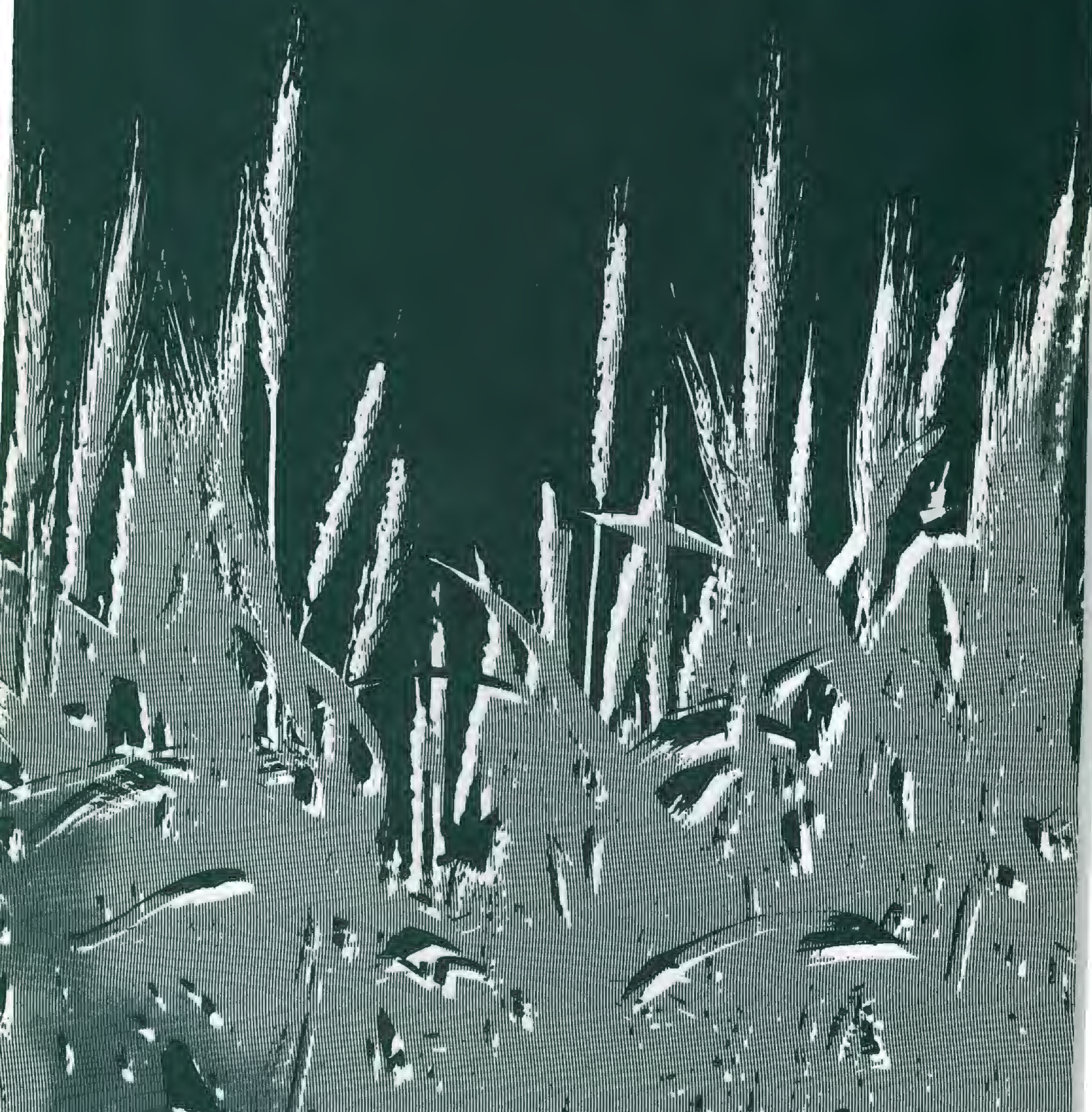
INTERMARKET PRICE DIFFERENCES FOR JULY WHEAT FUTURES CONTRACTS, CHICAGO AND KANSAS CITY, 1965-77



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Intermarket Price Differences for July Wheat Futures Contracts, Chicago and Kansas City, 1965-77

Wade L. Smith and Leo V. Blakley*

Wheat prices are relatively stable when production controls accompanied by large government stocks in storage are in effect. After the end of harvest, wheat prices typically increase, usually reflecting storage costs, and then begin to decrease in the spring with the approach of the next harvest. In some years the wheat price may change only 20 cents per bushel over the entire crop year. Producers respond by selling most of the crop when it is harvested. There is little incentive to do otherwise. Changes in the level of support prices from year to year also are modest. Marketing strategies are almost obsolete under these circumstances.

The scene is drastically different when stockpiles do not exist. Rumors of a potential increase in demand can cause prices to soar; then confirmation of the potential increase can cause prices to fall somewhat. If the potential increase has been exaggerated, the fall can be steep. Similarly, changes in estimates of production can cause large changes in prices.

The 1972 and 1973 crop years provided an example of how wheat prices increased in response to a large increase in export demand when stockpiles had been depleted. The average Gulf wheat price increased from $1.73 per bushel in 1971-72 to $4.94 per bushel in 1973-74 (Table 1). As the price of wheat increased dramatically, so did its volatility. Table 1 shows the standard deviation and the coefficient of variation of the cash wheat price series at the Gulf over the 1971 crop year to be $.04 per bushel and 2.04 respectively. The standard deviation of that same series in the 1972 crop year increased to $.31 per bushel and the coefficient of variation increased to 11.84. The increase was even more striking the next year as the measures of variation advanced to $.68 per bushel and 13.68, respectively. When the price of wheat tripled in two years as prices fluctuated wildly, it is understandable that more emphasis would be placed on evaluating different methods of marketing wheat. For the 12-year period the average price was $2.57 with a coefficient of variation of 46.72. The magnitude of this variation was much larger than for any particular year.

Many managers faced with high price volatility have turned to forward contracting to alleviate some of the risk. There are several methods of forward

*Former Graduate Assistant and Professor, respectively, Department of Agricultural Economics, Oklahoma State University.

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Table 1. Mean, Standard Deviation and Coefficient of Variation of the Gulf Wheat Prices, Crop Years 1965-66 Through 1976-77

Crop Year	Mean	Standard Deviation (dol per bushel)	Coefficient of Variation
1965-66	1.85	.11	5.97
1966-67	1.99	.10	5.07
1967-68	1.72	.09	5.06
1968-69	1.53	.05	3.13
1969-70	1.55	.05	3.52
1970-71	1.72	.05	2.77
1971-72	1.73	.04	2.04
1972-73	2.65	.31	11.84
1973-74	4.94	.68	13.68
1974-75	4.33	.61	14.02
1975-76	4.11	.24	5.90
1976-77	2.92	.27	9.22
12 Years	2.57	1.20	46.72

contracting including hedging on the futures market.[15] If the wheat producer or elevator manager chooses to use the futures market, there are five different contract months on four separate exchanges from which to choose. The primary emphasis of this study will be on Oklahoma producers and managers and the opportunities open to them in choosing among the commodity exchanges that will accept delivery of hard red winter wheat against their futures contract. Both the Kansas City and Chicago Boards of Trade accept delivery of hard red winter wheat and the price differentials between these two markets will be the center of analysis in this study.

One problem facing producers is the selection of the exchange to be used for placing a hedge. Paul, Heifner and Helmuth [15] stated that generally the futures contract should be sold with a par delivery point closest to the cash market where the commodity will be sold. They further state that the first exchange to consider for hard red winter wheat is the Kansas City Board of Trade. This is certainly correct. They did not explain, however, that there are instances when it would be most advantageous to use the Chicago Board of Trade to place the hedge instead of the Kansas City Board of Trade. That was not the main thrust of their exposition. The futures quotes of the Chicago and Kansas City Boards of Trade are seldom identical and their difference is protean. At times the Chicago futures quote can be 10 to 15 cents above the Kansas City quote and at other times the inverse is true.

An extreme case in point would be the 1972 crop year. Early in the crop year the Kansas City futures quote was 6.375 cents above the Chicago futures quote, but toward the end of the crop year the Kansas City quote was 24.250 cents under Chicago. This move of 30.625 cents is the amount that could have been made or lost by choosing to deal on one Board of Trade rather than the other. The relationships change from year to year. The very next year the short hedger could have earned 15 to 20 cents by hedging in September or October at Chicago instead of on the Kansas City Board of Trade and removing the hedge in May or early June. Thus a correct decision by the producer as to whether or not to place a hedge on a particular market can be as important as the decision to hedge.

Objectives

This study involves an analysis of the intermarket price differentials between the Kansas City and Chicago futures markets. The primary objective is to isolate and analyze the factors which are associated with changes in the intermarket price differentials between the Kansas City and Chicago Boards of Trade. Specific objectives include:

1) Determine the variables which have had a significant influence on the intermarket price differentials.
2) Analyze the consistency of effects of variables over time.
3) Construct models useful in the selection of which futures market to use for hedging or forward pricing under alternative sets of circumstances.

Linear regression techniques and weekly futures quotes from the Chicago and Kansas City Boards of Trade between 1965 and 1977 are the primary techniques and data used in the analysis.

Review of Previous Studies
Futures Markets and Price Discovery

Intersection of market supply and market demand curves determine price in the perfectly competitive market. The equilibrium price is the price at which the market will clear. No seller will be willing to accept less than the equilibrium price and no buyer will pay more, all else constant. One major assumption underlying this equilibrium is that of perfect knowledge. Perfect knowledge means that all participants involved in the marketing of this commodity have total, complete and exact information concerning all things past, present and future.

In the actual marketing of a commodity there is not perfect knowledge of supply and demand conditions. Price must be "discovered" by the market participants based on current information. The buyers and sellers in the real world markets do not have the advantage of having perfect knowledge concerning all relevant variables. They must then use available information and attempt to seek out the market clearing price through buying and selling activities. This process of price discovery, in effect, involves price forecasting.

The price discovery process is reflected in futures market prices. For example, consider the July futures contract for wheat. This is the first contract in the "new" crop year for wheat. In August, the July futures quote should reflect the consensus of traders as to the price of wheat the following July. However, the information that is available concerning the coming crop at that point in time is at best quite limited. Only expectations are available. No significant portion of the crop even has been planted. Other factors such as weather and the amount of wheat grazed-out, which can change the total production substantially, are unknown. After August, the information begins to improve. In December, the United States Department of Agriculture issues the first official estimate of winter wheat production. In addition by December, processors and exporters have better ideas of the total demand for the crop. In theory the trader in the futures market determines what is believed to be the "correct" price for the commodity during the delivery months on the basis of existing information. If the current futures quote is above the trader's expected price he will sell a quantity of futures contracts expecting to buy them back when the expected price is achieved. If the trader's judgment is correct he receives a profit of the difference between the two prices. This profit would be equal to the losses of the trader's whose judgment was incorrect. Therefore, the collective actions of traders help in the establishment of the "correct" price.

With each bit of new information, the market price is adjusted. There is, therefore, a continual balancing of the judgments of traders who believe that the current price is higher or lower than the price will be in July. As the information improves and the crop approaches harvest there is less and less uncertainty associated with the supply and demand factors. Finally a market price will exist when the contract matures. This price will be based on all relevant information known at that time.

Theories of Changes in Futures Prices

In a 1960 study Holbrook Working [28] put forth statistical evidence refuting the long held belief that futures markets are primarily speculative markets. He did so by showing that the amount of speculation, measured in dollar value of open speculative contracts, has differed greatly between commodities. Some commodities were found to have ten, twenty or even several hundred times as much speculation as others. The differences in the amount of speculation were basically dependent upon the level of hedging in the markets. A close correspondence was shown between changes in the respective levels of speculation and hedging. His analysis led him to the conclusion that speculation in all futures markets is primarily dependent upon the amount of hedging in that market. He further concluded that no market can exist without a sufficient level of hedging for support.

Keynes-Hicks Hypothesis

Keynes [11] and Hicks [10] advanced one of the early hypotheses concerning the movement of the futures prices. They viewed futures prices as downward biased estimates of expected spot prices. Their hypothesis is referred to as the theory of "normal backwardation." It is based on the idea that holders of the cash commodity can hedge themselves against price risk by the sale of futures contracts. Keynes and Hicks believed that since this was a valuable service to hedgers they were willing to pay others (speculators) to take long positions in the futures market thus bearing the risk of a change in price. It is evident that this hypothesis is founded on several premises. First and of major importance is that no forward market can exist without speculators, who will be net long, to accept the risk of a change in price. In addition, these speculators are expected to be willing to buy futures contracts only if the futures price is below the expected cash price. Finally, hedgers are viewed as only interested in the futures market for the purpose of transferring risk. Thus, speculators must make a profit or they will not engage in assuming the risk of a price change.

Under the theory of "normal backwardation" hedgers would expect to pay a risk premium for the protection they seek. This concept is similar to the payment of insurance premiums where the person desiring insurance must pay a small sum to be insured against the possibility of a large loss. The cost of the insurance increases as the possibility of a loss increases.

Keynes and Hicks concluded that speculators, as a group, should be making money through their risk-taking activities on the futures market. Thus, an upward trend would be a normal characteristic of all futures markets. To test this hypothesis an upward trend of price during the contract year should be evident, especially as the delivery date approaches. If this trend exists it would imply that the level of futures contract prices is not a reliable estimate of the expected cash price. This theory has been widely discussed but current evidence tends not to support it. Working [30], Telser [17] and Gray [9] all have tested the hypothesis for harvest commodities and found that there is no tendency for futures prices to rise over the calendar year as a whole.

Random Walk Hypothesis

The random walk hypothesis was suggested by Holbrook Working [29] as early as 1949. He noted that time series data often possess characteristics similar to those of cumulated random numbers. The separate items of time series are by no means random, but changes between successive items tend to be largely random. The hypothesis came about as a result of studies into why futures prices seem to exhibit different responses at different points in time when economic factors appear to be consistent at these points in time. In addition the Hicks-Keynes hypothesis did not explain changes in futures prices. These points lead to the idea that price changes were caused, to a great extent, by pure random variation.

The random walk theory suggests that successive price changes in markets such as futures markets are independent and thus past history of a series generates no information that would be useful in predicting future price changes. For the random walk theory to hold, the market under consideration should be an "efficient" market. A market would be regarded as efficient if the market price was, at all times, the consensus of a large group of equally well informed individual traders, each attempting to maximize profits. In a theorectical market such as this, the price at any given time would represent all available information. This price would also reflect information concerning future events (even though this knowledge is imperfect).

According to the random walk hypothesis differences of opinion concerning the validity of the imperfect knowledge causes actual prices to move randomly about the "efficient market price." In addition, prices change in response to new information which itself may be random. In this type of theoretical market a trader would be successful only if he were more adept at decoding currently available information than the average trader. In theory the futures market would make the process of price discovery more "efficient" through more accurate price forecasts. Thus futures markets should implicitly provide a larger quantity of widely dispersed and readily available information to all persons involved in the marketing of the commodity. This suggests that a smaller degree of unwarranted price variation might be expected in the presence of a future market for the commodity, all other things equal.

Random walk does provide an explanation of erratic changes in futures prices but does not explain the existence of trends in futures prices. Trends which occur infrequently would not be inconsistent with the idea that futures prices represent the best available estimate of the price on the delivery date. Thus, the random walk hypothesis does not disallow the existence of trends in a price series but the hypothesis would be invalid if consistent and regular trends were observable.

Intermarket Price Differentials for Wheat

Gray [8], in a 1961 study, analyzed the relationships among three futures markets for wheat. He stated that all futures markets depend upon hedging for their existence, but the relative amounts of hedging vary from market to market. Most hedgers in wheat futures would prefer to hedge on either the Kansas City or Minneapolis markets rather than Chicago so as to get a "closer" hedge. The hedge is "closer" in a geographical sense in that elevators and milling firms are more heavily concentrated in areas around Kansas City and Minneapolis than around Chicago. The hedge is also "closer" in that the smaller market's futures contracts require delivery of a certain class of wheat which more nearly fills the needs of most hedgers. In contrast the Chicago market's contract will accept delivery of various classes of wheat.

Gray then used the idea of hedger's preference for the two markets but with much higher relative speculation at the larger third market to set up a simple example. Initially he assumed that Kansas City and Minneapolis were preferred by *all* hedgers and Chicago had *all* of the speculation. In this situation, all matched hedging would go to the two smaller markets and all unmatched hedging would go to Chicago where it would be matched by speculation. If changes in the level of reported hedging were observed, he hypothesized that open interest would change between Chicago and the smaller markets such that matched hedging would help business in the smaller markets and unmatched hedging would help business in Chicago.

Spreaders provide a link for speculation to flow from one market to the other when speculation on smaller markets is inadequate. Price disparities show up when unmatched hedging begins to build up at Kansas City or Minneapolis (Gray [7]). When prices on these exchanges are out of line with Chicago, hedgers tend to go directly to Chicago with their business, perhaps hoping to replace the hedge at the smaller market should the opportunity arise. This continuous surveillance tends to keep intermarket price differentials in line with what the trade feels are comparative values.

Hedgers apparently are not willing to pay spreaders large profits in order to achieve a "closer" hedge. Beyond a certain point all unmatched hedging tends to go directly to Chicago. Gray stated in clear terms that the level of unmatched hedging determines the amount of business at Chicago and the level of matched hedging determines the amount of business in the smaller markets. However, despite hedgers' preference for the closer markets, much hedging may go to Chicago because that market has a high price elasticity of demand for futures contracts. Stated differently, there is ample speculation to absorb the hedging.

Cootner [4] felt that a sufficient condition for the payment of risk premiums by hedgers as a group was that the price of a futures contract rise monotonically from the time that net short hedging first occurred to the time when it first became zero and that the price decline monotonically from the moment net long hedging begins to the time it becomes zero. Cootner emphasized that this was clearly not a necessary condition.

In relation to the above statement Cootner hypothesized that prices of wheat futures contracts should rise and fall, on the average, during times of short and net long hedging respectively. One problem in the 1967 study was that data were available only for a short period. Because of the lack of data Cootner used supply data as a proxy for hedging data. He felt that when supplies peaked it would be safe to assume that hedging was net short. Long hedging was then assumed to rise from some fixed date in the spring. This theory is an alternative to the theory of "normal backwardation." If inventories are low, hedging may be net long as an offset to forward contracts to deliver and speculators may be short. Under these conditions prices would have to fall if speculators are to make money.

In a 1964 study, Toulemendale [20] attempted to analyze this hypothesis by analyzing intermarket price differentials among the London, Sydney and New York wool futures markets. The markets in New York and Sydney deal in the raw form of wool known as "grease wool." The London market deals in semiprocessed forms of wool referred to as "wool tops." Though the sample period was very short, Toulemendale found an average profit per transaction using a trading scheme developed along the lines of Cootner's theory. From July 1 to December 1, the New York futures gained relative to Sydney and London. Conversely the reverse occurred from December 1 to July 1.

Clifton [2] also analyzed the price differentials arising from spreads among the Chicago Board of Trade, the Kansas City Board of Trade and the Minneapolis Grain Exchange. His 1965 study outlined the basic factors of market differences. One major factor indicated was government policy. Included under government policy were differing support and loan prices for the three main types of wheat (hard red winter, soft red winter and hard red spring for this study) and government stocks of wheat. The government's influence on "free" carryover and supplies was a highly important factor influencing the spreads. Other factors influencing the intermarket price differences were specified as quantity, type and location of the three wheats concerned, and the costs of shipping wheat from one market to the other. Supply and demand forces for each class of wheat could bring about changes in the spreads nearly to the approximate freight differences before wheat would be moved from one terminal to another. He also noted that the Minneapolis and Kansas City futures contracts can only be filled by spring wheat and hard red winter wheat respectively. Thus, conceivably these markets could "run away."

Characteristics of Two Markets for Pricing Wheat

Chicago, Illinois and Kansas City, Missouri are two of the major markets for hard red winter wheat. Kansas City is located near the center of production. Chicago is located in the general area involved in moving wheat from production areas to some of the major consuming areas of the central and eastern regions of the United States.

Location Differences

The marketing areas of the two locations under simplified assumptions of equal prices and transfer costs would be separated by a straight line equidistant between the two locations and perpendicular to a straight line connecting the two markets. With major consumption located east of Chicago and major export points located south of Kansas City, simple analysis would show Chicago supplying the population centers with flour for domestic consumption with some chance for a small amount of exports. The Kansas City market would then serve all of the Gulf export points and some small amount of domestic consumption in that area.

In the "real world," however, a "transit" system of rail rates affects the relative advantages of specific locations. The transit system of rail rates was designed to neutralize the advantage of flour millers located in production areas over the millers located in the population centers. Prior to the instigation of this system, flour and wheat moved at the same rates per hundredweight. Thus, the reduction in weight by milling caused rates to favor those flour millers located in the regions of production. Under the transit system the total freight cost from wheat origin to flour destination would be equal regardless of the location of the flour mill between the two points. Transit privileges applied not only to milling but to storage as well. The system permitted millers in various locations to compete equally with regard to transportation costs.

However it did not make all mill locations equally competitive in a given market. Following an analysis of Mailee and Solum [13], the effects of transit privilege upon the two markets can be illustrated for domestic demand in Figure 1. In this example, the supply area for the Kansas City mill is much larger than for the Chicago mill, but the Kansas City mill has a smaller effective market area. Except for wheat or wheat products shipped to the west

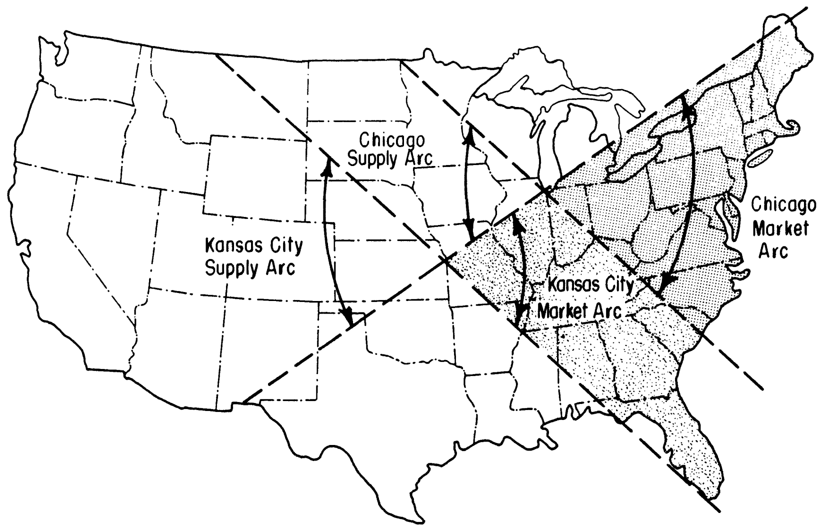

Figure 1. The Effective Marketing Area of Flour Mills Located in Chicago and Kansas City Under the Transit Rate System

or outside the area where the transit privilege pertains, the Chicago location has an advantage in serving the larger population centers to the north and east.

The results are not the same for the export market. The major wheat exporting regions of the United States can be divided into four coastal areas. The basic divisions are the Great Lakes area, the Atlantic area, the Gulf area and the Pacific area. In terms of the level of export activity of each area, the Gulf ports certainly lead. Over the past few years the Gulf ports have seldom exported less than 50 percent of the total exports of the United States. The ports of Houston and New Orleans are of major importance in this area.

Grains being transferred by rail to points for export are able to receive lower rates than those for domestic movement. In addition the transit privilege is also applied here. If wheat is stored at some point between the export point and the point of production it may continue its movement to the export area at some later date for the same cost per unit of distance as before. An example of this type of pricing is that wheat moved from Kansas City to Houston for domestic use could be shipped for $1.44 per cwt. in 1976. The same distance would cost $0.90 per cwt. if the wheat were going for export.

The grain exported through the Gulf ports is primarily hard winter wheat that was produced in the Great Plains area. Typically the grain moves from points of production to local elevators. From there it may go to the Gulf for export. The movement of wheat from local elevators to the Gulf is normally done either by truck, rail or barge. The Kansas City market area is quite fortunate in that it is both a major rail center and on a waterway to the Gulf.

This factor makes Kansas City a logical market for the local elevators. Even if the grain is not sold in the Kansas City market it is often priced using the Kansas City market.

The Chicago market also has an export facility available with grain shipped out through the lakes. This shipping route is more costly to many foreign destinations than is the route from the Gulf area. In addition, the Chicago export route is closed several months during the winter.

Briefly, it seems that Kansas City is better located to take advantage of export demand than is Chicago. Periods of expanded export demand would appear to favor the Kansas City market relative to the Chicago market. Conversely, periods of slack export demand would be expected to favor Chicago relative to Kansas City, all other things equal. Changes in export vs. domestic utilization of wheat, therefore, could affect the magnitude and direction of the intermarket price spread.

Futures Market Contract Specifications

The Chicago Board of Trade is the major wheat futures market. During the time period of this study, Chicago had from two to four times as many open contracts as Kansas City. Kansas City in turn is the second largest futures market. The roles are reversed for cash wheat. Kansas City is both a hub of milling activity for the domestic market and a pricing point for the export market.

Examination of the futures contracts of each of the exchanges indicates that the Kansas City contract calls for delivery of hard red winter wheat whereas the contract at Chicago allows for delivery of hard spring wheat and soft red winter wheat as well as hard red winter wheat. Number 2 soft red winter wheat is deliverable to Chicago or Toledo at par with the other classes deliverable through a set of discounts and premiums. At one time the Kansas City Board of Trade broadened its contract to allow deliveries of other contracts but the contract allowing delivery of soft wheats in Kansas City fell into disuse in 1953 [32]. The contract was then made more selective calling for delivery of hard winter wheat only. This aspect of the Kansas City contract makes it highly desirable for hedging by millers of hard winter wheat if delivery of wheat is involved. In contrast, the Chicago contract is broad and can be used by all hedgers. Both markets, therefore, have advantages for specific types of hedging.

Analysis of Chicago-Kansas City July Intermarket Price Differentials

Contracts and Time Period

The price differential between the two markets was defined as the Chicago closing wheat futures quote minus the Kansas City closing wheat futures quote on the same day in the contract month. The price differential could have been defined in the opposite way with direction of influence of the variables simply reversed.

Thursday Price

The closing price on Thursday was selected for use in the model. The use of one day of the week as a representative of the entire week should restrict the analysis to a midweek price. On Friday there could be a substantial amount of liquidation of contracts by those who do not wish to hold positions over the weekend. This is in contrast to Monday when speculative reaction to weekend news may be greatest. Having removed both Monday's and Friday's price from consideration there was little difference among the other three choices of day of the week. However, Thursday's price was selected because of the availability of data on related variables. *Grain Market News* [23] contains Thursday's price of all cash price series that were used. Some non-price data are available that are not recorded on Thursday. One of these is the level of inspections of wheat for export within the next thirty days which is reported on Friday of each week.

The data that were not available to the public on Thursday were put into the model so that the effect would be felt on the Thursday directly following its release. One exception was data on commitments of traders which are now obtained monthly and released about 10 days later [21]. It was decided that since an explanatory equation was being formulated, committment of traders data would be introduced on the Thursday following the date the observations were taken.

July Contract

This study will focus primarily on the intermarket price differentials of the July contract. Several factors contributed to the choice of July as the contract month to study. First, since the July contract has been one of the most heavily and consistently traded of the contract months, there would be less chance of encountering missing data. Second, the July contract could be used by hedgers of hard red winter wheat because of the timing of the wheat harvest. Paul, Heifner and Helmuth [15] stated that normally the hedger should sell the contract that calls for delivery just after the planned storage interval is terminated. This would indicate the July futures contract should be used to hedge any wheat that is to be sold at harvest or shortly thereafter. In Oklahoma, the largest percentage of monthly wheat marketing occurs in June (Table 2). Thus, the July contract could be used in the hedge.

A final factor contributing to the selection of July as the contract month was the fact that July permitted comparisons based on either crop or contract years. Prior to June 1, 1976, the wheat marketing year or crop year was defined by the U.S. Department of Agriculture as July 1 through June 30. After this date the marketing year was changed to June 1 through May 31.

Table 2. Monthly Farm Marketings of Oklahoma's Wheat Expressed As a Percentage of The Total Sales, Crop Years 1965-66 Through 1974-75

Crop Year	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
						(Percent)						
1965	4	36	8	4	4	5	6	10	11	5	5	2
1966	2	41	7	4	5	3	5	10	7	6	7	3
1967	6	33	8	3	3	4	4	13	13	6	5	2
1968	2	39	10	5	4	7	6	7	8	4	4	4
1969	3	38	9	4	4	5	5	10	9	5	5	3
1970	2	28	6	8	16	6	4	6	8	5	5	6
1971	2	39	8	6	5	6	5	7	9	5	4	4
1972	8	29	13	18	8	2	3	5	7	3	2	2
1973	2	30	18	16	8	4	3	5	7	3	2	2
1974	3	21	10	8	13	11	5	7	6	5	6	5
1975	3	15	21	21	9	2	6	7	5	7	2	2
1976	5	20	18	6	5	3	5	9	8	10	6	5

Source: United States Department of Agriculture and Oklahoma Department of Agriculture, *Oklahoma Agricultural Statistics*, Oklahoma Crop and Livestock Reporting Service, 1966-1975 issues.

The contract futures quotes for July span the crop year for all years included in the study. Trading in the old July futures contract terminates on the eighth trading day before the end of the month (July). Even though a "new" July contract may be traded several months before the "old" July contract expires, the "new" contract will not be examined in this study until the "old" contract expires. The contract year, therefore, refers to the quotes for the July contract during the period beginning the first week in August and continuing through the third week of July.

Throughout the study the terms crop year and contract year will refer to the year from the first Thursday in August to the third Thursday in July.

The Time Period

The 1965-66 through 1976-77 crop marketing years were selected for the study. Data were available on all the variables to be included in the study on a continuous basis. The period covers several years in which there were large government surpluses and as many years as possible where the government-held stocks were low. In addition a time period encompassing 12 full crop or contract years should allow for significant changes in the relatively slow moving variables.

One slow moving variable was the magnitude of unbalanced hedging at Kansas City. From the early to middle 1960's, net hedging at Kansas City was heavily unbalanced by an exceptionally large amount of short hedging. However, in the early 1970's the trend began to change to more nearly balanced hedging. This type of phenomena would be expected to affect the spread and permit the Kansas City market to carry a greater hedging load. Ideally the time period should be as long as possible to reflect trends in variables such as net hedging.

Model

The futures prices at the two markets are highly interrelated. Over the aggregate time period, the simple correlation coefficient between the futures closing prices at Chicago and Kansas City on Thursday of each week was 0.99. However, one particular variable may affect one market more than the other. An example might be the cash price of wheat of the Gulf. A change in this price would be taken into account both at Kansas City and Chicago but the greatest effect could be registered at Kansas City because of its geographical proximity and the fact that wheat for export at the Gulf is often priced on the basis of Kansas City price. Conversely a change in the cash price of soft wheat in Chicago probably could have a larger effect on the Chicago futures market than on the Kansas City market. In some cases there are variables which do not have a theoretical basis for determining the direction of effect.

The explanatory model of the intermarket price differentials for July wheat closing prices on the Kansas City and Chicago Boards of Trade is shown in equation (1). It is made up of nine variables that are hypothesized to be economically significant.

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9) \qquad \text{Equation (1)}$$

The variables included in Equation (1) are summarized with the unit of measure accompanying each designation as follows:

Y = Chicago-Kansas City intermarket price differentials for the July contract's Thursday close (cents per bushel)

X_1 = The Gulf price of No. 1 hard winter ordinary protein wheat (cents per bushel)

X_2 = Inspections for export (1,000,000 bushels)

X_3 = The Gulf basis (cents per bushel)

X_4 = Wheat-corn price ratio at the Gulf (each price in cents per bushel)

X_5 = Long hedging by reporting traders on the Kansas City Board of Trade (1,000,000 bushels)

X_6 = The ratio of short hedging reported by large traders to total open interest at Kansas City

X_7 = Short reported spreading at Kansas City less long reported spreading at Kansas City (1,000,000 bushels)

X_8 = Total open interest on the Chicago Board of Trade (1,000,000 bushels)

X_9 = Short reported speculation at Chicago less long reported speculation (1,000,000 bushels)

Multicollinearity or linear dependence among vectors of independent variables in a multiple linear regression analysis can have serious effects on the estimation of parameters. Mason, Gunst and Webster [14] note that poor precision in the estimation of individual parameters does not necessarily imply that the estimated model is a poor predictor. In addition if the estimated model is restricted to situations where the multicollinearity holds, at least approximately, the prediction equation often works quite well. That is, individual parameters may be estimated poorly but the linear combination may be estimated well.

Price Variables

The three price-related variables that were included in this study (Gulf price of wheat, wheat-corn price ratio and the Gulf basis) do occasionally display high degrees of correlation within a crop year. However, it was deemed important to include not only an absolute level of the cash wheat price but the level of wheat price relative to the price of corn. A change in relative prices such that wheat becomes competitive as a feed grain could be an important indicator of a change in potential utilization. In addition the Gulf basis may indicate the relative strength of demand for exports at the Gulf. The Gulf price of wheat indicates this to some extent but may not encompass the full effect of changes in export demand. Several other price related variables were analyzed before omitting them from the final model.[1]

Commitments of Traders Variables

Several transformations of the commitments of traders information were studied but not included in the final model.[2] Some were not included because they added little to the statistical quality of the model and others were excluded because of high correlation with other independent variables. For this study, no commitments of traders variables or transformation of those variables were used in the final model if the simple correlation coefficient between the variable and one of the independent variables was greater than 0.80 over the complete time period.

Estimated Coefficients and Interpretations

Results reported are based on the "best" explanatory equations arrived at for each crop year for each of two situations. The first situation included the Gulf price (X_1) and excluded the Gulf basis (X_3) as possible independent variables. The second situation reversed the variables with Gulf Price excluded and the Gulf Basis included as possible independent variables. The "best" explanatory equation was the equation which explained the largest amount of variation in the price differential and had all of the regression coefficients statistically significant at the 80 percent level. The coefficient of determination (R^2) was used to measure the share of variation explained. The results are presented in Tables 3 and 4.

The average intermarket price difference between the Chicago and Kansas City Thursday closing quotes over the entire period was 0.39 cents per bushel. However, the price differential ranged from a low of -26 to a high of 24 cents per bushel. Delineation of each of the nine variables expected influence and its actual relationship with the intermarket price difference, within crop years and over two periods, will be discussed below.

Cash Price of Wheat at the Gulf

Expectation. The cash wheat price series at the Gulf (X_1) is for No. 1 hard red winter wheat, ordinary protein content. The price is reported in cents per bushel f.o.b. track. The data were collected from *Grain Market News*, published weekly by the United States Department of Agriculture. The cash grain market and the futures market are very closely related. Futures bids, especially

[1]The price related variables that were analyzed but subsequently not used in the final model were the weekly change in Chicago and Kansas City futures closes, Thursday's trading range at Chicago and Kansas City, and cash corn price at Kansas City and the Gulf.

[2]The variables relating to the commitments of traders data that were studied but not included in the final model were total open interest at Kansas City, reported short hedging at Kansas City, reported short and long speculation and hedging at Chicago, reported long and short spreading at Chicago and Kansas City, net reported hedging at Kansas City and Chicago, the ratio of long hedging to total open interest at Kansas City, the ratio of long hedging to short hedging at Kansas City, net reported spreading at Chicago and the sum of net reported speculation and hedging at Chicago.

Table 3. Statistical Coefficients for Regressions of Specified Variables Excluding the Gulf Basis on Chicago-Kansas City July Wheat Futures Price Differentials, Crop Years 1965-66 Through 1976-77

		Regression Coefficients for Variables								
Crop Year	Intercept	Gulf Price X_1	Exports X_2	Price Ratio W/C X_4	Long Hedging X_5	Short Hedging Ratio X_6	Net Spreading X_7	Chicago Open Interest X_8	Chicago Net Spec. X_9	R_2
1965-66	27.086	-0.185	-0.071	-	-0.385	13.798	-1.493	0.015	-	
		(9.408)	(1.40)		(4.85)	(3.05)	(6.24)	(1.41)		.928
1966-67	1.915	0.144	0.097	-16.094	-0.201	-12.420	0.189	-	-0.133	
		(3.98)	(1.83)	(2.14)	(1.96)	(2.87)	(1.42)		(3.59)	.878
1967-68	42.423	0.208	0.051	-11.997	-0.052	24.475	-	0.013	0.137	
		(8.45)	(1.588)	(4.27)	(1.47)	(6.90)		(2.76)	(4.17)	.963
1968-69	29.468	-	0.090	-32.473	-	- -	-	0.046	-	
			(1.64)	(6.94)				(4.59)		.573
1969-70	-8.335	0.234	-	-13.925	0.132	-3.917	-	-0.075	-0.173	
		(3.10)		(-1.99)	(2.78)	(1.61)		(3.83)	(1.97)	.800
1970-71	33.400	-	-	-20.428	-	-	-	-0.042	0.197	
				(4.97)				(3.11)	(3.64)	.586
1971-72	31.533	-0.215	-	-	-	-	-	0.106	0.157	
		(2.65)						(4.27)	(1.37)	.427
1972-73	5.825	0.111	-	-	-0.208	-18.241	-4.950	0.143	-	
		(6.56)			(7.96)	(1.32)	(4.58)	(3.70)		.894
1973-74	57.431	-	-	-	-	-30.858	-12.160	-0.262	-	
						(1.97)	(3.19)	(4.43)		.357
1974-75	-11.246	.084	-	-	-	-	-	-.238	.265	
		(3.55)						(2.49)	(2.10)	.260
1975-76	-7.907	.114	-	-19.505	.076	-	3.380	-.104	-.433	
		(2.56)		(1.65)	(1.30)		(4.65)	(2.59)	(3.38)	.686
1976-77	63.720	-	-	-44.621	-.324	-	-	.075	-	
				(7.81)	(4.90)			(2.84)		.776
Last										
3-Year	-13.582	-.025	-.091	-14.602	-.114	43.465	1.476	.043	-.110	
Period		(2.91)	(1.43)	(4.02)	(2.86)	(5.89)	(3.98)	(2.05)	(2.41)	.619
12-Year	8.685	-.026	.415	-22.581	-.015	27.482	1.347	-.018	-.122	
Period		(10.60)	(10.59)	(8.96)	(1.34)	(9.40)	(8.75)	(3.61)	(4.96)	.562

Table 4. Statistical Coefficients for Regressions of Specified Variables on Chicago-Kansas City July Wheat Futures Price Differentials, Crop Years 1965-66 Through 1976-77

		Regression Coefficients for Variables								
Crop Year	Intercept	Exports X_2	Gulf Basis X_3	Price Ratio W/C X_4	Long Hedging X_5	Short Hedging Ratio X_6	Net Spreading X_7	Chicago Open Interest X_8	Chicago Net Spec. X_9	R_2
1965-66	-0.052	-	0.266	-14.227	-0.398	20.966	-1.516	-0.024	-0.177	
			(3.96)	(3.96)	(4.14)	(4.11)	(4.65)	(1.38)	(2.15)	.901
1966-67	8.997	-	0.238	-	-0.326	-16.649	-	-	-0.224	
			(4.55)		(3.78)	(3.87)			(8.82)	.866
1967-68	-22.002	-	0.096	-	-0.174	21.290	-	0.028	-	
			(3.56)		(4.94)	(7.79)		(5.96)		.922
1968-69	36.236	-	0.296	-38.035	0.322	-12.635	-	0.052	-	
			(2.26)	(7.08)	(2.73)	(1.65)		(4.34)		.614
1969-70	12.596	-	0.089	-	0.164	-4.449	-	-0.100	-0.161	
			(1.965)		(3.80)	(-1.70)		(8.312)	(1.886)	.766
1970-71	33.400	-	-	-20.428	-	-	-	-0.042	0.197	
				(4.97)				(3.11)	(3.64)	.586
1971-72	-24.291	-	0.266	-	-	20.079	2.348	-	-	
			(3.83)			(4.167)	(1.61)			.466
1972-73	-12.729	-	-0.088	10.183	-0.243	-	-	0.283	1.009	
			(1.82)	(1.79)	(5.92)			(7.04)	(5.18)	.840
1973-74	24.975	-	-0.101	9.130	-	-	-7.824	-0.277	-	
			(3.39)	(2.14)			(3.29)	(5.92)		.445
1974-75	-1.914	-	.251	-	-	35.939	3.446	-.283	-.259	
			(3.82)			(2.92)	(1.79)	(2.93)	(2.38)	.325
1975-76	26.214	-	-	-	-	-	4.417	-.138	-.685	
							(7.52)	(4.05)	(8.58)	.636
1976-77	63.720	-	-	-44.621	-.324	-	-	.075	-	
				(7.81)	(4.90)			(2.84)		.776
Last										
3-Year	-20.863	.113	.070	-23.743	-.146	43.571	1.451	.096	.059	
Period		(1.69)	(2.07)	(6.84)	(3.61)	(5.76)	(3.80)	(4.93)	(1.31)	.609
12-Year	3.729	.374	-.069	-22.047	-.061	32.156	1.180	.033	.170	
Period		(7.83)	(5.47)	(7.70)	(5.51)	(10.11)	(7.20)	(6.19)	(6.55)	.498

near month, are based on many of the same variables that determine cash prices. As the cash price declines so may the futures price. However, the question is which of the two futures markets move more as the cash price at the Gulf changes. It is hypothesized that the cash wheat price at the Gulf and the intermarket price differential would be negatively related if the gulf price were the only wheat price related variable in the model. That is, if the price of wheat at the Gulf increases in response to favorable export news, the Kansas City futures price would be expected to increase more than the futures price, all other things equal. Undoubtedly a change in the Gulf price of wheat would also be reflected in the Chicago futures price to some extent.

Result. The cash price of wheat at the Gulf (X_1) was included as a significant variable in 8 of the 12 crop-year equations (Table 3). The regression coefficient on this variable was -0.185 during the 1965 crop year. This suggests that during the 1965 crop year if the Gulf price of wheat rose by one cent per bushel, a 0.185 cent per bushel decrease would be expected in the intermarket price difference. An inverse relationship was expected if the Kansas City futures quote was assumed to be affected more by a change in this variable than was the Chicago futures quote.

This variable was not consistent as to the sign on the regression coefficient. In the 8 crop years in which the variable was included, it carried a positive sign six times and a negative sign twice. In the aggregate models, X_1 appeared as a significant variable with a negative sign. It is evident the Gulf price of wheat often affected the intermarket price difference, that the Chicago market often reacted more (positively) to a change in the Gulf price than did the Kansas City market, but that the average effect was greater for the Kansas City market.

Inspections for Export

Expectation. Under the U.S. Grain Standards Act, grain must be inspected before it is allowed to be exported. The quantity of grain inspected for export (X_2) is published each week in *Grain Market News*. These statistics do not include truck or rail shipments to Canada or Mexico. It is hypothesized that an increase in exports would increase the activity in both markets but would increase activity in the Kansas City market more than in Chicago because of its geographical proximity to the export areas of the Gulf. Exports are expressed in units of 1,000,000 bushels.

Result. The export variable (X_2) was included four times in the explanatory equations and in all cases it was in the early part of the period prior to 1969. The sign was positive in 3 years and negative in one year with low levels of statistical significance. In contrast, the variable was included in both aggregate equations and was highly significant. The regression coefficient on X_2 of 0.415 in the aggregate model indicates that an increase in the intermarket price differential of four-tenths cent per bushel would result from a 1,000,000 bushel increase in inspections for export. The effect was one-tenth cent per bushel during the past 3 years. The fact that inspections for export were highly significant over the entire study period but not within the crop year indicates that weekly export inspections offer little information useful in explaining the intracrop-year price difference but the level of exports may be quite helpful in explaining the change in the price differential over crop years. Also the signs indicate that the Chicago market reacted more than the Kansas City market to changes in inspections for export. When the Gulf basis rather than the Gulf price is permitted in the model, the export variable does not enter any equation except those representing the aggregate periods.

Gulf Basis

Expectation. Gulf basis (X_3) is usually defined as the difference between the cash wheat price at the Gulf and the most current, Kansas City futures month trading that is not in the delivery month. However, for this study the Gulf basis was defined as the difference between the cash price of wheat at the Gulf and the Kansas City July futures contract close on the same day. With the Gulf basis defined as such, it is obvious that if the Chicago wheat price were assumed constant, an inverse relationship would exist between the Gulf basis and the intermarket price difference when the Kansas City market responded positively to an increase in the cash price at the Gulf. A change in the Gulf basis is expected to affect the Kansas City futures quote more than the Chicago quote because of Kansas City's proximity to the Gulf ports. This should be especially true in periods of peak export demand.

Result. The results using the Gulf Basis (X_3) and excluding the Gulf price are reported in Table 4. In the 9 explanatory equations that included X_3, the sign on the coefficient was positive seven times and negative twice. The variable was significant in both aggregate periods. The two negative coefficients occurred during the 1972 and 1973 crop years, when the coefficient of variation associated with the Gulf price of wheat increased to 11.84 or more from the level of 2.047 in the 1971 crop year. The regression coefficient on X_3 during the 1965 crop year of 0.266 indicates that as the Gulf basis increased one cent per bushel, the intermarket price difference increased by slightly more than one-quarter cent per bushel. In the 1973 crop year, a one cent per bushel increase in the Gulf basis was associated with a one-tenth cent per bushel decrease in the intermarket price difference.

Wheat-Corn Price Ratio at the Gulf

Expectation. The wheat-corn price ratio (X_4) is determined by dividing the cash wheat price at the Gulf, discussed earlier, by the cash price of No. 2 yellow corn at the Gulf. Both of these prices are in cents per bushel. An inverse relationship is expected between the wheat-corn price ratio at the Gulf and the intermarket price differential. For illustration assume that the price of wheat at the Gulf increases relative to the corn price and moves away from a feeding value of wheat because of increased export demand. If the Kansas City price reflects this increase in export demand more than Chicago, a negative relationship would exist between the price ratio and the intermarket differential. On the other hand, if the ratio is declining (wheat becoming cheaper relative to corn) this would reflect pressure on wheat prices to move toward feed prices which should be reflected in lower Kansas City prices relative to Chicago prices and an increase in the differential.

Results. The wheat-corn price ratio at the Gulf (X_4) was an important explanatory variable in 7 individual crop-year equations and in both aggregate period equations (Table 3). No other variable showed as much consistency in the direction of influence as the wheat-corn price ratio. The magnitudes of the regression coefficients ranged from -11.997 to -44.621. An interpretation of the regression coefficient on X_4 over the 12-year period would show that if the ratio increased from its mean level of 1.195 to 1.295, an accompanying decrease of 2.258 cents per bushel would come about in the intermarket price difference. This is equivalent to an increase in the wheat price of about 22 cents to $2.85 per bushel, with corn prices held constant at $2.20 per bushel, being associated with a decrease of 2¼ cents in the Kansas City price relative to the Chicago price of wheat.

Reported Long Hedging at Kansas City

Expectation. The long hedging series (X_5) is derived from the positions of all traders on the Kansas City Board of Trade who have been classified as hedgers and whose long positions in the market are in excess of the required reporting level. The reporting requirements are set by the Commodity Futures Trading Commission (CFTC) [21]. For wheat, the reporting level was 200,000 bushels in 1977. The series, in 1,000,000 bushel units, was used for the monthly or twice monthly intervals as the data were available. The variable would have a negative relationship with the differential if the net effect were to strengthen the Kansas City price. The causality of effect could be in the opposite direction. That is, a narrowing differential could attract long hedging at Kansas City from Chicago.

Result. The statistical coefficients for long reported hedging at Kansas City (X_5) were negative in 5 of the 7 crop-year equations in which they were included. The regression coefficient for long reported hedging at Kansas City during the 1965 crop year suggests that during that year an increase in the level of long reported hedging at Kansas City was associated with a decrease in the price differential of 0.385 cents per bushel. As was the case with several of the previously discussed variables, the regression coefficient for the 12-year period shows the effects of averaging by being close to zero.

Ratio of Short Hedging to Open Interest at Kansas City

Expectation. The short hedging-open interest ratio is calculated by dividing the total positions of short hedgers, who hold positions in excess of CFTC positions limits, by the total open interest for the Kansas City Board of Trade as is reported in commitments of traders information. This variable does not indicate absolute levels of short hedging. However, it does give information concerning changes in short hedging. If short hedging and open interest increase by the same amount, the change in the ratio will be quite small. If short hedging increases at Kansas City and open interest remains unchanged, there has been a change in the mix of contracts held. It is expected that large short hedgers would enter futures market based on long inventory positions which would decrease the futures price at Kansas City. A positive relationship between the intermarket price difference and this ratio therefore would be expected.

Result. The ratio of reported short hedging to total open interest at Kansas City (X_6) was included in explanatory equations for 6 of the 12 crop years and in the aggregate equations. The regression coefficient was 27.482 for the 12-year period which suggests that an increase in X_6 from its mean level of 0.850 to 0.950 was associated with a 2¾ cent per bushel increase in the intermarket price difference. The increase would be much larger based on the coefficient for the last three years period. The signs of the regression coefficients were not consistent; two of the crop-year equations had positive coefficients and four had negative coefficients.

Net Intermarket Spreading at Kansas City

Expectation. The commitments of traders information gives the level of long and short spreading that is reported at Kansas City. The information includes each trader's long and short positions, to the extent they are balanced, without regard to which crop year or market is involved. Therefore, the long and short spread positions will differ by the amount of intermarket spreading. Net intermarket spreading for this study was calculated by finding the difference between long and short reported spreading in 1,000,000 bushel units. The calculation used in this study does include spreading between Kansas City and Chicago and spreading between Kansas City and Minneapolis but assumes that all spreading is applicable to the Chicago market.

Gray [7], in his 1967 study, also assumed that all intermarket spreading involved Chicago as one market. He stated that this probably was not literally true but felt the assumption was justifiable on the following three grounds. First, he held discussions with traders who actively engaged in intermarket spreading and they doubted the existence of any substantial spreading between the two smaller markets. Second, he found no correlation between net spreading for Kansas City and Minneapolis but each had an inverse relationship with Chicago. Last, net spreading at Kansas City was typically a much larger figure relative to Minneapolis which would allow for only a small portion to be spread to Minneapolis. Gray went on to explain that he felt intermarket spreaders did not attempt to forecast prices. He stated that intermarket spreaders were more "hedge anticipators." Thus he concluded that if the intermarket difference between Kansas City and Chicago were "out of line," spreading positions should not be expected to reflect this unless the hedging positions had brought about the misalignment.

If Gray's findings are accepted, the sign on the intermarket spreading variable would be expected to be ambiguous. Thus, this variable might not be useful in a predictive equation but could be useful in an explanatory model as indicative of the direction of price misalignment at a given point in time which has resulted from hedging needs in the Kansas City market. If intermarket spreading results from a downward pressure on Kansas City prices from another variable, then spreading and price differentials will be positively correlated. On the other hand if intermarket spreading results from a downward pressure on Chicago prices, the correlation will be negative.

Results. Net intermarket spreading at Kansas City (X_7) was included in 5 of the crop-year explanatory equations (Table 3). In three instances the resultant relationship between X_7 and the intermarket price difference was negative with a relatively large coefficient during 1973. However, whenever the variable was included in an aggregate period equation, the sign on the regression coefficient was positive. The coefficient on X_7 for the 12-year aggregate period indicates that an increase in net spreading at Kansas City of 200 contracts (1,000,000 bushels) resulted in an increase of 1.347 cents per bushel in the intermarket price differential. That is, the Chicago price increased relative to Kansas City in response to increased spreading on the Kansas City market. This is in contrast to the large increase in Kansas City price relative to Chicago from increased spreading at Kansas City during the 1972 and 1973 crop years.

Open Interest at Chicago

Expectation. A futures contract is considered open if it has been entered into but not yet liquidated by the purchase of an offsetting contract or by delivery. Contracts that are open are referred to as open interest. The aggregate of all long open interest is equal to the aggregate of all short open interest. The variable used in this study is reported in 1,000,000 bushel units. The level of open interest on the Chicago Board of Trade is expected to be an indicator of market activity. An increase in open interest indicates increased market activity but gives little indication of the direction of influence on the spread.

Result. The estimated regression coefficients associated with open interest at Chicago (X_8) carried negative signs in 5 crop years and positive signs in 6 crop years. The variable entered but the coefficient was small for the 12-year period which reflected the inconsistent relationship during the period. During the 1965 crop year the regression coefficient indicates that for every increase of 200 contracts in open interest at Chicago, the intermarket price differential increased by 0.015 cents per bushel. The largest changes indicated were an increase of 0.143 cents in 1972 and a decrease of 0.262 cents in 1973 in response to the increase of 200 contracts of open interest at Chicago. This was the period of high price variability in the wheat market.

Net Speculation at Chicago

Expectation. Net speculation on the Chicago Board of Trade, as used in this study, is defined as the total of large non-hedging positions. Speculation then encompasses both the spreading and long or short speculative positions. The level of net speculation at Chicago in 1,000,000 bushel units was reported either monthly or twice monthly and computed as the number of bushels in long positions subtracted from the number of bushels in short positions. If, on the average, large speculators at Chicago forecast lower prices and enter the market short, based on these expectations, a net increase in short positions would lower the Chicago futures price and increase net speculation, a negative relationship. Since this variable is anticipated to have very little effect on the Kansas City futures price, a negative sign would also be expected for the relationship between net speculation and the intermarket price differential.

Result. The coefficients associated with net speculation at Chicago (X_9) had a negative relationship with the intermarket price difference three times and a positive relationship four times in the crop-year equations when X_9 was included. The sign on the coefficients from the aggregate explanatory equations carried the expected negative sign. During the 12-year aggregate period, if net speculation at Chicago increased by 200 contracts (1,000,000 bushels) a decrease in the intermarket price differential of 0.122 cents per bushel was the result indicated by the regression coefficient, all other things equal. This coefficient was lower in size than the coefficients for individual years. This variable was not significant in the 1972 and 1973 crop years when the short hedging ratio and net spreading on the Kansas City market were significant.

Coefficients of Determination

The coefficients of determination (R^2) are reported in the last columns of Tables 3 and 4. In general, these coefficients were larger in the years of the study with more stable prices. The 1973 and 1974 crop years had the lowest coefficients of .357 and .260. Models which included the Gulf price gave higher R^2 values than models which included the Gulf basis for 6 crop years and the same values in 2 years, and lower values in 4 years.

Unbalanced Hedging at Kansas City

In an analysis of the three major wheat futures markets, Gray [8] concluded that as one of the smaller market's hedging load became more and more unbalanced, the unbalance at some point would be reflected in price disparities relative to Chicago. As the hedging load on the smaller market becomes more unbalanced, hedgers will tend to take their business directly to Chicago.

Hedging at Kansas City is much more important, relatively, than at Chicago. On the average, reported hedging at Chicago makes up less than 50 percent of the total open interest whereas reported short hedging at Kansas City rarely makes up less than 80 percent of the total open interest. Because Kansas City does not have a vast reservoir of speculation similar to that of Chicago, unbalanced hedging is particularly important. An unbalanced hedging load at Chicago is not nearly as important because the high levels of speculation can offset the difference in the hedging levels.

The simple statistics of data for each crop year indicate that a significant change had taken place in the distribution between long and short reported hedging positions on the Kansas City Board of Trade. During the 1965-66 through 1969-70 crop years, net reported hedging at Kansas City (short less long positions) was heavily net short. Reported hedging at Kansas City was, on the average, net short by 9.4 million bushels (nearly 1,900 contracts) in the 1969-70 crop year and by 18.4 million bushels (nearly 3,700 contracts) in the 1967-68 crop year. Values this large indicate a problem of matching hedging with speculation at Kansas City. The situation eased slightly in the 1970-71 crop year.

In the 1971-72 through 1973-74 crop years, the average net hedging at Kansas City became quite small and even turned net long by 2.3 million bushels in the 1973-74 crop year. The 1970-71 crop year seems to stand alone as somewhat of a transition year between years of balanced and unbalanced hedging at Kansas City.

The measurable effects of the change from unbalanced hedging in Kansas City to more nearly balanced hedging is first evident in the 1968 crop year equation in Table 3 and in the 1970 crop year equation in Table 4. In these equations neither of the variables concerning hedging at Kansas City (X_5 for long hedging and X_6 for the ratio of short hedging to open interest) came in as statistically significant. In the earlier years both X_5 and X_6 were included. The 1968 and 1970 crop years also reflected a substantial decrease in the coefficients of determination, down below 0.60 from almost 0.80 to 0.96 for the earlier crop years. In the crop years following 1970, X_5 was included in 3 crop years and X_6 was included in two (based on Table 3). Only in 1972 in the later years was the coefficient of determination above 0.80.

Reduction of Government Stocks

Wheat carry-over as of July 1, 1965 was slightly over 900 million bushels. Approximately 75 percent was under governmental control, either under loan to the government or owned by the Commodity Credit Corporation (CCC). Throughout the crop years of this study, governmentally controlled stocks were rarely below 50 percent of the total stocks. On July 1, 1972 the stocks of wheat totaled 985 million bushels and over 70 percent of this was under governmental control. However, the end result of political decisions made during the 1972-73 crop year was a reduction of the level of government stocks. Roughly concurrent with this, another political decison was made in the Soviet Union calling for massive import of grain, especially wheat. Subsequently, exports of wheat from the United States greatly increased. Average yearly exports during the 1965 through 1972 crop years beginning July 1 had been approximately 700 million bushels. In the 1972 crop year beginning July 1 exports of wheat were 1,131 million bushels and this figure advanced to 1,217 million bushels the next year.

The 1972 and 1973 crop years stand out as different in the analysis because of two main variables - the Gulf basis (X_3), and the wheat-corn price ratio (X_4). Gulf basis was a significant variable in Table 4, but the signs on the regression coefficients were negative rather than positive. The implementation of a policy to reduce government stock levels accompanied by the large increases in exports apparently had changed the relationship from positive to negative. That is, Kansas City was affected more than Chicago by changes in the Gulf basis. This was expected since the Gulf ports would handle a large percentage of the export sales, most of which would be hard winter wheat. A similar situation occurred for the wheat-corn ratio at the Gulf. This variable had been consistently negative in effect and then in the 1972 and 1973 crop years the signs of the regression coefficients were positive. Thus as the price of wheat moved away from a feeding value based on corn prices, the Chicago futures quote gained on the Kansas City quote.

Summary and Conclusions

The relatively low but stable cash wheat prices during the mid- to late 1960's gave way to the historically high, fluctuating prices of the early 1970's. Increased price variation brought about renewed interest in wheat marketing strategies. The use of forward contracting increased as producers attempted to reduce the risk of price changes. Hedging on organized commodity exchanges was one method which facilitated forward contracting.

There are several futures markets available for hedging inventories of wheat. However, only two of these markets will accept hard winter wheat as deliverable under current contract specifications. The Chicago Board of Trade, by far the largest wheat futures market in terms of the total number of contracts traded, allows for delivery of hard winter wheat, northern spring wheat and soft red wheat. The Kansas City Board of Trade, in contrast, allows only for delivery of hard winter wheats against their futures contract. This aspect of the Kansas City futures market is particularly desirable to hedgers who might be interested in accepting delivery of the wheat and who have specific needs for hard winter wheat.

If hedging is the tool chosen to use in forward contracting, the question is then one of which market should be used in placing the hedge. One general rule to follow could be to place the hedge with the market whose par delivery point is closest to the cash market where the commodity will be sold. Using this simple rule, hedgers in Oklahoma would place their hedges on the Kansas City Board of Trade. However, if this rule were followed consistently there would be times when losses would be incurred relative to using the Chicago Board of Trade for the hedge. During the time period of this study, the largest observed price differentials were Kansas City 26 cents per bushel over Chicago and Chicago 24.25 cents per bushel over Kansas City. Thus, the maximum observed range of the price differential was 50.25 cents per bushel and a correct decision by the hedger concerning the market to use could be as important as the decision to hedge itself.

The model of the intermarket price differential that was employed in this study suggested that the weekly difference between Kansas City and Chicago July futures price quotes was associated with nine variables during the 1965-66 through 1976-77 period. Three of these variables were related to various wheat price series, one concerned inspections for export and the rest were taken from information concerning commitments of traders in commodity futures. Weekly futures quotes of the Chicago and Kansas City Boards of Trade were analyzed using simple linear regression techniques. An explanatory equation was estimated for each crop year and the total period using alternatively the Gulf price and the Gulf basis as one variable. The "best" equation was then presented. "Best," as used here, refers to the explanatory equation which explained the largest amount of variation in the price differential with all of the regression coefficients statistically significant at the 80 percent level. The coefficient of determination (R^2) was used to measure the share of variation explained. The following conclusions are based on the equations using the Gulf price rather than the Gulf basis as one of the variables.

The most consistent variable in the entire study was the wheat-corn price ratio at the Gulf (X_4). It entered in 7 of the 12 crop-year equations and in the aggregate equations. The magnitude of the coefficients (all negative) were quite similar within and over the crop years. An increase in the ratio of around 5 percent, with the wheat-corn ratio assumed to be at its mean level of 1.195, was associated with a one cent increase in the Kansas City futures price relative to Chicago.

Inspection for export (X_2) was not a highly significant variable, statistically, in any of the individual crop-year equations even though it was included in the first four years. However, it was highly significant in the 12-year aggregate equation. The conclusion was that weekly inspections for export offered little help in explaining the intermarket price difference within the year, but the yearly average of this variable was quite important over the period. An increase in weekly inspections for export of about 2.4 million bushels was associated with a one cent increase in the price of Chicago futures relative to Kansas City. This would be an increase of approximately 125 million bushels during the course of a crop year if the increase were sustained throughout the year.

The 5 other variables (X_7, X_6, X_8, X_9, and X_5) were statistically significant in both aggregate equations. Net intermarket spreading (X_7) entered in 5 crop-year equations - 1965, 1966, 1972, 1973, and 1975. The signs on the coefficients for X_7 were negative three times and positive twice, but the coefficients in the aggregate equations were positive.

This suggests that over the entire period it would take an increase of about 1,000,000 bushels (200 contracts) of net short spreading to increase Chicago 1.3 cents per bushel relative to Kansas City, ceteris paribus. The indicated price change would be slightly larger for the last three years.

The ratio of short hedging to open interest at Kansas City (X_6) had inconsistent signs on the regression coefficients across crop years. However, the regression coefficients in the aggregate equations were positive. This was the expected sign assuming that short hedgers forecast price and then take positions in the market accordingly. The ratio would have to increase from its mean of 0.850 to 0.886 for the Chicago futures price to gain one cent per bushel relative to the Kansas City price. This would be equivalent to the open interest remaining constant and the short hedging at Kansas City increasing almost 300 contracts.

Net speculation at Chicago (X_9) was included in seven crop-year equations and in the aggregate equations. The regression coefficient of - 122 during the aggregate period suggests that for Kansas City to gain one cent per bushel relatively on Chicago, net speculation at Chicago would have to increase by almost 8.2 million bushels (1640 contracts). Thus, the intermarket price difference was not extremely sensitive to changes in the level of net speculation at Chicago.

Long reported hedging at Kansas City (X_5) was significant in 7 of the crop-year equations, four prior to the 1970 crop year. This is of interest because the hedging load at Kansas City was heavily unbalanced to the short side during most of the early period covered by this study. Reported hedging at Kansas City was, on the average, net short 9.4 million bushels per observation (nearly 1900 contracts) in the 1969 crop year and 18.4 million bushels (nearly 3700 contracts) in the 1967 crop year. This is, of course, more unmatched hedging than could be matched easily by speculation at Kansas City. As a result both long hedging at Kansas City (X_5) and the short hedging ratio (X_6) were included in all but 1968 in the 1965 through 1969 period. In the 1970 crop year the situation of net short hedging eased slightly. Then in the 1971 through 1976 crop years the average net hedging became much more manageable and even net long by 2.3 million bushels in 1973. During this period X_5 and X_6 entered the regression equation about one-half the time.

Total open interest at Chicago (X_8) had a negative relationship with the intermarket price differential in 5 crop years and was positive 6 years.

The Gulf price of wheat (X_1) moved in the same direction as the intermarket price difference in 7 of the 9 years based on linear trends. When the Gulf price of wheat was trending downward, the intermarket price difference trended downward which meant that the Chicago futures price was decreasing at a faster rate than Kansas City. When the Gulf price trended upward, the Chicago futures price tended to increase at a faster rate than Kansas City. These results were not expected. The cash price of wheat at the Gulf was included in 8 of the crop year equations reported in Table 3. The sign of regression coefficent was positive in six equations and negative in two. The inconsistancy of effect is reflected in the fact that X_1 entered the aggregate equation with very small regression coefficients.

In some ways the results from the study were disappointing. Many of the variables had inconsistent effects and a few effects were opposite those expected. Nevertheless, some general guidelines for use of the results in hedging may be illustrated. An example of market selection for hedging might be similar to the following. If the Gulf price of wheat is expected to trend downward over the next crop year, producers would be extremely interested in hedging their wheat crop.

The results of the study suggest that the Chicago futures quote could be expected to decline relative to Kansas City and a short hedge should be placed in the Chicago market. However, several other factors should be analyzed.

The size of the present intermarket price differential is one factor. If it is within a "normal" range then the next variable to look at is estimated exports of grain relative to last year. If the estimate represents a decrease from last year then this study would reinforce the decision to use the Chicago market for placement of the short hedge.

The wheat-corn ratio should also be projected. If wheat prices were low relative to corn and expectations were for the ratio to increase, this would reinforce the conclusions to use Chicago rather than Kansas City for the short hedge. In contrast, if the ratio were expected to decrease, this could be reason enough to use Kansas City rather than Chicago for the short hedge. The Kansas City market would have been selected in the above example for placing a long hedge or for the opposite effects of the variables specified.

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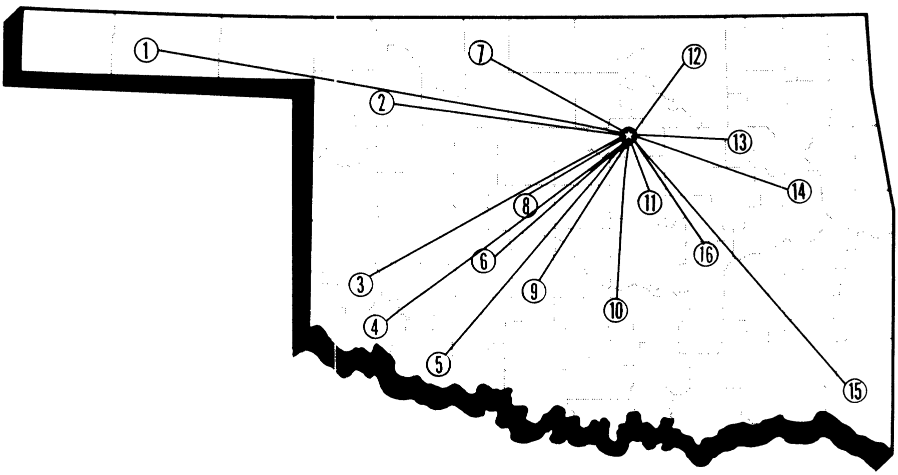

Main Station — *Stillwater, Perkins and Lake Carl Blackwell*

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2. **Southern Great Plains Field Station — *Woodward***
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