December in 1964, 1970, and 1976 in order to have exactly 52 observations in each year.

ANALYSIS

Variations in a price series are considered to result from the multiplicative effects of seasonal influences, long-term trend, cycles, and irregular movements. The series may be broken down into its separate elements by dividing the original prices successively by these effects as they are identified.

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[1]United States Department of Agriculture, Agricultural Marketing Service, Grain Division, Grain Market News, Weekly Summary and Statistics.

Seasonal Influences

Seasonal indexes were calculated using a 52-week moving average and ratio to trend. Ratio to trend is obtained by dividing each week's price by the corresponding value of the moving average and expressing the result as a percentage. The seasonal indexes are the average ratio to trend for each week over the years considered.

The data were divided into two series for the 11 crop-years 1961-62 through 1971-72 and the four crop-years 1972-73 through 1975-76.[2] Seasonal indexes were calculated for each of these series. Graphs of the weekly seasonal indexes for each of the five major classes of wheat are presented in Figure 1. Tables 1 to 5 in the appendix contain the numerical values of the seasonal indexes.

1961-72 Compared to 1972-76

It is apparent from visual examination of Figure 1 that there is greater range and variation in the 1972-76 seasonal indexes than in those for 1961-72. The highs and the lows occur earlier in the season in the 1972-76 series in all cases. The difference of the two series of seasonal indexes was confirmed by statistical testing. The standard deviations[3] for each series are shown in Tables 1 to 5 in the appendix. Appendix Table 6 presents results of tests of homogeneity of variance establishing that price patterns in the two periods were not the same. Also, both these series, with the exception of soft white wheat in 1961-72, are different from a single series for the entire 1961-76 period.

Variation By Week

The standard deviations of the seasonal indexes of the largest class of wheat, hard red winter, are plotted by week in Figure 2. The figure depicts how much the standard deviations change over the course of a year--for example, in 1961-72 from 1.4 percent in early December (23rd week) to 8.1 percent in late June (51st week); in 1972-76 from 4.2 percent in late September (13th week) to 14.7 percent in mid-February (33rd week).

Variation By Year

Price patterns in different years vary from the seasonal index for a given week. They also vary from the seasonal indexes over the course of any given year. For example, the ratios to trend and seasonal indexes for hard

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[2]Ratios to trend for the first and last 26 weeks of data cannot be calculated due to the requirements of the 52-week moving average.

[3]The standard deviation is a measure of variation for a given series of values. Approximately two-thirds of all observed values may be expected to fall within one standard deviation and approximately 95 percent within two standard deviations, plus or minus, of the average value of the series.

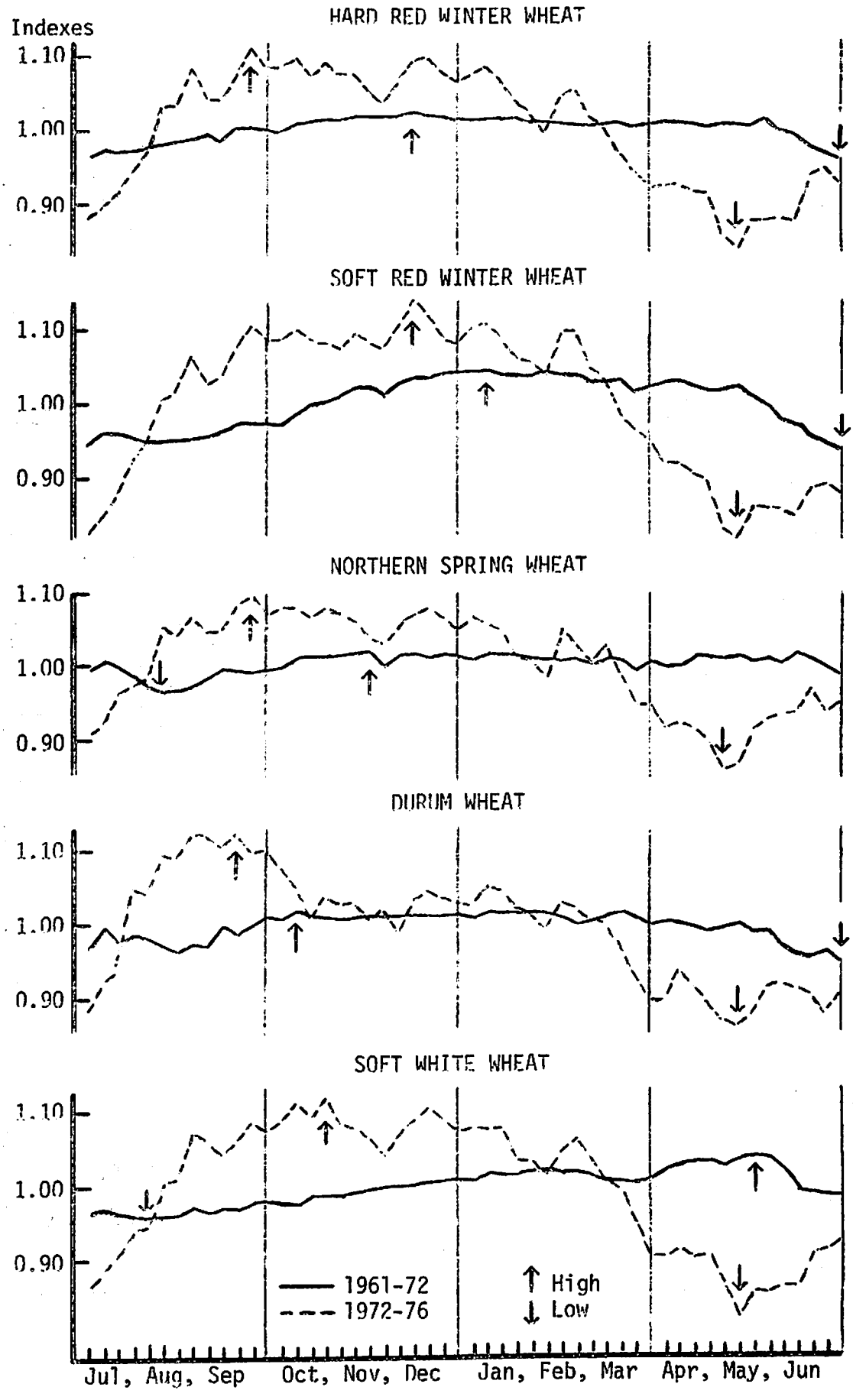

Figure 1. Seasonal Indexes by Week for Cash Prices of the Five Principal Classes of Wheat for Crop Years 1961-72 and 1972-76

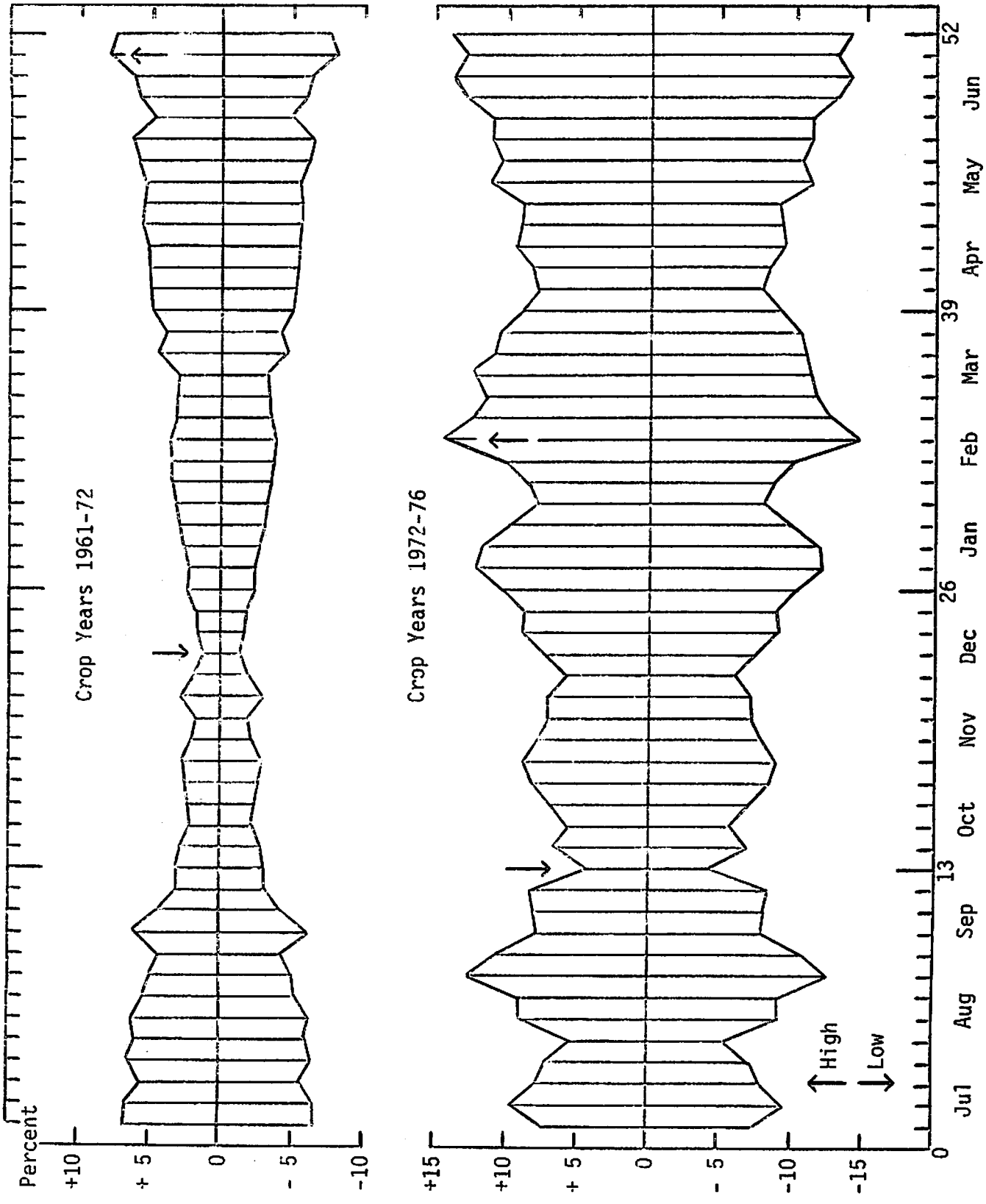

Figure 2. Standard Deviations of Weekly Seasonal Indexes of Cash Prices of Hard Red Winter Wheat

red winter wheat for two crop years are presented in Figure 3. In 1965-66 the two are not very far apart but frequently are going in opposite direction--there was not a great difference in indicated price, but the patterns were very different. In 1973-74 they are considerably further apart but usually are going in the same direction--there was considerable difference in indicated price, but the patterns were similar.

The ratios to trend and seasonal indexes for each year were compared statistically. These statistics are presented in Tables 7 to 11 in the appendix for each crop year and crop-year period for the five classes of wheat. They show the price patterns corresponded reasonably well with the seasonal indexes in all except 12 of the 85 cases tested.

Trend

Wheat prices had very little variation during the crop years from 1961-62 through 1971-72 due to the government program. However, in 1964 the certificate payment was introduced and the loan level reduced. The average price of wheat dropped correspondingly. The trends for 1961-64 and 1964-72 were considered to be the average prices for these groups of crop years.

Prices in crop years 1972-76 ascended very rapidly until early 1974 and then declined in a series of see-saw movements. There was much more variation in prices than in crop years 1961-72. The trend during crop years 1972-76 was considered to be a mound-shaped parabolic curve. The seasonally adjusted prices and trends for hard red winter wheat are depicted in Figure 4. Statistics pertaining to the trends for all classes of wheat are presented in Tables 12 and 13 in the appendix.

Cycles

The influence of trend was removed by dividing the seasonally adjusted prices by the corresponding trend values--leaving only the combination of cyclical and irregular movement. A five-week, second-degree, polynomially-weighted moving average was used to smooth out the irregular movement while preserving the amplitude of the cycles. The procedure was applied twice to produce adequate smoothing. The plot of the cyclical movement for hard red winter wheat is shown in Figure 5.

The cycles continued uninterrupted through the entire 1961-76 time period for all classes of wheat. There was moderate variability in the timing and amplitude of the cyclic waves.

Length of Cycles

Examination of the plots of cyclical movement revealed two complete cycles averaging for all classes of wheat 232 weeks (4.46 years) between lows. There was an average of 238 weeks (4.58 years) between the highs of the two cycles. The time from the low at the start of a cycle to the following high averaged 126 weeks (2.42 years). The subsequent low occurred

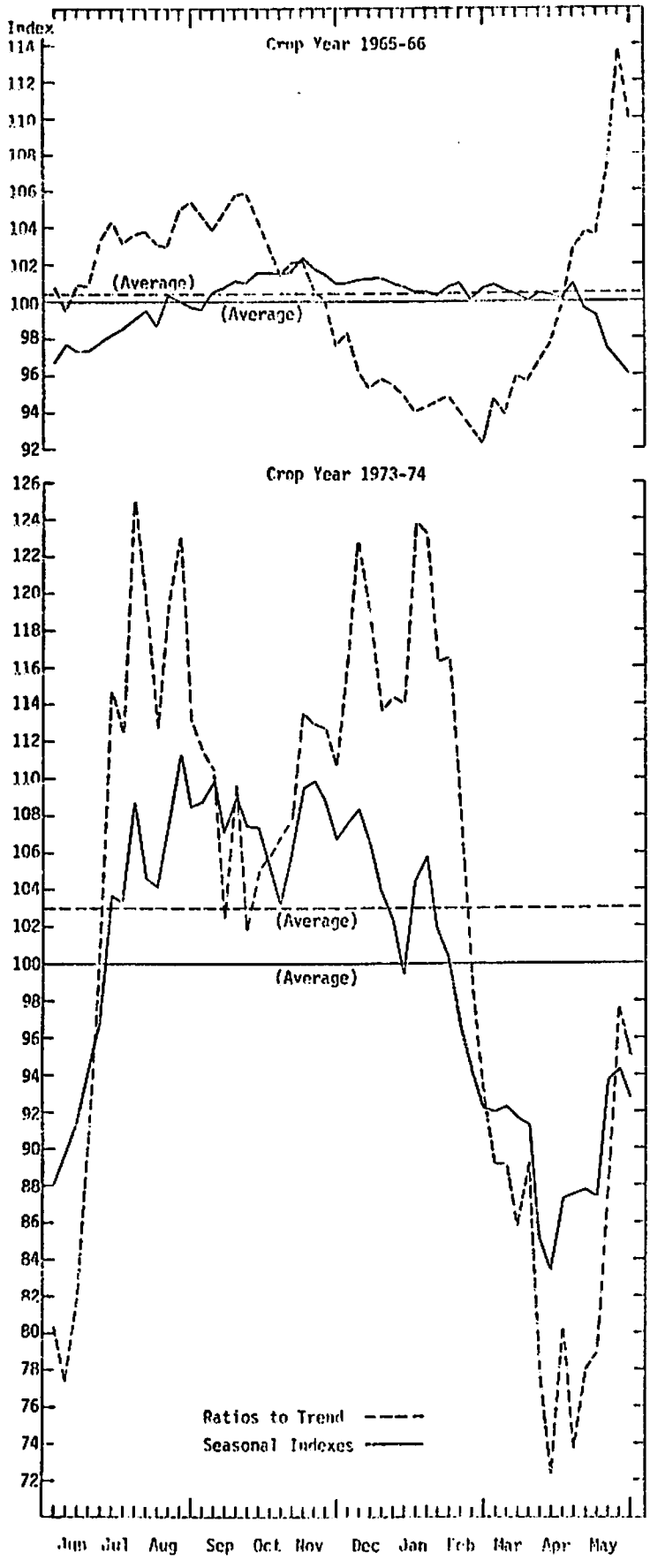

Figure 3. Ratios to Trend and Seasonal Indexes of Cash Prices of Hard Red Winter Wheat for Crop Years 1965-66 and 1973-74

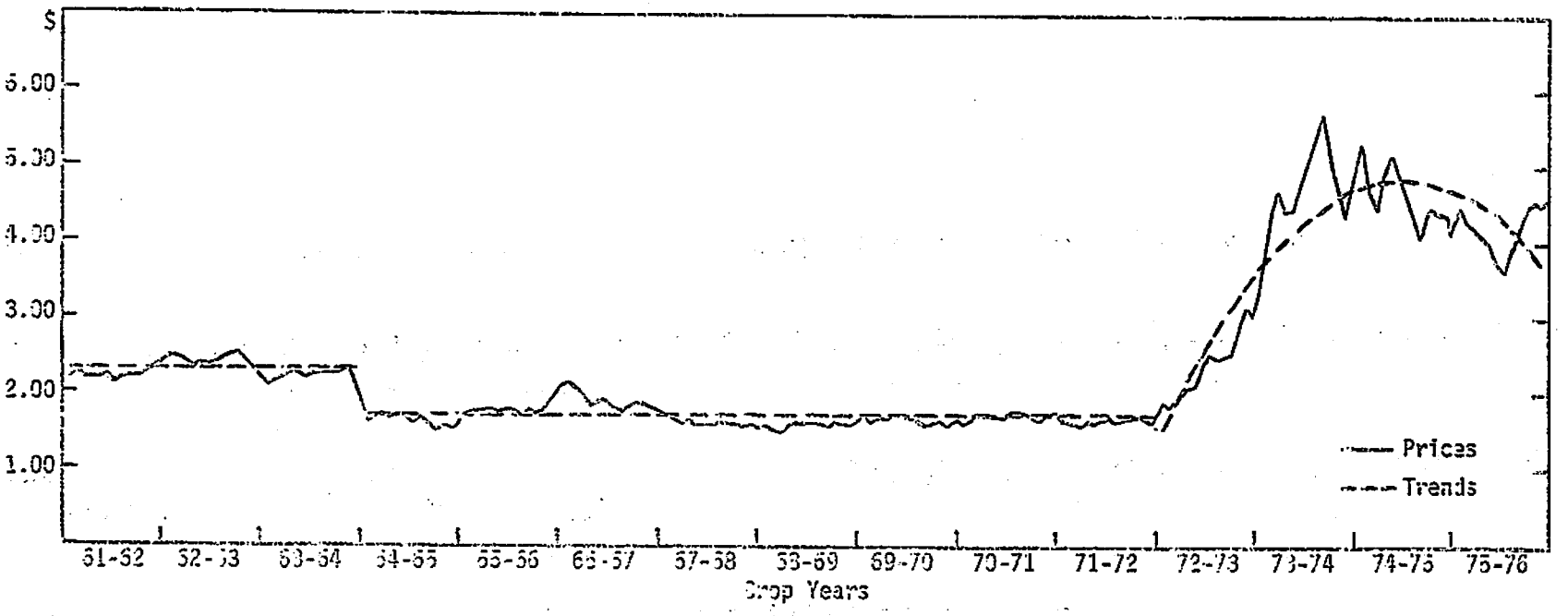

Figure 4. Seasonally Adjusted Cash Prices and Trends for Hard Red Winter Wheat for Crop Years 1951-51, 54-72, and 72-76

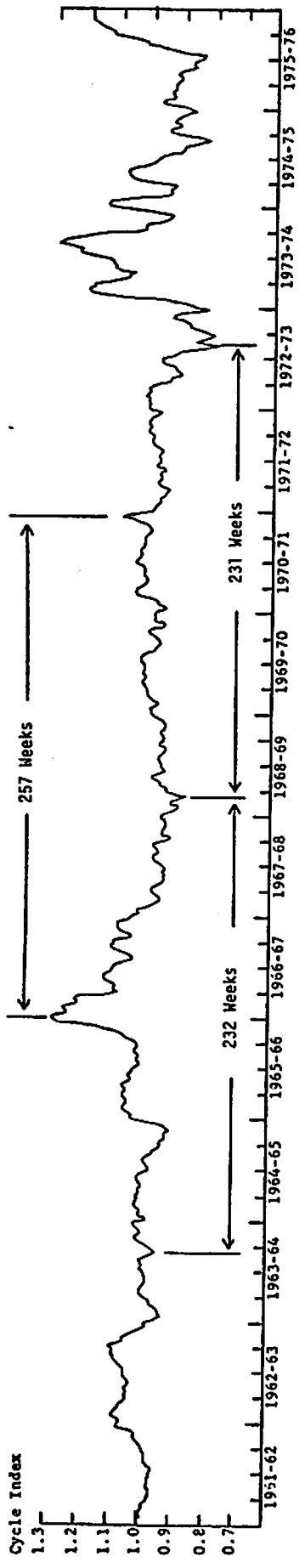

Figure 5. Cyclical Movements in Cash Price of Hard Red Winter Wheat for Crop Years 1961-76

an average of 106 weeks (2.04 years) later. The down movement of a cycle was more rapid than the up movement in most cases. The length in weeks of the cyclical movements up and down and the average dates of highs and lows for all classes of wheat are presented in Table 14 in the appendix.

Amplitude of Cycles

The amplitude of the cyclical movement was calculated as the percentage change in cyclical index values from low to high and from high to low. The average gain from low to high for all classes was 31.9 percent. The average loss from high to low was -29.9 percent. The amplitude of cyclical movement for all classes of wheat is shown in Table 15 in the appendix. The proportionate percentage effects of cyclical movement may be estimated from any week of the cycle to any other week by using the amplitude and length of cycle factors.

CONCLUSIONS

Seasonal patterns in cash wheat prices changed from crop years 1961-72 to crop years 1972-76. There was much greater variability in the latter period. Highs and lows occurred earlier in the crop year. In contrast, the cyclical pattern of prices did not change during the entire period. The trend was horizontal for crop years 1961-72 and then a mound-shaped curve until the end of crop year 1976.

Present and future seasonal price patterns of wheat could not be determined due to the limitations of the price data. However, it may be inferred from the present wheat surplus situation with much wheat going under loan--as it did prior to 1972--seasonal patterns may have returned to those of 1961-72. Trend now should be horizontal as it was in those years. The cyclical pattern probably has continued as it was throughout the 1961-76 period. Extension of that pattern indicates the most recent cyclic high should have occurred in July, 1975, and the following low in August, 1977.

Use of the Study

Commodity futures traders and others in the grain trade may use this information to estimate the course of cash wheat prices for all classes of wheat. Due allowance should be made for the variability in the factors for the various influences. The cash price estimates should consider the cumulative effects of seasonal, trend, cyclical, and irregular movements.

Seasonal Indexes

The 1961-72 seasonal indexes may be used as long as the present surplus situation exists to estimate purely seasonal influences on wheat prices. The average price effect of these seasonal influences for all classes of wheat is 0.42 percent of the low index per week from low to high and -0.21 percent of the high index per week from high to low. The estimates would provide information for decisions on sales, storage, hedging, or speculation.

Trend

Trend should be negligible until there is a change in government program price levels or a shortage situation develops. Trend effects can be very great if a grain shortage causes program controls to become inoperative. The trend in such cases has become a mound-shaped curve. The curved trend effects can be estimated from the severity of the shortage.

A short-term shortage in 1966 resulted in a rise of approximately 25 percent in wheat prices. Supply caught up and prices returned to program levels after one year. The long-term shortage in 1972 resulted in an increase in prices of from over 250 to nearly 400 percent in the various classes of wheat. Prices returned to program levels only after five years. The form of the price effect in both cases was similar, although the smaller one in 1966 was considered an irregular movement while the much larger and longer effect beginning in 1972 was treated as a trend. Everyone involved in the grain trade should be especially watchful for grain shortage situations because of the extreme price effects.

Cycles

Cycles in prices tend to persist over very long periods of years. Their effects can be estimated if the amplitude and duration of the cycles are known. These effects should not be ignored even in relatively short-term transactions.

The average price effect of the cycles for all classes of wheat was 0.25 percent of the low index per week from low to high and -0.28 percent of the high index per week from high to low. Cyclic effects more than doubled seasonal influences when both were going in the same direction and overcame seasonal influences when the effects were going in opposite directions.

Knowledge of wheat price cycles should be especially useful to producers in making planting, marketing, and storage decisions. Cyclic considerations could indicate full, partial, or no hedging to merchandisers and processors. Speculators should watch for instances when cyclic and seasonal influences both were positive or both negative.

Further Research

This investigation accomplished its objectives; however, it leaves unanswered many additional questions. These include whether seasonal price patterns have returned to those of 1961-72, if trend has again become horizontal in line with government program prices, and if cycles still are operating as before.

Further research might develop a price forecasting method using the cumulative effects of seasonal, trend, and cyclic influences. Forecasts could be tested for accuracy within the period from which the effects were developed and in extension of it. The value of a forecasting method of known accuracy would be immeasurable to the commodity market and grain trade. One use of particular interest to commodity traders would be in estimating cash prices for forward contract months in order to make the best use of spreads.

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APPENDIX TABLE 1. SEASONAL INDEXES FOR CASH PRICES OF HARD RED WINTER WHEAT FOR CROP YEARS 1961-72 AND 1972-76

Crop Year Month	Week	1961-72 Seasonal Index	1961-72 Standard Deviation	1972-76 Seasonal Index	1972-76 Standard Deviation
July	1	96.731	6.712	88.056	7.382
	2	97.667	6.590	89.755	9.552
	3	97.272	5.573	91.465	7.929
	4	97.350	6.452	94.119	7.246
	5	97.818	5.986	96.997	5.379
	6	98.145	6.246	103.582	9.045
	7	98.530	5.338	103.312	9.133
	8	98.984	5.071	108.703	12.738
	9	99.499	4.357	104.620	10.908
	10	98.594	6.290	104.110	7.833
	11	100.336	4.483	107.635	8.203
	12	100.010	3.134	111.250(+)	8.421
	13	99.733	3.100	108.460	4.214
October	14	99.585	2.791	108.747	6.755
	15	100.515	2.198	109.866	5.639
	16	100.750	2.435	107.088	6.939
	17	101.145	2.601	109.009	8.310
	18	101.015	2.692	107.472	8.793
	19	101.639	2.036	107.363	7.843
	20	101.602	1.853	105.282	7.170
	21	101.464	2.958	103.165	7.136
	22	101.663	1.923	106.056	5.910
	23	102.239(+)	1.367	109.420	7.379
	24	101.767	1.573	109.813	9.044
	25	101.501	1.739	107.810	8.762
	26	101.049	2.451	106.671	10.190
January	27	101.082	2.239	107.616	12.212
	28	101.195	2.719	108.340	11.837
	29	101.216	3.167	106.426	9.927
	30	101.261	3.214	103.846	7.934
	31	100.959	3.544	102.424	8.569
	32	100.814	3.647	99.461	10.201
	33	100.556	3.685	104.346	14.693
	34	100.548	3.379	105.752	12.522
	35	100.277	3.317	101.786	11.593
	36	100.740	3.190	100.388	11.269
	37	100.987	4.613	96.659	10.919
	38	100.106	4.012	94.203	10.648
	39	100.682	5.076	92.209	8.995
April	40	100.908	5.116	92.047	7.853
	41	100.645	5.260	92.284	8.344
	42	100.418	5.322	91.682	9.450
	43	100.022	5.627	91.291	9.157
	44	100.505	5.545	85.233	9.071
	45	100.399	5.436	83.429(+)	11.359
	46	100.192	6.051	87.296	10.518
	47	101.033	6.420	87.542	11.255
	48	99.597	4.733	87.759	11.220
	49	99.227	5.986	87.400	13.059
	50	97.392	6.236	93.703	13.888
	51	96.712	8.126	94.312	12.879
	52	95.923(+)	7.494	92.737	14.023

NOTES:
1. Seasonal index high (+) in 1972-76 is 11 weeks earlier than 1961-72.
2. Seasonal index low (+) in 1972-76 is seven weeks earlier than 1961-72.
3. Seasonal index range in 1972-76 (111.250-83.429) is over four (4.405) times greater than in 1961-72 (102.239-95.923).
4. Standard deviation for the 1972-76 series (8.165) is over five (5.385) times greater than for the 1961-72 series (1.516).

APPENDIX TABLE 2. SEASONAL INDEXES FOR CASH PRICES OF SOFT RED WINTER WHEAT FOR CROP YEARS 1961-72 AND 1972-76

Crop Year		1961-72		1972-76	
Month	Week	Seasonal Index	Standard Deviation	Seasonal Index	Standard Deviation
July	1	94.919	6.348	82.500	6.105
	2	96.033	6.518	85.259	10.084
	3	96.110	6.091	88.165	9.507
	4	95.551	6.261	92.793	8.798
	5	94.968	6.176	95.446	5.835
	6	94.961	6.310	100.266	8.553
	7	95.149	6.569	101.864	10.703
	8	95.326	5.910	106.683	13.381
	9	95.904	5.683	102.663	9.754
	10	96.283	5.578	103.533	9.794
	11	97.134	6.222	107.524	7.812
	12	97.292	4.564	110.647	8.435
	13	97.216	4.434	108.678	6.299
October	14	97.174	4.078	108.541	8.178
	15	98.662	3.803	109.956	6.690
	16	99.850	3.471	108.405	9.113
	17	100.159	3.680	108.073	9.155
	18	100.975	3.749	107.205	10.035
	19	102.047	4.255	109.163	9.266
	20	102.207	3.638	108.170	9.300
	21	101.197	2.610	107.658	10.641
	22	102.697	2.851	110.480	8.941
	23	103.421	2.950	113.901(+)	11.444
	24	103.551	3.087	111.879	12.083
	25	103.933	2.359	108.461	11.342
	26	104.064	3.130	108.058	12.326
January	27	104.166	2.781	110.152	14.574
	28	104.310(+)	3.582	110.569	15.136
	29	103.849	4.181	108.220	13.650
	30	103.722	4.103	105.776	12.152
	31	103.528	3.936	105.378	13.463
	32	103.963	4.028	103.441	14.629
	33	103.746	4.260	109.631	17.687
	34	103.950	4.168	109.774	15.531
	35	102.995	3.750	104.467	14.938
	36	102.797	3.116	102.902	14.987
	37	103.123	4.798	98.647	14.090
	38	101.309	3.061	96.179	13.162
	39	101.886	4.792	94.819	10.032
April	40	102.515	4.912	91.958	8.295
	41	102.719	4.578	91.948	8.535
	42	102.072	4.779	90.059	9.643
	43	101.392	5.315	89.408	8.182
	44	101.456	5.068	82.921	9.159
	45	102.079	5.459	81.796(+)	12.303
	46	100.514	5.069	85.801	12.831
	47	99.638	6.143	85.648	13.722
	48	97.322	5.424	85.446	13.780
	49	96.821	6.207	84.376	15.610
	50	95.036	7.431	88.316	16.113
	51	94.620	8.009	88.904	11.648
	52	93.720(+)	8.015	87.495	15.362

NOTES:
1. Seasonal index high (+) in 1972-76 is five weeks earlier than 1961-72.
2. Seasonal index low (+) in 1972-76 is seven weeks earlier than 1961-72.
3. Seasonal index range in 1972-76 (113.901-81.976) is over three (3.03) times greater than in 1961-72 (104.310-93.720).
4. Standard deviation for the 1972-76 series (9.959) is nearly three (2.898) times greater than for the 1961-72 series (3.437).

APPENDIX TABLE 3. SEASONAL INDEXES FOR CASH PRICES OF DARK NORTHERN SPRING WHEAT FOR CROP YEARS 1961-72 AND 1972-76

Crop Year Month	Week	1961-72 Seasonal Index	1961-72 Standard Deviation	1972-76 Seasonal Index	1972-76 Standard Deviation
July	1	99.406	5.140	90.665	8.276
	2	100.515	5.706	92.086	7.735
	3	99.888	5.134	96.126	8.938
	4	98.531	5.780	97.340	5.978
	5	97.053	5.914	98.391	4.230
	6	96.567(↓)	6.088	105.080	10.067
	7	96.793	5.660	103.787	8.943
	8	97.107	3.980	106.736	10.712
	9	98.110	4.433	104.278	9.843
	10	99.259	4.663	104.506	7.733
	11	99.115	4.597	107.818	8.807
	12	99.082	3.740	109.122(↑)	8.546
	13	99.443	3.371	106.604	4.162
October	14	99.606	2.079	107.565	4.850
	15	100.804	2.893	107.652	4.766
	16	100.968	3.490	105.103	6.651
	17	100.920	2.513	107.776	6.114
	18	101.030	2.447	106.758	8.736
	19	101.480	2.132	105.300	8.238
	20	101.679(↑)	2.384	103.450	8.875
	21	99.783	4.345	102.477	7.675
	22	101.236	2.267	105.203	7.068
	23	101.477	2.084	106.593	6.116
	24	100.993	1.958	107.141	9.192
	25	101.208	1.730	106.039	9.584
	26	100.902	2.147	104.534	9.604
January	27	100.381	1.469	106.135	10.995
	28	101.197	1.372	105.196	10.672
	29	101.223	1.804	104.058	10.229
	30	100.959	1.681	100.467	8.774
	31	100.613	2.067	100.050	10.500
	32	100.390	1.878	97.931	11.728
	33	100.025	1.778	104.891	14.418
	34	100.292	2.129	101.888	12.766
	35	99.702	2.034	100.267	13.310
	36	100.678	2.381	102.486	11.845
	37	100.280	3.334	97.816	10.614
	38	98.936	2.688	94.407	9.800
	39	100.042	3.063	94.627	10.638
April	40	99.712	2.986	91.353	6.440
	41	99.730	3.264	92.149	8.042
	42	100.883	3.398	91.356	9.159
	43	100.703	4.321	89.733	7.810
	44	100.622	4.949	85.593(↓)	8.600
	45	100.818	5.156	86.454	11.097
	46	100.021	4.171	90.883	10.541
	47	100.572	5.105	92.431	8.854
	48	99.983	5.709	93.204	9.750
	49	101.064	6.880	93.113	11.474
	50	100.289	4.979	96.646	13.520
	51	99.658	5.243	93.066	12.653
	52	98.271	6.189	94.671	14.935

NOTES:
1. Seasonal index high (↑) in 1972-76 is eight weeks earlier than 1961-72.
2. Seasonal index low (↓) in 1972-76 is 14 weeks earlier than 1961-72.
3. Seasonal index range in 1972-76 (109.122-85.593) is over four (4.603) times greater than in 1961-72 (101.679-96.567).
4. Standard deviation for the 1972-76 series (6.544) is over five (5.321) times greater than for the 1961-72 series (1.230).

APPENDIX TABLE 4. SEASONAL INDEXES FOR CASH PRICES OF DURUM WHEAT FOR CROP YEARS 1961-72 AND 1972-76

Crop Year Month	Week	1961-72 Seasonal Index	1961-72 Standard Deviation	1972-76 Seasonal Index	1972-76 Standard Deviation
July	1	97.189	3.843	89.022	14.505
	2	100.182	6.688	92.561	13.737
	3	98.086	3.423	94.418	9.751
	4	99.135	4.110	105.638	14.900
	5	98.597	4.504	104.905	12.163
	6	97.609	5.789	110.045	17.178
	7	96.983	6.802	109.404	14.418
	8	97.824	6.917	112.579	18.056
	9	97.614	7.101	112.622	18.954
	10	100.349	6.992	110.823	16.084
	11	99.151	4.906	112.990(↑)	14.521
	12	100.712	5.973	110.161	9.781
	13	101.648	6.853	110.524	7.972
October	14	101.201	4.596	107.991	3.865
	15	102.381(↑)	5.581	105.616	6.689
	16	101.689	4.836	101.489	8.748
	17	101.374	4.617	104.360	6.401
	18	101.152	3.504	103.229	9.603
	19	101.278	2.892	103.399	4.922
	20	101.364	2.900	101.168	6.969
	21	101.351	2.501	102.785	5.449
	22	101.420	3.409	99.137	7.470
	23	101.719	4.553	103.612	5.625
	24	101.540	3.628	104.918	11.944
	25	101.610	4.228	103.948	12.994
	26	101.510	4.429	103.463	11.880
January	27	101.406	4.243	103.052	11.502
	28	101.971	4.129	105.539	12.862
	29	101.907	2.707	104.821	12.195
	30	101.867	2.812	102.836	12.008
	31	101.996	3.214	101.803	12.314
	32	101.634	3.551	99.771	11.848
	33	101.037	2.863	103.487	13.548
	34	100.226	2.700	102.821	14.122
	35	100.467	2.871	100.915	15.627
	36	101.329	2.554	100.252	15.957
	37	101.834	2.900	97.058	13.868
	38	100.965	2.507	92.979	10.307
	39	100.007	3.751	90.294	12.797
April	40	100.138	3.504	90.121	13.209
	41	100.195	4.720	94.261	12.857
	42	99.963	4.952	92.225	15.042
	43	99.323	5.075	89.825	15.556
	44	99.936	5.807	87.292	16.573
	45	100.115	6.294	86.402(↓)	19.766
	46	99.057	5.295	88.048	18.542
	47	99.215	4.991	91.824	15.578
	48	97.231	4.419	92.192	14.529
	49	96.144	3.875	91.411	16.133
	50	95.841	3.842	90.972	15.719
	51	96.485	2.906	88.260	15.654
	52	95.043(↓)	3.926	90.734	17.219

NOTES:
1. Seasonal index high (↑) in 1972-76 is four weeks earlier than 1961-72.
2. Seasonal index low (↓) in 1972-76 is seven weeks earlier than 1961-72.
3. Seasonal index range in 1972-76 (112.990-86.402) is over three and one-half (3.623) times greater than in 1961-72 (102.381-95.043).
4. Standard deviation for the 1972-76 series (7.697) is over four (4.095) times greater than for the 1961-72 series (1.880).

APPENDIX TABLE 5. SEASONAL INDEXES FOR CASH PRICES OF SOFT WHITE WHEAT FOR CROP YEARS 1961-72 AND 1972-76

Crop Year Month	Week	1961-72 Seasonal Index	1961-72 Standard Deviation	1972-76 Seasonal Index	1972-76 Standard Deviation
July	1	97.105	5.483	86.841	6.209
	2	97.490	7.142	89.027	5.870
	3	96.964	6.019	91.109	9.850
	4	96.630	5.889	94.720	10.292
	5	96.472(↓)	5.985	95.091	10.002
	6	96.509	5.900	100.838	14.149
	7	96.480	5.418	101.459	12.087
	8	97.439	4.923	108.030	12.873
	9	96.941	4.745	106.701	12.338
	10	97.392	5.393	104.649	9.004
	11	97.383	5.114	106.728	10.476
	12	97.962	4.401	109.214	10.289
	13	98.439	4.590	107.761	7.844
October	14	98.238	4.026	109.048	6.948
	15	98.085	2.973	111.757	4.001
	16	99.000	3.271	109.496	5.861
	17	99.079	2.730	112.231(↑)	5.095
	18	99.008	2.695	108.763	7.112
	19	99.543	2.348	108.170	6.802
	20	99.854	2.291	106.607	8.204
	21	100.173	2.256	104.766	8.463
	22	100.170	1.972	107.440	8.058
	23	100.487	2.504	109.100	7.127
	24	100.772	2.271	110.873	9.921
	25	100.809	2.422	109.140	8.672
	26	101.105	2.343	107.724	9.429
January	27	101.000	2.790	108.061	10.116
	28	101.963	3.140	107.982	9.452
	29	101.698	3.611	107.905	7.971
	30	101.693	3.396	103.444	7.892
	31	102.044	4.149	103.451	9.503
	32	102.114	4.524	101.571	10.811
	33	101.780	4.739	104.922	14.740
	34	101.690	4.739	106.321	15.303
	35	101.319	4.268	103.172	15.149
	36	100.963	3.652	100.897	12.436
	37	100.687	3.459	99.072	12.418
	38	100.534	3.731	95.376	8.225
	39	101.055	3.649	90.599	8.404
April	40	102.124	3.508	90.257	8.456
	41	102.855	5.158	91.611	8.774
	42	103.113	5.168	90.225	9.682
	43	103.163	5.577	90.641	9.254
	44	102.916	6.292	86.513	8.791
	45	103.580	6.685	82.110(↓)	11.017
	46	103.851(↑)	6.854	85.612	11.015
	47	103.795	6.568	85.494	10.229
	48	102.218	4.477	86.428	10.025
	49	99.314	6.393	86.365	10.354
	50	98.914	6.899	90.736	10.309
	51	98.498	7.018	91.223	6.703
	52	97.585	6.808	92.728	9.597

NOTES:
1. Seasonal index high (↓) in 1972-76 is 29 weeks earlier than 1961-72.
2. Seasonal index low (↓) in 1972-76 is 12 weeks earlier than 1961-72.
3. Seasonal index range in 1972-76 (112.231-82.110) is over four (4.082) times greater than in 1961-72 (103.851-96.472).
4. Standard deviation for the 1972-76 series (8.939) is over four (4.050) times greater than for the 1961-72 series (2.207).

APPENDIX TABLE 6. TESTS OF HOMOGENEITY OF VARIANCE OF SEASONAL INDEXES OF CASH PRICES OF WHEAT FOR CROP YEARS 1961-72, 1972-76, AND 1961-76

Class	Variance			F-Test Statistic		
	1961-72	1972-76	1961-76	1961-72 Versus 1972-76	1961-72 Versus 1961-76	1972-76 Versus 1961-76
Hard Red Winter	2.30	66.66	8.02	28.99	3.49	8.31
Soft Red Winter	11.81	99.19	18.80	8.40	1.59	5.28
Northern Spring	1.51	42.82	3.81	28.31	2.52	11.25
Durum	3.53	59.24	7.86	16.77	2.22	7.54
Soft White	4.87	79.90	6.60	15.90	1.36*	12.10

*Not significant at .05.

APPENDIX TABLE 7. COMPARISON OF RATIOS TO TREND AND SEASONAL INDEXES OF CASH PRICES OF HARD RED WINTER WHEAT BY CROP YEAR AND CROP-YEAR PERIOD

Crop Year	Average Difference	Standard Deviation of Difference	b	R^2
1961-62	0.399	2.405	-0.343	0.141
1962-63	1.700	3.184	0.867	0.146
1963-64	1.818	6.929	3.901	0.550
1964-65	-3.974	4.075	2.570	0.581
1965-66	0.419	5.635	-1.431	0.206
1966-67	2.161	5.361	-1.319	0.196
1967-68	-0.618	2.381	0.782	0.202
1968-69	-0.607	2.800	1.740	0.514
1969-70	0.402	2.221	1.289	0.446
1970-71	1.180	2.778	1.097	0.265
1971-72	-2.881	2.980	1.847	0.520
1961-72	0.000	4.376	1.000	0.106
1972-73	-5.341	5.872	1.241	0.770
1973-74	2.966	8.740	1.691	0.811
1974-75	-0.185	6.267	1.018	0.638
1975-76	2.561	9.728	0.050*	0.005*
1972-76	0.000	8.446	1.000	0.479

*Not significant at .05.

APPENDIX TABLE 8. COMPARISON OF RATIOS TO TREND AND SEASONAL INDEXES OF CASH PRICES OF SOFT RED WINTER WHEAT BY CROP YEAR AND CROP-YEAR PERIOD

Crop Year	Average Difference	Standard Deviation of Difference	b	R^2
1961-62	0.589	3.658	0.118	0.038*
1962-63	0.925	3.081	0.523	0.322
1963-64	2.151	7.009	2.656	0.833
1964-65	-3.703	3.320	1.578	0.806
1965-66	-0.168	4.970	0.092	0.007*
1966-67	2.532	6.304	-0.296	0.050*
1967-68	0.020	2.690	0.902	0.574
1968-69	-1.039	2.532	1.245	0.763
1969-70	-0.531	2.865	1.364	0.768
1970-71	2.062	3.995	0.921	0.387
1971-72	-2.838	4.954	1.897	0.739
1961-72	0.000	4.728	1.000	0.342
1972-73	-5.956	6.249	1.159	0.785
1973-74	4.033	11.320	1.761	0.813
1974-75	-0.834	7.058	0.947	0.642
1975-76	2.756	11.486	0.132	0.029*
1972-76	0.000	10.052	1.000	0.492

*Not significant at .05.

APPENDIX TABLE 9. COMPARISON OF RATIOS TO TREND AND SEASONAL INDEXES OF CASH PRICES OF DARK NORTHERN SPRING WHEAT BY CROP YEAR AND CROP-YEAR PERIOD

Crop Year	Average Difference	Standard Deviation of Difference	b	R^2
1961-62	0.783	1.389	0.351	0.126
1962-63	0.950	1.728	0.523	0.135
1963-64	2.271	5.081	3.113	0.435
1964-65	-2.909	4.428	3.052	0.516
1965-66	-1.110	3.283	0.230	0.008*
1966-67	2.249	4.483	-1.699	0.325
1967-68	-0.131	3.388	-0.133	0.003*
1968-69	-0.636	1.909	1.569	0.542
1969-70	-0.292	1.901	1.603	0.559
1970-71	1.881	2.477	1.013	0.202
1971-72	-3.056	3.696	1.378	0.176
1961-72	0.000	3.724	1.000	0.097
1972-73	-5.488	5.955	1.401	0.775
1973-74	3.156	8.497	1.602	0.660
1974-75	-0.026	6.962	0.940	0.439
1975-76	2.358	9.003	0.057	0.003*
1972-76	0.000	8.299	1.000	0.380

*Not significant at .05.

APPENDIX TABLE 10. COMPARISON OF RATIOS TO TREND AND SEASONAL INDEXES OF CASH PRICES OF DURUM WHEAT BY CROP YEAR AND CROP-YEAR PERIOD

Crop Year	Average Difference	Standard Deviation of Difference	b	R^2
1961-62	5.143	5.122	2.215	0.452
1962-63	- 1.376	3.083	0.742	0.173
1963-64	1.267	4.231	1.870	0.448
1964-65	- 2.768	2.399	0.916	0.341
1965-66	- 2.981	4.520	1.574	0.312
1966-67	2.915	5.093	0.019	0.001*
1967-68	0.462	2.448	0.534	0.162
1968-69	0.538	3.958	1.537	0.363
1969-70	- 2.194	2.763	-0.097	0.010*
1970-71	1.352	2.024	0.617	0.273
1971-72	- 2.358	1.543	1.074	0.633
1961-72	0.000	4.337	1.000	0.156
1972-73	-10.006	8.588	1.447	0.667
1973-74	6.259	12.614	2.083	0.742
1974-75	1.606	8.086	0.235	0.096
1975-76	2.141	9.491	0.235	0.056*
1972-76	0.000	11.509	1.000	0.306

*Not significant at .05.

APPENDIX TABLE 11. COMPARISON OF RATIOS TO TREND AND SEASONAL INDEXES OF CASH PRICES OF SOFT WHITE WHEAT BY CROP YEAR AND CROP-YEAR PERIOD

Crop Year	Average Difference	Standard Deviation of Difference	b	R^2
1961-62	0.452	3.868	-0.329	0.076
1962-63	1.208	2.889	0.917	0.330
1963-64	2.514	7.199	3.750	0.820
1964-65	-3.165	3.619	2.177	0.784
1965-66	-1.984	4.718	-0.282	0.026*
1966-67	3.361	6.164	-1.080	0.252
1967-68	0.303	2.728	1.258	0.520
1968-69	-0.506	1.719	0.967	0.607
1969-70	-0.470	1.293	1.063	0.769
1970-71	1.908	2.834	1.675	0.701
1971-72	-3.621	2.642	0.886	0.356
1961-72	0.000	4.504	1.000	0.191
1972-73	-5.381	7.040	1.246	0.735
1973-74	3.601	8.586	1.454	0.747
1974-75	-0.694	6.195	1.044	0.695
1975-76	2.475	9.087	0.256	0.120
1972-76	0.000	8.507	1.000	0.521

*Not significant at .05.

APPENDIX TABLE 12. TRENDS OF SEASONALLY ADJUSTED CASH WHEAT PRICES FOR CROP YEARS 1961-64 AND 1964-72

Class of Wheat	Crop Years 1961-64		Crop Years 1964-72	
	Trend (Average)	Standard Deviation	Trend (Average)	Standard Deviation
Hard Red Winter	2.291	0.101	1.679	0.112
Soft Red Winter	2.073	0.091	1.542	0.157
Northern Spring	2.349	0.057	1.744	0.130
Durum	2.705	0.443	1.818	0.177
Soft White	2.129	0.086	1.587	0.112

APPENDIX TABLE 13. REGRESSION COEFFICIENTS AND R^2 FOR THE PARABOLIC TREND OF SEASONALLY ADJUSTED CASH WHEAT PRICES FOR CROP YEARS 1972-76

Class of Wheat	Intercept	Week*	Week^2	R^2
Hard Red Winter	-111.1678	0.3080	-0.0002	0.7703
Soft Red Winter	-122.5504	0.3431	-0.0002	0.6101
Northern Spring	-120.1430	0.3314	-0.0002	0.8069
Durum	-236.5541	0.6527	-0.0004	0.8039
Soft White	-115.1536	0.3216	-0.0002	0.7288

*Week = 625 (first week of July, 1972) to 832 (last week of June, 1976).

APPENDIX TABLE 14. LENGTH OF CYCLICAL MOVEMENTS IN CASH WHEAT PRICES FOR CROP YEARS 1961-76

Average Cyclical Movement		All Classes Average	Hard Red Winter	Soft Red Winter	Northern Spring	Durum	Soft White
Date	Status						
		- - - - - - - length of movement in weeks - - - - - - -					
Apr '64	Low	121	118	126	125	125	110
Aug '66	High	108	114	110	100	103	113
Aug '68	Low	130	143	141	117	109	142
Mar '71	High	104	88	87	121	135	87
Mar '73	Low						
Average							
Low to Low		232	232	232	232	236	226
High to High		238	257	251	217	212	255
Low to High		126	131	134	122	117	126
High to Low		106	101	99	111	119	100

APPENDIX TABLE 15. AMPLITUDE OF CYCLICAL MOVEMENTS IN CASH WHEAT PRICES FOR CROP YEARS 1961-76

Average Movement Date	Status	All Classes Average	Hard Red Winter	Soft Red Winter	Northern Spring	Durum	Soft White
		- - - - - - - - - - - percent change - - - - - - - - - - -					
Apr '64	Low						
		39.9	32.7	38.0	31.0	55.5	42.4
Aug '66	High						
		-28.6	-32.2	-38.4	-28.1	-21.1	-23.4
Aug '68	Low						
		23.9	24.4	42.1	26.6	4.6	21.8
Mar '71	High						
		-31.0	-27.0	-33.6	-30.2	-33.8	-32.0
Mar '73	Low						
Average							
Low to High		31.9	28.6	40.1	28.8	30.1	32.1
High to Low		-29.9	-29.6	-36.0	-29.2	-27.5	-27.2